Engaging science pedagogies: What Year 10 students in a Western Australian Independent school have to say about science learning.

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Declaration

I declare that this is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Signed:                                                              (Philip Hugh Jones)

Date:
Acknowledgements

I thank God first for the life He has given me and the opportunity to learn more about His created universe.

My wife, Joan I thank greatly as this has been a work completed together. Joan has helped me through her encouraging discussions, prayers and never ending support.

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Preface

This study has grown from two sources: first my own history and experience as a science teacher, and second my own views about society, science education and knowledge. While studying science pedagogy in England as a pre-service secondary school science teacher I became aware of discovery/problem solving approaches to science teaching and learning. Later as a qualified science teacher in England, I pursued a liberal/socially critical orientation to science teaching and learning.

During four decades of science teaching, in both England (1974-2004) and Australia (2005-2015), I observed that student engagement in science learning demanded science knowledge, significant interpersonal skills that enhanced a capacity to engage students in learning activities. During my professional career I have worked predominantly in new secondary schools engaged in the development of both science and whole school curricula in both England and Australia. Forty years of uninterrupted service in secondary education, involving roles of classroom teacher, Pastoral Head of Year, Head of Department, Head of Secondary School and Head of Senior School, has fostered rich personal knowledge and insight regarding secondary science learning and teaching. This research has emerged from a personal interest about how students learn science.

A case study methodology was used to find out what students perceptions are regarding what is going on in a year 10 science lessons when the students themselves believe they are learning science. Furthermore, how, if at all might these perceptions make connections with curricular orientations to teaching and learning? This research reveals that students believe they are learning science in more liberal/socially critical science classrooms. Furthermore, student engagement in year 10 science learning will be enhanced when students have access to knowledgeable and skilful science teachers who provide relational classrooms that nurture ownership of learning and include science learning activities that are meaningful to students’ current and future lives.
Abstract

Emerging from a personal and professional interest in student engagement with learning in secondary school science classrooms, this dissertation investigates the question: How do year 10 students understand, experience and respond to science teaching in secondary school?

Through the voices of some year 10 secondary school science students in an Independent Christian Secondary school in Western Australia, supported by some aspects of my professional experience, this thesis identifies, describes and explains the kinds of classroom conditions conducive for enhancing student engagement in science learning. A case study approach was adopted to investigate student perceptions of engaging pedagogies in year 10 science classes. Seeking a diverse range of strengths, abilities and attributes, all year 10 students, 60 in all, were invited to take part in the research program. The participating students consisted of a mixed gender group of 18 year 10 students, all with some interest in science learning. The students were interviewed in pairs and in focus groups, about the kinds of pedagogical, organisational and cultural conditions that enhanced their engagement in science learning. A time frame matrix was adopted to guide open ended questions and discussions. Drawing on year 10 student past, present and future perceptions of when they were learning science, this thesis identifies as essential ingredients a knowledgeable, passionate and committed teacher, hands on learning, relevance and ownership of learning, and relational learning, that connects with, and is relevant to student engagement in science learning.

Methodologically, the thesis acknowledges the value and importance of student voice in research relative to student engagement in science learning. Above all, the thesis reinforces the significance of building a relational learning environment that gives access to meaningful and relevant learning activities in science classrooms based on a culture of trust, respect and care.
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Chapter 1
Introduction

1.1 Background

This case study of engaging pedagogy in the secondary science classroom investigates the phenomenon of student engagement in science learning by addressing the question: How do 18 year 10 students from a small independent secondary school understand, experience and respond to science teaching in secondary school? In this section I want to elaborate on the broader conditions in which this thesis is carried out and why science education is so important.

Australia’s’ economic participation in the 21st century requires schools to provide suitably qualified and scientifically literate young adults. Connecting student literacies in science and Australia’s future, Tytler (2007) identifies three concerns regarding student engagement in science learning. First, in referring to the Relevance of Science Education (ROSE) project (Sjoberg & Schreiner, 2005), Tytler identifies a strong negative correlation between year 10 students response to science and their nations developmental index. Second, Aikenhead, 2006; Ziman, 2000 argue that the way science is practised, and the way it links with modern society has changed fundamentally since the basic shape of school science was set down. Third, Tytler (2007) draws attention to the nature and expectations of youth demanding flexibility and skill development in their education. Furthermore, science professionals have expressed concerns about public perceptions of science (Tytler & Symington, 2006, cited in Tytler 2007, pp. 2-3), arguing a need for more science-savvy citizenry who could engage in
public science issues and debates. As Australia continues to participate in a rapidly changing national and global technological community there is a demand for Australian schools to provide young adults who are informed in scientific and science literacy. School students who are grounded in scientific literacy regarding topics such as climate change, energy provision, health and communication, are scientifically knowledgeable. As such, these young Australians enhance the capacity of their community; they can be recognised as community members politically empowered to make informed decision regarding personal, local and national issues and requirements (Fradd, & Okhee, 1995; Mendro, R.L., 1998). Furthermore, with regard to science literacy, schools are expected to produce suitably qualified young adults with significant science knowledge necessary for the world of work and /or higher levels of science study. To achieve these demands, Australian Curriculum: Science (2009) stipulates school science departments provide engaging learning activities to promote the enhancement of science and scientific literacy of young Australians.

As a secondary science teacher I have been able to observe firsthand the natural curiosity that year 10 students have regarding science and scientific matters. Conversations with year 10 students about their ideas regarding topical science-based television programmes reveal that year 10 students have a keen interest in and enthusiasm to engage with science issues. My observations of high school students in science classes have revealed that most year 10 students have an appreciation of the relevance and importance of science to their current and future lives. Nonetheless, whilst there are year 10 students who recognise the value and importance of science in their community the numbers of year 10 students enrolling onto the disciplines of physical and biological science courses at senior secondary school level is low. Furthermore, whilst the numbers of young adults enrolling into universities in recent years has increased(numbers) there is disproportionate number enrolling onto physical science programs of study (Goodrum & Rennie, 2007).
The concern regarding secondary student engagement (and disengagement) in science learning in schools raises two key questions. First, what is going on in year 10 secondary science classrooms when year 10 students are engaged in science learning? And second, what do engaging pedagogies look like in the science classroom? This thesis investigates the perceptions of 18 year 10 students’ to find out from their point of view, what it is about school science that engages them in science learning. I hypothesise that there are two general perceptions that might help explain this. First, year 10 students experience a lack of choice for participating in relevant and meaningful science learning. Year 10 students in general have little or no say in making personal choices regarding lesson topics or avenues of personal and group interest within or as a part of the learning classroom. Year 10 students may perceive the learning matter as irrelevant to their current and or future life needs. A lack of opportunity to bring their own interests, curiosities and ideas into the classroom and to test and share their own science knowledge further disenfranchises them from learning. Year 10 students seek a relational classroom where they have some ownership of learning (Irvine, 2008). In response, year 10 students may engage in misbehaviour at school (Carrington, 2002). Truancy and low academic achievement (Carrington, 2002; Lamb, Walstab, Tess, Vickers & Rumberg, 2004 in Irvin 2006) and early school leaving (Ainley, 2002; Finn & Rock, 1997; Lamb Dwyer & Wynn., 2000; McMillan & Marks, 2003; Willms, 2003) are considered symptomatic of disengagement. Irvin argues that engagement is seen as an antidote for these problems in their first effects (Irvin, 2008).

Second, the demands of accountability brought on by the Australian Curriculum Assessment and Reporting Authority, may restrict teachers from modifying the curriculum and limit the provision of engaging curricula orientations to teaching and learning. To achieve the goals of the Australian Science Curriculum teachers will need to provide equitable and flexible learning activities that nurture student engagement in science learning.
In this regard, a school and its science teachers will be under pressure to address and meet the legislative demands of accountability and performance. It is understood that student performances will be measured through standardised test scores (National Assessment Program (NAPLAN) – Literacy and Numeracy years 3/5/7/9), which will be released on the My School web site. Significant pressures brought on by the rigours of accountability will come to bear on schools as they endeavour to meet the science learning needs of the whole school community (Heisted & Spicuzza, 2000). The performance of a school is measured by student achievements; examination results, grades and university entries, expectations of parents, and the expectations of employers (Ablard, Hoffhines, & Mills, 1996; Ablard, 1997; Ablard & Parker, 1997). The production and provision of a scientific and science literate population is, therefore, nested within a network of external accountabilities. Hence, Secondary Science teachers find themselves bound by interweaving networks of accountability stemming from community and political expectations for raising both scientific and science literacy in school.

The challenge ahead for this research is, therefore, to identify engaging pedagogies that connect more strongly with year 10 students’ lives in seeking to enhance a shift in engagement with science learning. My interest in student engagement in science learning has led to the following research questions:

1.) How might changes in curriculum and pedagogical orientations bring a shift in student engagement in the science classroom?

2.) What do year 10 students require to nurture interest, positive attitude and a desire to engage in learning in the science classroom?

3.) How might year 10 students’ ideas, beliefs and experiences become a part of engaged learning?
Enhancing engagement in science learning and prompting an increase in enrolments in secondary school science is an imperative. To support the development of science/scientific literacies and to enhance student engagement in science, this research seeks to use the voice of year 10 students to identify what works best for them.

1.2 Positioning the researcher and the study

This study has grown from two sources: first my own history and experience as a science teacher, and second my own views about society, science education and knowledge. Studying in England as a pre-service secondary school science teacher investigating and experimenting with pedagogy in the science classroom, I became aware of discovery/problem solving approaches to science learning. As a student teacher teaching the Nuffield science programs (1962), and then during the early years of my professional career in England, I adopted a relational orientation to teaching and learning, one that that fostered questioning and answering techniques, that sought to engage science students in discussion and shared discovery. This orientation to teaching and learning shaped my views on how science could/should be taught in secondary schools. For me this was new and different from the conservative academic pedagogy I had been exposed to during my own secondary school years. Here my lessons had been teacher driven and text book focused. The Nuffield approach encouraged teachers and students to work together as researchers and co-researchers on science investigations. In my experience this liberal/socially critical curricula orientation to teaching and learning nurtured year 10 students’ ideas and questions, and enhanced their engagement in science learning. As such, this more liberal progressive orientation to science learning sought to engage students in science learning by recognising the value of democratic and relational classrooms. Recognising and incorporating year 10 students’ ideas and questions in the lesson nurtured students’ natural interest regarding science/scientific matters. A relational classroom that allowed year 10 students to take
ownership and participate in meaningful learning activities offered opportunities for year 10 students to grow in science knowledge and locate science education within their place of lived experiences. Engaging year 10 students democratically in real problems, researching and discussing natural phenomena and constructing legitimate science and scientific knowledge provided genuine avenues for engaged science learning.

Forty years of teaching and management experience within six schools provided me with a wide and varied working knowledge of classroom practices. Emigrating from Nottingham, England to Perth, Western Australia in 1995 created an opportunity for me to use my skills, experience and knowledge to teach secondary school science at a school located in a low socio-economic area. Gaining responsibility for managing the transformation of a small (40 year 10 students, year 8 - 10) secondary school into a senior secondary school(years 7-12) further enhanced my awareness of engaging pedagogies. Working as Head of Secondary School with oversight of science and maths, developing whole school policies and curricula that addressed the needs of the community and addressing the expectations and accountabilities of the School Board, and State and Federal government requirements, provided a new and exciting journey of discovery that included a rich and diverse experience. Working with a team of dedicated teachers was a humbling privilege.

During my journey as a science teacher continually endeavouring to engage year 10 students in science learning, I have tried on occasions to answer the following kinds of questions:

- What can I do in my lessons to capture student imagination, interest and motivation?
- Why is it that some lessons work one day and not the next?
- How is it that year 10 students don’t seem to engage regularly in science learning?
• How, as a teacher/manager, might I be able to support teaching staff to enhance their knowledge, skills and effectiveness for enhancing student engagement in science learning?

In regards to my own views about society, science education and knowledge, I find agreement with Shor (1996) when he argues that no knowledge or teaching can be neutral. In reference to social constructionism (Andrews, 2012), individuals are the product of social experience and society is created by what human beings do together; as society changes everyday experience and conditions may be created that bring about change in human behaviour. Shor (1996) argues that, “education is essential to realising social change” (Shor, 1996, p.58). All formal education is politically oriented learning organised by one kind of authority or another. The developmental forces are teachers, subject matter, the learning process and institutional practices. Classroom teachers, in the powerful position of authority, are the academic experts deploying power and knowledge. They have the authority to question the status quo and negotiate the curriculum, rather than being, “the authoritarian educator unilaterally making rules and lecturing on preset subject matter” (Shor, 1996, p. 56). Societal decision making with regard to science and science education may be more democratically maintained if some consideration is given to the location of the student in the decision making process. When seeking a change in science education, where the goals of building community capacity and enhancing scientific and science literacies are worth pursuing, year 10 students’ perceptions and experiences should be considered. Re-engineering the science learning framework therefore requires input from year 10 students themselves.

Through my rich experience as a science teacher I have observed that year 10 students gain a deeper understanding of and participate in science learning when they are engaged in problem solving. When year 10 students are discussing, exploring and questioning the way
things are they are more likely to contribute to the construction of an individual’s understanding of their role in the community and of personal and local problems situated in the larger societies. Given the backdrop of current concerns about student engagement in science learning, industrial growth and development, and Australia’s’ environmental, social and cultural needs it is deemed timely to investigate some of the ways in which science teachers can enhance student engagement in science learning in the classroom. The democratic value of promoting student voice in this task is not to be underestimated. In this respect, student stories and perceptions of past, present and future participation in and experience of classroom learning activities are sought to support the emergence of meaningful student engagement. Enhancing classroom relationships, teacher knowledge, skills and practices, and classroom strategies and approaches is essential to fostering engaging pedagogies. That is what this thesis is about.

1.3 Orientating the research

There is a plausible link between the lived experiences of students who live in post industrial societies (Tytler, 2007) such as Australia, USA, UK and other developed countries, and attitudes to secondary science. Students today have to deal with changes in social structure, transference of economy, re-working of the occupational system and establishing new relations between science and society. I believe that year 10 students’ lived experiences of these phenomena provoke a shift in student attitude about the relevance and value of science learning.

Personal discussions I have had with year 10 students highlight the growing rejection by students of secondary school science and science teaching. Research also indicates that students have been disengaging from physical science due to a lack of relevance personally, socially and culturally (Sjoberg, 2000; Sjoberg & Schreiner, 2005). The results of the
Relevance of Science Education (ROSE) study (Sjoberg & Schreiner, 2005) indicate a high negative correlation between students’ assessment of the relevance and usefulness of science and their intention to work in science. Dr. Jim Peacock, former Australian Chief Scientist in his introduction to Re-imagining Science Education (Tytler, 2007) comments that, “there is a need to re-imagine science education, accepting a shift that is occurring in the way we think of its nature and purpose” (Tytler, 2007, p. 2). Student engagement and the relevance of the science curriculum is a cause for concern (Aikenhead, 2006). Aikenhead (2006) comments that, “the culture of school science with its traditional emphasis on canonical science concepts is at odds with students’ self identities, so for them science has little personal or cultural value” (Aikenhead in Rennie and Goodrum, 2007, p. 6). Given that this is not the first time the status quo in science teaching has been questioned, bringing student voice into the debate will further question why the status quo in science persists. Identifying engaging pedagogies will encourage teachers to experiment in the classroom with methodologies that involve greater student participation in the curriculum. Investigating 18 year 10 student’s perceptions of engagement in learning and engaging science pedagogy at this time is appropriate.

Central to this argument are the ideas of negotiating the science curriculum, power sharing and co-governance (Shor, 1996) as a means of fostering a more democratic syllabus through the act of co development; one that is egalitarian in nature and purpose. As an active participant of science teaching and experienced practitioner of school management I believe that school science classrooms are required to function as places for constructing science knowledge. The science classroom should provide environments that permit year 10 students to engage in relationships, socialise and take ownership of learning. On the topic of education for democratic participation and social and civic responsibilities, Berman (1997) reports:
Giving young people opportunity to participate in decision making about meaningful issues can impart their sense of responsibility, their ability to make a collective perspective, their prosocial behaviour, their understanding of democratic values and processes, and their personal and political efficacy (Berman, 1997).

A democratic science classroom might look forward to imaginative action in science teaching styles and pedagogy, recognising that year 10 students coming from different backgrounds may see things differently and have something to say about how things should be (Green, 1995). Democratic science classrooms would provide pedagogy that allows meaningful involvement of year 10 students, enhancing their personal engagement with science learning and self worth. As participants in these circumstances year 10 students have opportunities to learn science and know how to exist in the world. This allows them to recognise that what they and others have to say can facilitate their individual understandings in constructing an awareness of global and societal needs (Kincheloe, cited in Tobin 1990). In this approach students are not conceived of as human resources moulded by modes of assessment, increased rigour and altered authority structures for private interests (Green, 1995). A freedom to search and articulate intellectual thought is encouraged whereby students have an opportunity to share experiences, their interconnectedness and communion.

Science pedagogy represents a potentially important level in the political education of youth. Science teachers endeavouring to meet the rigour of the Australian Science Curriculum (ACARA) are required to provide engaging pedagogies that effectively encompass equity and flexibility. My personal experiences inform me that covering all aspects of a science/whole school curriculum and carrying out meaningful assessment demands efficient time management. Unfortunately, limitations of time for planning effective relational science classrooms that include discussion and negotiation may restrict the curricula orientation and pedagogy that a teacher might take.
1.4 An overview of methodology

The science classroom is the place where science pedagogy predominantly takes place and is therefore of central interest in this thesis. To understand the complexity of what is going on within the particular circumstances of a science classroom a case study methodology using qualitative methods was used to investigate student engagement in science learning. Using this qualitative research approach, a group 18 year 10 students from a small independent Christian school were invited to participate to identify the conditions conducive to engaging pedagogies in the science classroom. The 18 year 10 students were randomly selected from a pool of volunteers to gain a diverse range of strengths, abilities and attributes. The year 10 students were interviewed on either a one to one basis or in pairs. To validate and collect further data five year 10 students participated in a focus group discussion. All interviews lasted between 30 and 40 minutes.

A time framework question matrix adapted from Patton (Patton, 2002, p. 351, exhibit 7.3, p. 352) was used in the interviews to maintain an interview guide for different types of questions for supporting analysis and validation of the data. This interview guide was prepared to ensure that the same basic lines of inquiry were pursued with each person or group interviewed. The matrix (see page 65, table 2) also supported the interview as a guide for freedom to explore, probe and ask questions that elucidate and illuminate a particular subject. Six kinds of questions were used to help the participants in their response and to clarify the data. The following question headings were adopted (Patton, 2002, p. 349-372):

- Behaviours and experience: To help year 10 students identify observed engaging pedagogies/activities in time.
• Opinions and values: In understanding the cognitive and interpretive process of year 10 students these questions help identify what year 10 students think about science learning.

• Feelings/Emotions: Whilst it may be difficult to separate these fields I was looking for adjective/describing responses to student learning activities in science.

• Knowledge: To create a portrait of student perceptions about what a science lesson is about.

• Sensory/Interest/Motivation: To identify what sensory activities enhance year 10 students’ interest and support motivation toward engagement in science learning.

Prefatory/Summarising: To direct and focus the year 10 students’ attention to the nature of the next question and provide some time for thought. The summarizing transition provides opportunity for the year 10 students’ to make clarifications, corrections or additions.

1.5 The importance and limitations of a case study

This research is important for three main reasons. First, it contributes to an understanding of the kinds of learning strategies that engage 18 year 10 students in science learning. Observations from personal classroom experience, an awareness of school policy practice and procedures, active involvement in the implementation of the Australian Science Curriculum and an understanding of some global initiatives regarding science education e.g. 21st Century Science education in the UK, highlight the significance of student engagement in secondary science learning. In particular, I see the complexities of engaging pedagogy in science education amongst 14-16 year old year 10 students is important at the moment. Research discussed in the literature review (Lindahl, 2003; Sjoberg, 2000; Tytler, 2007) indicates concern with secondary student attentiveness, interest and performance in science education. Whilst there is an apparent interest in science in the community, where imaginations are
captured through science centred television programs, student interest and enthusiasm for science in the classroom is waning. There is a demand for more scientists in the global communities. Schools are entrusted with responsibility to meet this demand in producing suitably qualified young adults prepared to go onto higher education and/or to enter into the workforce. Furthermore, as well as jobs, schools are accountable for producing a scientifically literate community.

Second, this study, from the perspective of the year 10 students, investigates and examines what constitutes engaging pedagogies. It is evident from the literature that researching the perceptions and opinions of year 10 students regarding their experience of science at school may be integral in understanding ways of raising interest and engagement in science learning. Data collected from this research will contribute to the debate about engaging pedagogies in the science classroom and thus extending the knowledge base for those who are responsible for the management of change in science pedagogies.

Third, this investigation highlights the importance of competing curricula orientations that support the development and/or application of research based practices in pre-service teacher education, and/or ongoing professional development of classroom teachers around engaging pedagogies.

Case study research using qualitative research methods endeavours to adopt sensitivity to the limitations of the research methodology. There are, however, a number of limitations to be aware of. First, my own subjective perceptions have the potential to distort the data. Attention was therefore given to avoiding language or questions that might inhibit the emergence of student perceptions opinions and ideas. Interview conditions and approaches were planned to maintain a friendly positive and relaxed discussion, placing the participants at ease to encourage their responses in a positive and friendly way.
Second, the participants in this case study are not representative of year 10 students in all Australian schools. These year 10 students were from a small Christian school, and hence their lived experience and perceptions of culture, social values and differences in pastoral care may not reflect the behaviours or perceptions of most year 10 students in this age group. It was not known how other year 10 students in the wider community might have responded. The use of interviews and discussion group were important in interpreting the validity, reliability and generalisability and avoid surrounding hidden assumptions (Creswell, 2012).

Third, using interviews and discussion groups enhanced the investigation. Cross checking interview data for emerging themes of engaging pedagogy was recognised as appropriate for effective triangulation purposes. This was an essential element in identifying strengths and weaknesses of the question matrix. Focus group discussion was used to increase the validity and understanding of engaging pedagogies compensating for weaknesses present in the interviews. Understanding and evaluating claims to knowledge made by qualitative research is important in ensuring the research is trustworthy (Paton, 2002).

Whilst conclusions of this investigation may not be related to fundamental circumstances of teaching styles or methodology, the emerging themes regarding engaging pedagogy in the science classroom will contribute to alternative explanations and emergent theoretical frameworks worthy of further investigation (Creswell, 2012).

1.6 The structure of the thesis

The thesis comprises of five chapters. This introductory chapter provides a background overview of the problem, the position of the researcher regarding the study, the orientation, direction and limitations of the study, an overview of the methodology and the importance of the research. With the support of relevant literature chapter two outlines and unpacks three
relevant fields of research, student engagement, student voice and curricula conceptions/orientations to science teaching.

Chapter three describes the methodology and research site relevant to the investigation. The methods used and questions orientating the research will be highlighted whilst addressing relevant and necessary ethical issues. Analysis of the data will be explained and processes of validation through appropriate triangulation methods will be presented.

Chapter four will continue with an analysis of the perceptions of 18 year 10 students regarding engaging pedagogies. Student perceptions provide four emerging themes:

- access to knowledgeable passionate and committed teachers
- the importance of meaningful hands on learning
- relevance and ownership of learning
- relational learning.

Chapter five provides conclusions, a discussion connecting these emerging themes with engaging pedagogy and recommendations that include suggestions and pathways for building the community capacity of the school and its partners.
Chapter 2

Literature Review

This chapter discusses literature relevant to student engagement in science learning. The research process has been shaped and guided by two influencing factors, my professional experiences as a secondary science teacher and my reading of the literature during the investigation. Analysing the connections between my professional experiences as a science teacher and related literature has revealed three themes for exploration and discussion: encouraging student engagement in science; valuing student voice; and curricula orientations to science learning and teaching.

2.1 What encourages student engagement in science?

Research studies of students’ descriptions of science in secondary schools indicate that science classrooms are places where knowledge is transferred to students from the teacher or text book (Fensham, 2006). Students further indicated that where this approach to teaching is adopted the content is boring and irrelevant to their lives, and difficult to learn in comparison to other subjects (Fensham, 2006). Australian studies of students’ attitudes found that more than 50% of students agreed that science at school was not relevant to their current or future lives, nor did it help them make decisions about their health (Goodrum, Hackling & Rennie, 2001). Students do not like science compared with other subjects; and most do not agree that science has made them more critical or sceptical and more appreciative of nature (Jenkins & Pell, 2006).

Student engagement in science is an essential element to the teaching and learning process (The Education and Training Committee, Parliament of Victoria (ETCPV), 2006). The ETCPV (2006) highlights that increasing levels of student engagement in science, along with
improving teacher quality, are key factors for supporting high quality teaching and learning in science. Students are most likely to engage in science learning if they enjoy their studies and see relevance to their own lives and are confident in their abilities (ETCPV, 2006). The Catholic Education Commission of Victoria, as quoted in the ETCPV (2006) states that:

Teaching practices and curriculum that are exciting and engaging, make links to relevant real life situations, cater to different learning styles, are inquiry based, promote discussion, including that on ethical and controversial issues, are multidisciplinary and include sufficient practical work (p. 159).

‘Hands on’ experimentation is emphasised in some science curricula. Helping students to achieve desired outcomes and developing ideas from practical experiences is a complex process (Hofstein & Lunetta, 2004; Gunstone, 1991). Meaningful learning in the classroom requires time and opportunity for interaction and reflection (Champagne, 1990). The Victorian Model Solar Vehicle Challenger Committee (ETCPV, 2006 p. 176) argues that “science should be seen as a dual process: designing and carrying out experiments, and making and interpreting observations”. Practical work in science should be included because this approach enables’ a connection between hands on activities and relational science classrooms; the development of science skills and processes, as well as development and use of science language (ETCPV, 2006). Hands on science pedagogy that promotes student engagement in science learning is, therefore, more likely to provide learning activities that lead to quality experiences and enhance a shift in student engagement with science learning (Goodrum, Hackling, & Rennie, 2000). There are three reasons for this. First, hands on activities lead to relationships that include discussion and idea/question sharing. In these circumstances motivation to engage in science becomes stimulated through cooperative interactions between students and teachers, and facilitates science learning through curiosity, creativity and enjoyment of science. Second, hands on activities provide concrete experiences of natural phenomena. Planning investigations and participating in science processes support
the development of investigation and problem solving skills together with the skills associated with using scientific equipment. Third, the development and use of science language as part of, and through discussion of, and participation in hands on activities, contributes to students’ development of understanding of scientific explanations of the world in which they live. Hands on activities provide learning experiences that help students to experience and understand the nature of science.

In light of Fensham’s study (2006), as discussed earlier, Peacock (in Tytler, 2007) comments that science should not be restrictive but rather exciting discovery; by helping year 10 students understand the world around them, open ended tasks and relevance are vital in helping year 10 students make rational decisions on important matters (Tytler, 2007). Given that year 10 students are naturally curious and love investigating, Tytler’s view reinforces the idea that it is important for science teachers to capture year 10 students’ imagination and engage year 10 students with science learning through flexible programs and investigations. It is widely recognised that the task of engaging students in science learning in the middle years of schooling is challenging (Tytler, 2007; Peacock in Tytler 2007; Sjoberg & Schreiner, 2005; Lindahl, 2003; Sjoberg, 2000). Furthermore, these studies indicate that by this age students’ interest in science is decreasing. However, according to Tytler (2004), little insight is available that might give reasons for this, and he contends that that such insight is needed if secondary science teachers are to find productive ways forward for the development of an engaging science curriculum.

As a practising and experienced secondary science teacher, I have had ongoing discussions with year 10 students who tell me that science in schools can be too hard and unattractive, often placing them in a position where they find difficulty in relating the learning material to their current and future lives. Lyons (2006) supports this perspective when he argues that, for these reasons, secondary school science needs to be the focus of change, where the science
classroom environment is central to student learning. The lack of attractiveness of school science to year 10 students as outlined earlier sets a very high bar for some year 10 students to become sufficiently interested and engaged in learning science (Lyons, 2006).

During the 1950’s scientific and technological knowledge for all citizens became a feature of basic education (Scherz & Oren, 2006). In terms of engagement with science learning, Scherz and Oren (2006) acknowledge two different student sub-populations. First, are those pursuing science and technology in years 11 and 12 and post secondary science education. This group of students, recognised by DeBoer (2000) as engaged in enhancing their science literacy, highlights the responsibility of secondary science education to provide for year 10 students who are not only sympathetic to the promotion of positive scientific attitudes, but demonstrate a willingness to make use of scientific expertise. Such students are people who view science in a sophisticated way, are able to use knowledge in more contexts and able to make sense of scientific information (King & Kitchener, 1994; Linn & Songer, 1993 in Scherz & Oren).

A second yet equally significant sub-population includes those year 10 students who learn science as part of their general education. Engaging such year 10 students in science learning has become necessary for fostering a scientifically literate nation. Consequently, schools and science teachers are expected to promote the development of positive attitudes toward science and technology (Simpson, Koballa, Oliver & Crawley, 1994). In a whole-community context teachers and schools are accountable for providing suitably qualified young adults who are skilled, knowledgeable and possess some understandings of science along with informed and positive attitudes toward science professions and science related professionals (Scherz & Oren, 2006). In terms of community capacity building, scientific literacy is a high priority for all citizens. The lessons and skills that science education provides can have repercussions that
help make for more responsible citizens, a strong economy, a healthier environment, and a brighter future for everyone.

The actual picture of student engagement with science learning, whilst demonstrating some variability, is overall disappointing. Some disenchantment with Australian science education has been demonstrated through the numbers of year 10 students who take science subjects in the post-compulsory years of schooling (Goodrum, Hackling & Rennie, 2000). During the 2000’s (2002-2010) however, science at tertiary level in Australia has managed to be only marginally behind the pace of other disciplines (Norrie, J., 2012) Challenging behaviour at school, resistance to participation in science learning, truancy and low academic achievement have also been cited as consequences of disengagement from science learning (Carrington 2002; Lamb, Walstab, Tess, Vickers & Rumberge, 2004). Disengagement is also considered to be a major factor in early school leaving (Ainley, 2002; Finn & Rock, in Irvin, 1997). As an international priority student engagement in learning has become a popular catch phrase in education circles (Butler-Kisber & Portelli, 2003), a major educational goal (Irvin, 2006) and prerequisite for academic success (Montgomery & Rossi, 1994). The number of students disengaged in a school population may be more than two-thirds, all of whom are at risk of dropping out of school, having minimal involvement in school or demonstrating minimal engagement with learning (including science) in school (Wehlage, Rutter, Smith, Lesko & Fernandez, 1989; Cothran & Ennis, 2000; Schmoker, 2006). In contrast, engagement has been defined as the willingness of students to make a psychological investment to comprehend and master knowledge and skills (Wehlage, Rutter, Smith, Lesko & Fernandez, 1989). Year 10 student engagement in science learning may be regarded as the extent to which year 10 students are actively engaged, committed to and involved in their own science learning.

Hofstien, Sherz and Yager (in Scherz & Oren, 2006, p. 967) argue that:
“Student attitude and perceptions are influenced by factors such as the media and other factors that include their social environment, difficulties experienced in learning science at school, and the content of the school (science) curriculum”.

Science education is a “two-way relationship” (Scherz & Oren, 2006, p. 967) that influences and is influenced by students’ visual perceptions of their lived science classroom experience. I have observed in the science classroom that year 10 students who are actively participating with the learning activity are engaged science learners. Such students may be seen to use hours of personal study in social groups that positively influence their attitudes toward science learning (Edutopia, 2013). I have further come to recognise that some provision of learning resources such as basic and novel science equipment, on-line media, interactive white-boards, information technology and hands on laboratory work nurture student engagement in science learning. Student engagement in learning science is fostered when a teachers’ interest in students is apparent; the teacher takes the time to discuss the students’ personal learning and development.

Despite the importance of student engagement, there is a lack of consensus regarding how student engagement in science can be encouraged in schools (Irvin, 2006). Developing and incorporating study skill programs into science teaching, building student relationships with teachers, facilitating partnerships with local industry organisations, improving curriculum and pedagogy and creating meaningful place based community programs are amongst some of the strategies cited as facilitating engagement. The plethora of different understandings and conceptions of engagement by teachers and decision makers justify further the appropriateness of researching and clarifying student perceptions about the nature of engaging pedagogy and how it might be achieved.

Year 10 student engagement in secondary science learning is, therefore, the focus of this thesis. Statistical data provided by Martin, Mullis, Gonzalez and Chrostowski (2004) highlight the reality that student enthusiasm for secondary school science does not match that
enthusiasm for science found within primary schools. There is some agreement that some disengagement in science learning may be associated with general disengagement during these middle school years (Wyss, Heulskamp, & Siebert, 2012). However, there remains a need to conduct research that seeks to identify more positive and richer science classroom activities for redressing the imbalance between science engagement and disengagement in the upper middle and senior school years. Listening to student voices and investigating their perceptions of science learning is of value in providing a lens for identifying and focusing upon ways to develop engaging pedagogy in the science classroom (Palmer, 2013).

2.2 Valuing Student Voice

Rudduck and Demetriou (in Butler-Kisber, 2003) argue the need for involving students in day-to-day business of creating a learning community in schools. Butler-Kisber and Portelli (2003) support the notion that when students are consulted and able to share their ideas and questions, they have ownership of what is going in the classroom and experience a stronger sense of engagement through social membership in the learning process. Based on this position, it can be argued that understanding year 10 students’ perceptions about engagement with science learning is important, particularly in view of the often content-driven nature of science teaching. Encouraging teachers to focus on and listen to what year 10 students have to say about science may enhance student ownership of the science learning process. Year 10 students may become better learners by having opportunities for active intervention in science lessons. Here they can experience self-worth, are respected and are valued (Ruduck & Demetriou, in Butler-Kisber & Portelli 2003).

One study suggests that “science does not have relevance to students’ lives” (Olitsky, 2007, p. 35). In the light of these findings, Olitsky suggests that “if school science courses were designed to reflect students’ lived realities, student interest in science might improve”
When students fail to see connections between academic knowledge and their current and future lives, not only does the learning appear to be irrelevant, but there is little reason to engage (Brantlinger, 1991; Erickson & Shultz, 1992, in Cothran & Ennis, 2000). However, for students, engaging science pedagogy has the potential to make clear the relevance of science learning to their everyday world (Rennie, 2006). Such engaging pedagogy will be implemented using teaching and learning approaches that involve students in active inquiry and research (Bybee, 2006). The importance of the relational classroom and a relevant curriculum in promoting student engagement in science learning is highlighted throughout the literature. In order to understand what this might mean for year 10 students, being aware of their perceptions is important for informing and equipping teachers to evaluate and plan learning in science. Cothran and Ennis (2000) argue that “very little is known about what students think about schooling and education”. Furthermore, Cothran and Ennis (2000, p. 107) cite Stinson (1993) claiming that:

“Educators blame students for their lack of engagement, but have appeared to have little interest in understanding how students perceive school and how they assign (or fail to assign) meaning and value to their experiences there” (Stinson, 1993, cited in Cothran and Ennis, 2000, p. 107)

This insight reinforces the idea that student voice is important in evaluating education models and conceptualising reform efforts intended to lead to approaches to science teaching that year 10 students find meaningful and more engaging (Cothran & Ennis, 2000).

In relation to science teaching, Tytler (2007) argues that:

“Most conceptual change schemes in science incorporate elements associated with sociocultural perceptions of learning involving interdependence between the social and individual process of learning”. (Hubber & Tytler, 2004, in Tytler 2007, p. 34).

Here, cognitive development is rooted in social interactions (Vygotsky, 1978). Furthermore, the ideal classroom is one in which enjoyment, fulfilment, ownership and engagement in learning, incorporating mutual respect between student and teacher, is evident (Goodrum,
Hackling & Rennie, 2001). Attention should be given to altering the environment of the
science classroom in ways that increase students’ opportunities for meaningful participation
and social interaction surrounding science learning (Olitsky, 2007; Palmer, 2012). In these
classrooms, where social interactions are valued, year 10 students have opportunity to share
ideas and the teacher acknowledges the perceptions of the student. Such a classroom may be
described as a sociocultural classroom. In other words, this is a classroom where students are
encouraged to share their perceptions through exploratory activities and talk where the
teacher supports high quality conceptual discussion either in groups or in the whole class
(Tytler, 2007). Science classrooms as potential communities of practice, however, may be
made difficult by the physical settings and teacher-centred practices of most classrooms
where year 10 students’ desks face forwards, learning is teacher initiated and interaction
among the students is not facilitated (Lemke, 1990, cited in Olitsky, 2007). Seeking student
perceptions of their past, present and future learning in science, with regard to both the social
and physical classroom environments and the importance and relevance of the science
curriculum, will provide valuable insights into the implementation of engaging pedagogy in
the science classroom. An engaging science pedagogy will make science learning relevant to
year 10 students’ everyday world (Rennie, 2006), and be implemented using teaching and
learning approaches that involve year 10 students in active inquiry and research (Bybee,
2006a). Student feedback is important for helping teachers evaluate science learning.
Communicating with year 10 students and paying attention to what they have to say helps us
to identify the key elements of an engaging pedagogy. Diverse ideas are available with regard
to the implementation of engaging science pedagogy. For example, the materials published
by the Nuffield Foundation, 21st Century Science, (Nuffield Foundation, 1970) are widely
known. Interestingly, such diversity of pedagogy highlights the extent of disagreement and
the range of interpretations as to what engaging pedagogy in science might be.
The research discussed in this thesis brings to the fore secondary student perceptions of engagement in science learning using the voices of 18 year 10 students to make plain their experiences and conceptualisation of science and focusing on their impressions of the ways in which science is taught in the classroom. Listening to year 10 students’ voice on these matters has relevance to raising levels of engagement in science learning in the current educational climate. Previous research has indicated a need for better communication between students and teachers, higher quality teaching, and improved student representation in school matters (Mitra, in Butler-Kisber & Portelli, 2003). Engaging year 10 students in science learning as co-learners/researchers with the teacher, providing some opportunity of ownership of learning that involves discussion and questioning, facilitates inclusion of student voice in the lesson that may give rise to effective classroom pedagogy (Butler-Kisber & Portelli, 2003). As argued by Shore:

“Learning is the result of social experience and society is created by what human beings do together and provides new conditions for human behaviour and social development” (Shor, 1996, p. 58).

2.3 Curricula orientations and science learning

There is a challenge for science education to develop a science curriculum that acknowledges new life patterns, emphasising community connections and sustainability (Wynn, 2004, cited in Tytler, 2007; Australian Curriculum, Assessment and Recording Authority, ACARA, 2012). Based on a study of the life patterns of 200 immediately post degree people, Wynn (2004) argues that:

“[university] students’ values and choices are shaped by uncertain and changing conditions. [university] students value flexibility – the capacity to make choices and be proactive about job mobility – rather than predictability, as a basis for future security” (Wynn 2004, cited in Tytler, 2007, p. 5).

As discussed, many secondary school students, though not all find the school science curriculum on offer to be unimportant, disengaging, and irrelevant to their life interests and
priorities (Tytler, 2007). The culture of school science, with its traditional emphasis on canonical science concepts, is disconnected from students’ self-identities (Aikenhead, 2006), so for them science has little personal or cultural value (Aikenhead, 2006). In a comparison of independent studies of students’ perceptions of the nature of school science in England, Sweden and Australia, Lyons (2006) found remarkable similarity in students’ views about their science classes. Three common and interrelated themes: transmissive pedagogy, decontextualised content, and the perceived difficulty of secondary school science: seemed to be at the heart of students’ lack of interest in upper middle school science and declining enrolments in advanced senior school physical science courses and undergraduate university science programmes (Lyons, 2006).

Since the 1950’s the Australian science curriculum has broadened in purpose and endeavoured to find ways of helping a student population that has demonstrated a wide range of interests and differing levels of motivation to what has essentially been an academic program (Tytler, 2007). Tytler (2007) continues to argue:

“In post-industrial society, youth has responded with new life patterns that are different to those presumed in previous eras, and which have implications for schooling in general, and for the way the science curriculum and careers in science are envisaged” (Tytler, 2007, p. 5).

It can be argued, therefore, that student engagement/disengagement in secondary science learning stems from the nature of a science curriculum that responds, or fails to respond, to students’ new life patterns and expectations (Murray and Reiss, 2001). A content-laden science curriculum hampers the efforts of even the best science teachers to provide an engaging science education for all of their year 10 students. This problem is not confined to Australia (Tytler 2007). On the basis of his review of a large body of international research findings, Aikenhead (2006) was able to conclude that a recurring evidence-based criticism of traditional school science has been “its lack of relevance for the everyday world” (p. 31).
When students enter the middle school science classroom they are confronted by new language demands represented by definitions and terminology not necessarily used in their everyday lives (Fang, 2006). Students are expected to engage with what might be regarded as unfamiliar activities and develop skills that they may use generically, but which are now applied/regarded differently: for example, the everyday occurrence of looking at things and making notes become measuring, observing, recording and reporting, whilst making a cup of tea involves boiling water to 100 degrees Celsius, decanting, dissolving, filtering, and producing a residue and filtrate. Here the space and place of the science classroom is considered as constituting complex theorisations of material and symbolic life which for students to date may be regarded as under examined and under theorised components of their educational studies (Gulson, Symes & Sumision, 2007 cited in Smyth et al, 2008). Major influences on student engagement in science learning include social organisation in classrooms and schools, student interactions (Wigfield, Eccles, & Rodriguez, 1998) and the meanings that people assign to achievement situations (Molden & Dweck, 2000).

Student engagement in science learning may be shaped by curricula orientations to teaching and learning and the conceptions and actions of teachers and teaching. Having looked at research on student engagement in science learning, attention will now focus on alternative curricula orientations to teaching and learning as suggested by Kemmis, Cole and Suggett (1983), with particular regard to science learning and teaching. The three distinct curricula orientations to teaching and learning - academic/vocational, liberal progressive and socially critical - as identified by Kemmis et al. (1983) form a useful framework for analysing the science curriculum and science teaching.

2.3.1 Academic/vocational orientations to the science curriculum and teaching

An academic/vocational view assumes that there exists within society a commonly held set of goals and that the function and purpose of all education is to socialise, sort and select
students to play a functional role in society (McMahon & Portelli, 2004). A vocational/neoclassical science curriculum, whereby year 10 students are to find their place in society with the necessary inferred scientific skills and science knowledge (Kemmis et al. 1983), as identified in terms of the needs of national productivity and prosperity, leads to students who are compliant, conditioned and indoctrinated (McMahon & Portelli, 2004). In these science classrooms the curricula foundation of science learning is knowledge based and skill and content driven. The position of the student in the academic science classroom is one that can be explained using Freire’s notion of ‘banking education’ with the pouring of prescribed science knowledge into empty vessels (Freire, 1970). Such a goal driven orientation contains an expectation of mastery of academic science work, of finding of one’s place in society, and developing and acquiring the science skills to fulfil work roles (Kemmis et al., 1983). In this context, the traditional science curriculum has failed, and, as argued by Maeroff, “perhaps may not originally have intended to engage large numbers of students in science learning” (Maeroff, 1998, cited in McMahon & Portelli, 2004, p. 68).

The educational reform agenda (Australian Curriculum; Science; ACARA) and educational researchers (Goodrum et al; Aikenhead; Goodrum et al; Tytler) tell us that active engagement in learning is an important goal for all year 10 students. For centuries, however, educators have assumed that student learning consisted of rote memorization of new knowledge by students listening to lectures and reading books, and where their progress was measured by their ability/capacity to recite what they had heard and read. The adoption of a traditional academic science curricula orientation to teaching and learning is observed in science classrooms where the science teacher, in a place of authority, bypasses or displaces children’s experiences to explain natural phenomena (Lyons, 2006). An academic/vocational curricula orientation to science learning creates classrooms where science teachers’ status/power hierarchy is visible and the pedagogy incorporates teacher initiated text book
based science learning (Tytler, 2007). Lindahl (2005) draws attention to students’ resentment over the lack of opportunity for personal opinion and expression in science that is a consequence of transmissive pedagogies.

Research has indicated that:

“Transmissive pedagogy lacks relevance to some students, is decontextualised, does not engage students’ interest and commitment, and is unnecessarily difficult” (Aikenhead, 2006; Lyons, 2006; Lyons 2005 cited in Tytler 2007, p. 9).

Within the conservative/vocational curricula orientation to science learning year 10 students’ willingness to participate within a rigid framework of science specialism and differentiation may be taken for granted. In an academic/vocational orientation to the science curriculum the science pedagogy denies year 10 students the freedom to select and engage in science, which is of interest to them. Kemmis et al. (1983) argue that freedom of selection to engage in learning, which is of interest, to students comes as a result of the students’ performance, described in terms of set criteria and outcomes with regard to what is known, mastery of skills and propositional knowledge.

Research has consistently demonstrated that many of the problems and issues in science education are a consequence of the nature of a content-laden curriculum (Goodrum, Hackling & Rennie, 2000). Such a curriculum inhibits even the best teachers from providing an engaging science classroom environment (Rennie & Goodrum, 2007). Aikenhead (2006) has made reference to recurring evidence that traditional school science has a lack of relevance in the everyday world. Whilst this may not apply to all students, many do find the school science curriculum to be unimportant, disengaging and irrelevant to their life interests, career avenues and priorities (Rennie & Goodrum, 2007). Many students are located in a traditional curriculum that has not only failed to engage many learners (Maeroff, 1998, cited in McMahon & Portelli, 2004, p. 68) but is at odds (Klein, 2006, cited in Tytler, 2007, p. 35) with the way practising scientists learn and create knowledge. This involves analogy and
metaphorical thinking, and affective responses and judgements to refine and construct ideas (Klein, 2006, in Tytler, 2007). Thus the focus on textbooks and formal explanations of abstract concepts may be misplaced (Tytler, 2007). It can be argued that Australian secondary school science learning that is based on a conservative/vocational orientation to science learning holds an outdated and discipline-bound view of science (Tytler & Symington, 2006). Student engagement in science learning is “not well served by the strong focus on abstract canonical ideas that pursue predominantly disciplinary expertise” (Tytler, 2007, p. 21).

It has been suggested that the school science curriculum holds an outdated and discipline-bound view of science (Tytler & Symington, 2006). Positive images of science and technology, however, are in part a consequence of quality teaching. The report from the global science forum held by the Organisation for Economic Co-operation and Development, (OECD, 2006, p. 37) draws attention to the importance of teachers “consciously making efforts to improve the image of science and technology”. Indeed, the survival of the planet depends on a change of people’s attitudes toward the world (Wilson, 2002). It is important for schools, and science teachers in particular, to nurture the formation of young people’s attitudes and values. Given the impact of a multimedia world in which current year 10 students increasingly find themselves and how younger students are now developing multimedia literacy in advance of those of their teachers (Tytler, 2007), the Internet and the capacity this brings for global communication suggests it is not unreasonable to accept that traditional approaches to science education are not fruitful in such an environment (Peacock, 2007).

School science teachers have typically promoted positivist conceptions of science (Bentley & Garrison, 1990; Milne, 1993), believing in and influenced by inductive-empiricism and positivism (Koulaidis & Ogden, 1988, 1989). These views of the nature of science have been criticised by Milne (1993) as a misrepresentation of the true characteristics
of science as a selfcorrecting mode of inquiry. To enhance student engagement in science learning, therefore, it is necessary for “science teachers to consider a shift toward a non-traditional curricula and pedagogical model” See: (National Curriculum Framing Paper, 2008, p. 11 point 59). In order to enhance student engagement in science learning and enquiry toward science and scientific matters, science teachers should be encouraged to shift their curricula orientation to teaching, one that critically adopts/embraces a liberal and/or socially critical orientation to the curriculum.

2.3.2 Liberal/progressive orientations to the science curriculum and teaching

Liberal progressive classrooms are characterised by the teacher’s role as leader and facilitator, active inquiry by students, and an emphasis on understanding the reasons for social phenomena (Kemmis et al., 1983). Science classrooms are less authoritarian and provide movement and peer group discussion; more openness of movement and socialising (Changing Schools, 2010). Classrooms provide opportunities to become a place of mentoring, allowing the student to make real their experience of science learning and to engage in opportunities where they have chances of working independently within an individualising science learning environment (Kemmis et al., 1983). Considering student interests connects with a liberal/progressive science curriculum and a student centred approach to science learning. Curriculum approaches that acknowledge both intrinsic/extrinsic interest and motivation have importance (Harackiewicz, Barron, Carter, Lehto & Elliott, 1997). The psychological literature (Harackiewicz et al 1997; Hidi, 1990; Hidi and Berndorf 1998; Hidi and Harachiewicz, 2000; Hoffman, 2000) reminds us that student interests are central to learning and reinforces a liberal/progressive science curriculum that emphasises student centred approaches to science learning. Science learning that occurs when instruction is inquiry-oriented encourages students to actively think about and try out new ideas in light of their prior knowledge, to personally transform the knowledge for their own use, and to apply
it in other situations (Vygotsky, 1978). Liberal curricula orientations to science may combine and connect with academic/traditionalist science learning approaches in providing some opportunity for students to construct new information or knowledge that may be academic and/or vocationally oriented (Kemmis et al., 1983).

By way of summary, a liberal progressive orientation is characterised by:

- Student autonomy
- Control through involvement in decision making
- Recognition of student effort
- Choices based on interest
- Engaging task delivery by the teacher
- Provision of challenge. (Ames, 1992; Griffin & Symington, 1997)

The location of science in the liberal/progressive curriculum prepares year 10 students to participate with learning activities that are in a more place-based context. In these science classrooms the science learning material will provide some focus on relevance to a student’s current and future life, and provide a more critical-democratic agenda (Smyth, Angus, Down & McInerney, 2008). Furthermore, in a liberal/progressive classroom (year 10) students who adopt mastery goals are more willing to engage in challenging tasks (Ames & Archer, 1998) and use different study strategies (Nolen & Haladyna, 1990). In a science classroom adopting a liberal orientation to the science curriculum, the science teacher seeks to engage the year 10 students in a curriculum of discovery and enquiry, leading them to become active constructors of knowledge through attitudinal shifts with enriched intrinsic/extrinsic interest in science.

It should be acknowledged that the teacher’s positive emotional support is a key pedagogical component in classroom interactions. As such they are to be regarded as
important at both the academic and at the interpersonal levels with students’ feelings about engagement with learning taken into account (Meyer & Turner, 2002). Teachers participating in a liberal/progressive oriented curriculum as co-learners who demonstrate qualities of enthusiasm, humour, love of learning and modelling of positive emotions and motivation help create an instructional context associated with students’ reports of positive affect and motivation to learn (Meyer & Turner, 2002). Located in a liberal/progressive orientation to the curriculum, the knowledgeable science teacher is able to operate as a leader while at the same time attending to the needs of year 10 students and deliberately building on year 10 students’ existing understandings. Under these circumstances, classroom democracy is promoted, as teachers become conversant/acquainted with students’ ideas and interests thus facilitating higher achievement and knowledge that is longer lasting (Hoffman, 2000).

A liberal/progressive goal of engaged learning may be achieved through an engaging pedagogical process that focuses on building on student strengths, and goes beyond promoting individual achievements (McMahon et al., 2004). Within a liberal/progressive oriented curriculum (Kemmis et al., 1983) student engagement can encompass more than individual academic achievement. In any given context, the practice, maintenance and transferability of liberal/progressive student-oriented engagement is a consequence of human awareness where students experience connectedness to the school environment and relationships among individuals and groups (McMahon et al., 2004).

However, even where liberal/progressive orientations to curriculum encompass and go beyond academic achievement, conservative expectations of schooling continue to operate. Emphasis on understanding and problem solving and a move away from the transfer model is becoming an international trend (Goodrum, Hackling & Rennie, 2000). In alignment with a liberal/progressive curricula orientation suggested by Kemmis et al. (1983), Goodrum et al. (2000) provide the following two principled goals regarding science teaching and which
coalesce with a liberal/progressive curricula orientation to enhance engagement in science learning. First, it is suggested that the science curriculum focuses upon open-ended scientific investigations that are centred on enquiry. Here, year 10 students have an opportunity to investigate, construct and test ideas about the world in which they live. In so doing, they have an opportunity to exercise higher order thinking skills with topics in science that are relevant to their needs, concerns and personal experiences. Second, Goodrum et al. (2000) suggest that teaching and learning should operate in an environment that is characterised by values of enjoyment, fulfilment and ownership of and engagement in science learning. In such an environment, mutual respect exists between students and teacher and assessment is viewed as necessary for learning and is consistent with and complementary to good teaching.

Furthermore, engaged year 10 students are more likely to attain self-actualisation if they have learned how to learn and pursue values of truth and honesty. In this curricula orientation, students rightfully participate in the reconstruction of a scientific and technological society each to the level of his or her abilities (Kemmis et al., 1983). They are seen as socially responsible citizens prepared to use their skills, knowledge and other talents in society without impediment (ACARA, 2014).

The Australian Science Curriculum (NCFP, 2009) reinforces the call for curriculum and pedagogy that is meaningful and rewarding, such as can be made possible in a liberal/progressive classroom where year 10 students experience opportunities for learning skills and concepts that are relevant to their present and future lives. It does remain the case, however, that the consequential pressures of accountability and calls for standardised testing will reinforce the status quo. This demonstrates that distinctions are never clear cut. The implementation of a wholly liberal/progressive orientation to teaching and learning would be unlikely. This would be due in part to the changing phenomenon of the science classroom and the pressures imposed on the teacher to prepare year 10 students to perform at high academic
levels of attainment in accord with the expectations of a performance driven academic education system. Against the backdrop of the Australian National Science Curriculum (2009), teachers are accountable for the provision to society of suitably qualified scientific and science literate young adults equipped to make necessary contributions toward national productivity and prosperity. There is a growing disparity between science education provided in schools and the needs of young people as future citizens (Miller & Osborne, 2001). Rapid technological change indicates the need for science education that is not outmoded and is increasingly relevant to both the needs of the individual and of society as a whole (Miller & Osborne, 2001). Indeed, analysis of the labour market suggests a need for the development of an Australian community demonstrating ‘critical’ scientific literacy that leads to an increase in the number of individuals with a broader scientific and science literacy to support their role in national productivity and to enable them to participate in a democratic society (Miller & Osborne, 2001).

In a liberal/progressive orientation to learning (Kemmis et al, 1983), internet social networking and information technology systems readily allow year 10 students to access science information, ideas and perceptions and increasingly enable year 10 students to construct their own understandings of the world. Student interest in science based programs on television and the media demonstrate student social and critical engagement with science matters, highlighting possibilities for the purposeful cultivation of scientific literacy. My observation of these early 21st century science year 10 students indicates that they have both the capacity and the skills and resources for being socially and critically engaged in science learning. Where constructivist learning is in place, respect is afforded to student’s prior knowledge and alternative conceptions may be nurtured (Brooks, & Brooks, 1993). A socially critical science curriculum which is the next focus of this discussion, acknowledges the world of the student, their knowledge, skills and awareness of the world around them.
2.3.3 Socially critical orientations to the science curriculum and teaching

Disturbed by the educational system's complicity in the reproduction of oppressive social conditions, a socially critical curricula orientation to teaching and learning, point towards education as the primary means for changing society (Daigre, 2000). As proposed by Kemmis et al (1983) a socially critical curricula orientation seeks to weaken the boundaries between school and community, endeavouring to engage learners in community based action and analysis rather than just give them skills. A socially critical/democratic orientation to science teaching and learning is considered to be an ongoing reconstructive process, leading to democratic reconstruction (McMahon et al., 2004). As such a socially critical curricula orientation to science learning is associated with equity, community, creativity and taking difference seriously (Portelli & Solomon, 2001). A socially critical curricula orientation to school science that starts with children’s’ life-worlds adopts non-traditional approaches through a pedagogy that encourages new ideas and understandings to explain natural phenomena. For example, Aboriginal and Torres Strait Islanders exist as part of the diverse Australian community, many of who continue their daily lives with different lifestyles to the diversity found amongst non-Indigenous Australians. Michie (2002) has suggested that Indigenous science should be included in the curriculum as part of the way we can understand science. Indigenous science helps in reminding all Australians that there are different ways of looking at the world and that knowledge may be valued in different ways. Michie (2002) further comments that the aim of the science curriculum should be to promote a consideration of differing worldviews; not solely to enrich Western science but to facilitate a two-way exchange of knowledge and of cultural understanding.

It has been suggested by Barton (1998) that the notion of understanding socially constructed science knowledge permits an approach to the science curriculum that aims to deconstruct the major descriptions of science by uncovering the privileged positions within
its production (Barton, 1998). Here, the science curriculum has the capacity to put across
democratic illustrations of science that are more realistic and inclusive, leading to a liberating
and authorizing science education for the future (Barton, 1998). In a socially critical
curriculum year 10 students are not subjects of knowledge banking, falling victim to
alienation and oppression (Kemmis et al., 1983). Year 10 students’ science learning is
enriched within a relationship between both liberal/progressive and socially critical curricula
orientations; where year 10 students’ have opportunity of choice to engage in science
learning. In such a socially critical curricula orientation, engagement in science learning is
realised by and through relationships between year 10 students and science teachers working
together.

A socially critical curricula orientation to science teaching provides opportunities for
teachers and year 10 students to operate within the freedoms of a negotiated arrangement
with weak and limited boundaries between the science classroom, the wider school
curriculum and other partners in the community (Kemmis et al, 1983). Operating as
knowledgeable leader, project organiser and resource provider the science teacher practising
in a socially critical/democratic orientation, connects collaboratively with students and their
life world, with an emphasis on emancipatory interests. The teacher who considers
community needs and culture, and the current and future worlds of the year 10 students is in
social partnership with the year 10 students, co-researching and investigating relevant topics.
In a socially critical curricula orientation to science learning and teaching, science teachers
have an opportunity to connect as ethnographers and co-learners with students, leading to a
partnership of empowerment (McMahon & Portelli, 2004). Critical engagement in science in
this context is a cultural process within which science knowledge is shared by those who
struggle for social justice. Science learning takes place respectively and responsibly for the
purpose of improving lives for the teacher and those who struggle for social justice (Fear, Rosaen, Bawden, & Foster-Fishman 2006 in Smyth et al., 2008).

In socially/critical science classrooms teaching and learning fit together with no clear boundaries, providing some potential for releasing the student’s power (or lack of) to own their learning of science. Such a political shift, however, may not necessarily provide for enhancing student interest and motivation to learn more about science or to construct further understandings of science brought into the classroom or school in general. Discussions encountered with some year 10 students in the science classroom, however, reveal a rejection of the ideas of science and science teaching. Therefore, for some year 10 students, simply changing the orientation to teaching may not necessarily enhance a shift in engagement in science learning without considerable unlearning.

As a classroom practitioner since 1974, I have observed that no knowledge or teaching can be neutral. Ideologically speaking all emerges from some position in society and influence the development of the student in one direction or another (Shor, 1996). All formal education is politically oriented learning organised by one kind of authority or another. The authorities are seen as the teachers, the subject matter, the learning process and the institutional practices. Classroom teachers, in the position of authority, are the academic experts with the potential for deploying power and knowledge. Whilst having the authority to question the status quo of traditional pedagogy and professionally negotiate the curriculum some science teachers if not most view themselves as “the authoritarian educator unilaterally making rules and lecturing on preset subject matter” (Shor, 1996, p. 56) - a consequence perhaps of their own lack of political freedom/recognition of voice, in the decision making arena of school policy making. From my professional experiences this state of affairs can be partially explained by the fact that teachers are viewed as technicians increasingly held to account by external mandates and regulations.
2.4 Conclusion

This chapter has reviewed the literature that connects with three aspects of science learning: student engagement in science learning, the values of student voice and competing curricula orientations to science teaching and learning.

First, the literature supports the notion that engagement in science learning is of national and global concern. Furthermore, science learning is connected with knowledgeable teachers acting from a position of authority, presenting science in an interesting and motivating way, acknowledging that relational learning promotes ownership of learning and enhances engagement in science learning. Furthermore, pedagogy that includes hands on learning experiences that are meaningful and connect with year 10 students’ current and future lives enhances science learning (National Science Curriculum, 2009).

Second, the relational and knowledgeable science teacher is potentially positioned to listen to the voice of year 10 students. Listening to and acknowledging student voice nurtures a stronger sense of worth and sense of learning community membership, respect and agency thus leading them to become better learners (Ruduck & Demetriou in Butler-Kisber et al., 2003). It also supports community capacity building (Thomson & Comber cited in Butler-Kisber et al., 2003) by allowing year 10 students to discuss, explore, question and analyse how science contributes to their community.

Third, the literature supports the notion that shifts in curricula orientations support shifts in engagement in science learning. Changes in power roles will influence how students experience the science classroom (Shore, 1996). In a given lesson a skilled science teacher will adopt pedagogy that includes one or more curricula orientations including:
- conservative orientation that is teacher/text book centred and focused on knowledge and skill development
- liberal/progressive orientation that will provide a passport of opportunity for engagement in discussion, nurturing student voice and recognising student perceptions of science emerging from their lived experiences, or
- socially critical orientation that involves the teacher and year 10 students democratically working together nurturing discussion, ownership of learning and connecting science with the year 10 students’ lived world and the needs of the community (Kemmis et al., 1983).

Irvin (2006) reports that “engagement is facilitated by developing student skills, building relationships with teachers and other adults in the community, improving curriculum and pedagogy and creating community programs to meet students’ physical and psychological needs” (Irvin, 2006 p. 1-2). As Aikenhead (2007), cited in Rennie and Goodrum (2007), argues:

“...the culture of school science with its traditional emphasis on canonical science concepts is at odds with student’s self identities, so for them science has little personal or cultural value” (p.6).

Therefore an investigation of student perceptions of engaging pedagogy in the science classroom is timely.
Chapter 3

Methodology

Theoretical and Conceptual Framework

Introduction

Within the broader context of a national push for economic productivity that places schools under pressure to produce scientifically literate students, this research is designed to explore the question: How do year 10 students understand, experience, respond to and engage with science teaching in secondary school? My own professional experiences have suggested that engaging pedagogy in science learning incorporates teachers who know their subject, understand student needs, provide experiments and investigations, engage relationally in the learning process and facilitate student ownership of learning. This investigation of year 10 student perceptions of engaging pedagogy in secondary science will therefore adopt and explore a theoretical framework structured around knowledgeable and passionate teachers, hands on learning, relational learning and ownership of learning, to explore evidence of this framework in science classrooms in an independent Christian school in Western Australia. Furthermore, the research also seeks to investigate critical connections between student engagement in science learning and curricula orientations: conservative/vocational, liberal progressive and socially critical as described in the previous chapter (Kemmis et al., 1983).

3.1 The School Site

Bay View Christian School is an independent school located in Nirvana Bay, Western Australia. It is situated within a rich industrial and commercial environment that provides employment in applied science and technology and infrastructure supporting business and
human resource management. Driven by a primary resource economy in a social environment enriched by tourism, Nirvana Bay demonstrates significant population growth due to the demand for skilled tradespeople in building and construction, hospitality, health, real estate, commerce and other professions that serve social and community needs. Despite the existence of flourishing industries youth unemployment in the region, at the time of the investigation, was 12%. Poor student retention at school and a perceived lack of student engagement in learning has created cause for concern for many secondary schools in the area.

The continuing expansion and development of local science and engineering based industries puts pressures on schools to provide scientifically literate and skilled young adults who are well equipped to either enter the workforce and/or to go onto higher levels of study. The lack of engagement of year 10 students in the science classroom may not only limit the potential of schools to provide such skilled young adults, but also may limit the development of general scientific literacy in the community. Seeking engaging pedagogy for enhancing student engagement in science learning is, therefore, of importance for building the capacity of the year 10 students of Bay View Christian School and of the community as a whole.

As a small independent K-12 school, Bay View Christian School manages to maintain viable enrolment numbers. The numbers of year 10 students at risk of disengaging from school in general has, in recent years, been well below the local averages. A strong, educationally supportive culture is evident within the school, where the like-minded school community fosters a values-rich learning environment. There is a consensus in the community, shown by results of school-initiated surveys, that the positive interaction between all members of the school community helps students feel more connected, cared for and valued; a major feature of schools where student engagement is evident (Howard, 2001; Cotton, 1997; Finn, 1998). Both formal and informal surveys in the school have indicated that some parents have chosen to enrol their children at Bay View Christian School because
of its commitment to pastoral care and its endeavours to honour the integrity and identity of
the individual student. Bay View Christian School annually celebrates many academic and
community successes, and these have been highlighted in the college weekly news letter,
local and state newspapers and on the school web site.

The school fosters a curricula emphasis on a culture based on Christian values, which nurture
the personal and spiritual growth and development of young adults, is apparent in several
initiatives. At the time of the research the school supports a program of community service,
which includes all students in years 10-12. This community service aims to bring young
people into contact with the wider community, raising awareness of others and showing the
relevance of schooling to their current and future lives. In addition, a leadership team in the
form of a prefect body is established each academic year. Year 10 students are encouraged to
apply for prefect positions and are selected by interview. This team of young leaders is
mentored and supported by a member of the teaching staff who also facilitates student
activities regarding general routine organisation and management and curriculum matters.
New enrolments into the school generally come as a consequence of word-of-mouth
advertising, which further highlights parent/carer satisfaction for some families.
Consequently, year 10 students are encouraged to engage in science learning in an
environment where they are valued and recognised as individuals. However, despite the
positive influences of a strongly caring, child-focused educational community based on
Christian values, concern existed regarding year 10 students in Bay View Christian School
Senior School disengaging from senior school physical sciences.

During the period 2002-2010 Bay View Christian School noted concerns regarding student
engagement in science in the middle school and low student enrolment in science programs in
year 11. Science teachers, the Head of Senior School and the Principal engaged in discussions
about ways of changing pedagogy to enhance student engagement in science learning.
Student engagement in science had been recognised as a national and global concern (Goodrum, Hackling, & Rennie, 2000; Rennie, & Goodrum, 2007). In addressing this issue, ideas about engaging pedagogy were discussed for adaptation to the year 10 science teaching and learning program. After careful consideration it was agreed that engagement in science learning might be enhanced when year 10 students had access to knowledgeable teachers, had opportunity to participate in hands-on learning that connected with relevant science and scientific matters, and had some opportunity to pursue their own questions and ideas.

Whilst these approaches signalled a shift toward a liberal progressive curriculum (Kemmis et al., 1983), for teachers wishing to develop engaging pedagogy such a shift was in contrast to a community and senior management driven expectation for a more conservative orientation. This approach which fostered formal learning was more typical of traditionalist ‘filling of jars’ approach to learning (Kemmis et al., 1983). Consequently learning programs that were teacher centred as well as text-book centred were more commonly observed across the school accommodated by an assertive discipline policy. Year 10 students experienced assessment-driven programs of study incorporating regular and frequent end of topic tests, homework assessment items and end of semester examinations. Year 10 students moving into year 12, having matriculated from academic courses of study in the previous year, were then subject to examination early in their final year if they wished to retain their chosen avenue of study.

It has been suggested by Kemmis et al. (1983), and discussed in the literature review (McMahon & Portelli, 2004; Portelli & Solomon, 2001), that a socially critical approach to teaching and learning acknowledges and values learning programs that facilitate engaging pedagogy based on student knowledge and experience. In contrast a conservative/vocational orientation to teaching and learning (Kemmis et al 1983) is at odds with a socially critical orientation. The latter is set and driven by expectations of national and local productivity, employability, assessment pressures and league tables. It is politically located within cultural
expectation of a disciplinary hierarchy, controlling groups of year 10 students. An investigation of student perceptions of learning in science will provide information and insight regarding understanding of student engagement in the science classroom.

3.2 Relevance of the research at Bay View Christian School

In seeking to enhance student engagement in science learning the teachers at Bay View Christian School recognised a need for evaluation of the pedagogy in the year 10 science programs. The senior school science teachers decided to investigate and trial a more democratic science classroom. Pedagogy that was located in more liberal and/or socially critical curricula orientations was investigated, discussed and put into practice. Applying their combined science knowledge and their understanding and awareness of the needs of the year 10 students and local community, the team of teachers considered ways of facilitating relational learning activities that connected in some way with year 10 students’ lives. Teachers endeavoured to provide a more engaging pedagogy by including investigations and research topics that year 10 students considered interesting and relevant to their current and future lives.

Three key approaches were chosen:

i) the provision of investigations that were meaningful to year 10 students’ lives;

ii) a future science curriculum that included greater variety in terms of learning activities and place of learning (Millar & Osborne, 2001);

iii) the adoption of a 14 week teacher/science discipline rotation model.

Because of the planned innovations in science learning, an opportunity emerged to research student perceptions, interest, motivation and engagement in the science classroom at Bay View Christian School.
3.3 Authenticity and credibility of student voice

Student satisfaction in school accurately predicts their academic achievement (Samdal, Wold & Bronis, 1999). Providing an opportunity for student voices to be heard and thereby bringing attention to year 10 students’ attitudes, interest and reasons for choosing to engage in science learning can contribute to an understanding of how to develop engaging pedagogies in science.

Teachers can better understand how year 10 students think, behave and feel by getting to know the world in which they operate and what they are trying to do. When asked, students are more likely to come up with their own ideas about what is achievable and engaging in the classroom (Down, Ditchburn & Lee, 2004). The report of The Education Alliance (2004) comments:

If asked, students have much to say about teaching and learning that can help schools have more effective educational environments for them, and as such, student voice can be a powerful tool for improving student performance and closing the achievement gap (p. 3).

What year 10 students have to say about their experiences in any classroom can be of help in identifying ways of establishing and maintaining effective learning environments.

Research in organisational change in education indicates that reforms may be more successful when participants feel ownership (Levin, 1999). Furthermore, “student voice is recognised as an agent for school reform and renewal” (Raymond, 2001; Levin, 1999, cited in The Education Alliance, 2004, p. 3). Involving year 10 students as stakeholders in participatory research allows year 10 students to contribute to inventive ideas that help schools overcome obstacles, boosting educational success. Research supports the notion that student engagement has a strong relationship to success or failure in school (Montgomery & Rossi, 1994; Finn, 1989; Wehlage, 1983). From four decades of science teaching experience I have learned that taking note of what students have to say fosters student interest, identification
and active involvement in classroom activities. Coupling this approach with personal and social associations with staff and peers boosts engagement and improves achievement and behaviour (Howard, 2001a; Samdal, Wold & Bronis, 1999).

Student-centred strategies, such as providing choice and autonomy in choice of assignments, foster an emergence of student voice. These strategies in turn provide links to improved motivation and learning, greater perceived self-efficacy, increased academic challenge and greater relevance (personal/social/cultural) of curriculum and pedagogy (Howard, 2001a, 2001b; Smith, Butler-Kisber, LaRoque, Portelli, Shields, Sparkes & Vibert, 2001; Levin, 1999; Lumsden, 1994; Raywid, 1994b; Kohn, 1993; Deci, Vallerand, Pelletier, & Ryan, 1991; Deci & Ryan, 1985).

### 3.4 A case study approach

As a qualitative research method: “A case study is not a methodological approach but a choice of what is to be studied” (Patton, 2002, p. 447). Thomas (2004) states that:

> A case study may be considered as a detailed examination of a single example of a class of phenomena where the case study research strategy can be used to pursue an examination of one or a small number of instances in a phenomenon of interest (Thomas, 2004).

As a working definition:

> A case study may be characterised as a detailed examination of a series of related events which may exhibit some active theoretical principal (Thomas, 2004, p. 128).

With regard to social and behavioural sciences a case study can be used to describe and analyse an object, person, group, event, state, condition or process. Furthermore, a case study is an empirical enquiry that can be used to investigate an existing observable fact within its real life context (Thomas, 2004). The process of constructing the case study as proposed by Patton (2004) pursues three steps:
Step 1: Assemble the raw data, consisting of all information regarding the setting.

Step 2: Construct a case record as a collection of raw data organised, classified and edited.

Step 3: Write a final case narrative about the phenomenon either chronologically or thematically. As a record it should provide information that allows the reader to understand what is going on in the case (Patton, 2002).

There is widespread acceptance that the way in which the researcher perceives the world will shape the paradigm used (Aldridge & Fraser, 1999). If the science classroom and learning at Bay View Christian School are viewed through the eyes of year 10 students then it may be possible to measure and learn more about engaging pedagogy rather than through eyes of an external observer (Aldridge & Fraser, 1999). Qualitative research has demonstrated a capacity to provide in depth and richly detailed documentation about the research environment, enabling an understanding of people in real life. This approach to research can be applied to a study of the way year 10 students operate, where rich data is obtained as a result of the methods used (Gillham, 2000). Getting to know the world in which 14–15 year old year 10 students at Bay View Christian School operate, and what they are trying to do in the science classroom, will therefore contribute further to the understanding of how they think, behave and choose to engage in science learning. In order for the researcher to gain a deeper understanding of what is going on in the classroom (i.e., when year 10 students recognise they are learning science), a case study approach was adopted to investigate year 10 student perceptions of engaging science pedagogy at Bay View Christian School. In seeking answers to questions that began with ‘how’, ‘why’ and ‘what’ a case study approach was used to examine and interpret patterns in data transcribed from in-depth interviews and focus group discussion. These interviews, with the support of the literature review provided an enriched understanding of year 10 student engagement in science learning.
A case study research approach was used to investigate science education, accommodating a qualitative research paradigm that incorporated a detailed analysis of data, which focused upon a particular problem of an individual or group. Three paradigms, as described by Patton (2002) were used in formulating this study: positivist/constructivist, constructivism/constructionism and hermeneutic (Patton, 2002):

- Positivist and realist paradigm: to investigate what could be established about a phenomenon and to observe and interpret patterns and provide plausible explanations regarding connections between the elements of the research topic.

- Constructionism/constructivism: to find out how realities are constructed in a human phenomenon; including exploring perceptions, truths and explanations, beliefs and world view, also, considering the consequences of these constructions for behaviours; and for those with whom participants interacted (Patton, 2002).

- Hermeneutic paradigm: to help interpret the conditions of the phenomenon. In the context of qualitative enquiry hermeneutics focuses upon interpreting something of interest (Patton, 2002), including interviews and observed actions, aimed at enhancing understanding by relating parts to wholes and wholes to parts (Patton, 2002).

The first step was to find out what was going on in the year 10 science lessons at Bay View Christian School. This investigation used a positivist and realist paradigm to investigate what could be established about engaging science learning at Bay View Christian School. In so doing, this case study sought to observe and interpret patterns and provide plausible explanations regarding connections between student engagement in science learning, engaging pedagogy and curricula orientations to teaching and learning science. Thereafter, within the context of Bay View Christian School, this investigation sought to study science learning in year 10 science classes that corresponded as much as possible within the year 10 students life world.
Second, by using the paradigm of constructionism/constructivism, this case study of science learning sought to find out how the year 10 students at Bay View Christian School constructed their reality. This process included exploring the reported year 10 students’ perceptions, truths and explanations, beliefs and world view of science learning. In addition, the process considered the consequences of these constructions for their behaviours and for those with whom they interacted (Patton, 2002).

Third, in an attempt to minimise bias, a hermeneutic paradigm was adopted to help interpret the conditions under which science learning took place at Bay View Christian School. In the context of qualitative enquiry hermeneutics focuses upon interpreting something of interest (Patton, 2002), including interviews and observed actions, aimed at enhancing understanding by relating parts to wholes and wholes to parts (Patton, 2002). According to Tripp (1994), it is never possible to describe everything about a situation or say in any absolute terms what makes up an adequate description. The hermeneutic approach to this investigation, however, has sought to systematically map meaningful possibilities in order to check what has/has not been covered. In pursuit of covering the necessary and sufficient issues in this investigation the following table, fig. 1, page 57 provided by Tripp, (1994, p. 18) was considered:

**Fig. 1, Data analysis support**

<table>
<thead>
<tr>
<th>The component</th>
<th>Reason for inclusion</th>
<th>Kind of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context</td>
<td>Comparable Comprehensive</td>
<td>Concepts &amp; categories</td>
</tr>
<tr>
<td>People</td>
<td>Comparable Comprehensive</td>
<td>Concepts &amp; categories</td>
</tr>
<tr>
<td>Things</td>
<td>Comparable Comprehensive</td>
<td>Concepts &amp; categories</td>
</tr>
<tr>
<td>Events</td>
<td>Comparable Comprehensive</td>
<td>Concepts &amp; categories</td>
</tr>
<tr>
<td>Relationships</td>
<td>Comparable Comprehensive</td>
<td>Concepts &amp; categories</td>
</tr>
</tbody>
</table>

(Tripp, 1994)
Adoption of this approach as part of the data collection and analysis helped the researcher to identify inconsistencies arising during in-depth interviews and focus group discussion. The approach offered opportunity for deeper insight into the relationship between the inquiry approach and what was going on in the classroom, making it possible to interpret its meaning (Patton, 2002).

Using the data collection methods of in-depth interviews, focus group discussions, and interview notes the data analysis of this investigation sought to provide detailed narrative descriptions and explanations of the phenomenon of science learning taking place at Bay View Christian School. The embraced methodology, paradigms and evidence triangulated from these methods allowed for reasonable confidence that the research had captured what was going on in science learning. The employment of these strategies strengthened the investigation, contributing to an illumination of the inquiry question.

3.5 Ethical considerations

It was important to avoid treating the year 10 students of this investigation as objects (Kennedy, 1975). Involving year 10 students as partners in the research process required critical consideration of ethical concerns. When seeking participatory interaction there is a need to redress the balance of power between the researched and the researcher (Kennedy, 1975); participants must be empowered by the research process for their own integral involvement (Guba & Lincoln, 1989). Friere (1970) has commented that the social responsibility of qualitative researchers is to avoid seeing and treating participants as passive objects. By working with them the possibility arises to help participants become increasingly knowledgeable, active, responsible and therefore increasingly liberated. In seeking student perceptions and opinions of science education it was important to engage them in the
discussion, to honestly listen to and participate as they ‘gave voice’ to their experiences and
to facilitate and nurture ownership in the growth and development of voice.

After gaining permission from the Murdoch University Ethics Committee, and the schools
agreement to participate (appendix 1), the recruiting of participants commenced with an
address to all year 10 (14-15 yr. old) year 10 students and science teachers at Bay View
Christian School. The presentation highlighted and explained the purpose and procedure of
the investigation and provided opportunities for questions to be asked and answered. Year 10
students were informed that both the school and their personal identities at all times would be
protected and that the school would receive a report of the findings. Year 10 students were
provided with letters and participant application forms to take home for their
parents/guardians to read and consider (appendices 2, 2(a), 3 and 4). Informed consent from
parents/guardians and individuals was required prior to the commencement of any interviews
or discussions. Eighteen participants were randomly selected from the group that submitted
application forms. This was a necessary process in favour of demonstrating a fair test using a
group of participants of mixed ability, gender, personal interests and social background.
Random selection also endeavoured to remove all possible teacher/school influences and was
aimed to protect the case study from selecting year 10 students who were interested in
science and/or science learning. Despite this, all participants in the case study showed
evidence of having an interest in science and science learning (and it must be acknowledged
that the decision to submit a form was probably indicative of some interest in science). All
year 10 students who submitted a form were sent thank you letters informing them of the
outcome of their application (appendices 5 and 6). This procedure was necessary to ensure
that participants from Bay View Christian School understood that they were not for any
reason obliged to participate in the investigation, nor were they required to answer any
questions they might not wish to answer. All year 10 students were provided with
information on how the interview data might be used, who would have access to the data and who they may contact for questions. It was necessary at the start of each interview/discussion to explain to year 10 students its purpose whilst refraining from talking about the topic to avoid influencing what might be said during the discussion. How the focus group interview fitted within the broader context of the investigation for triangulation purposes was also explained. Risks and benefits of the study to the individual and the community were also highlighted.

Caution was necessary with respect to non-achievable promises of rewards or outcomes, and special precautions were necessary to maintain confidentiality of participants who chose their own pseudonyms or letters for identification in the researcher’s notes. Teacher identity was also protected when year 10 students answered open ended question regarding classroom activities and instruction. Whilst the likelihood of students sharing the discussions outside the interview setting was acknowledged, special precautions had been put in place to protect their identity. All students who had been selected to take part engaged and participated in both in-depth and focus group discussions and interviews.

Data emerged from an open and active exchange between researcher and year 10 students. As previously mentioned, to secure meaningful responses to the interview and discussion group questions, significant emphasis was placed on a relationship between researcher and year 10 students (Reinharz, 1983; Reason, 1988). As a researcher who had also been a teacher and senior manager in the school there was a risk that some participants who, whilst talking with me, might feel uncomfortable or threatened. It was therefore important to reduce any stressful situations for these students (Patton, 2002). This was addressed by adopting a calm, friendly approach and by carrying out the in-depth interviews and focus group discussions in the nearby Church common room. The room provided an environment that was comfortably furnished and where participants had freedom to leave at any time during the
interview if they so wished; an environment that was non-threatening where year 10 students might feel ‘at ease’. It was accepted as unreasonable to expect year 10 students to maintain confidentiality about their selection or non-selection. It was recognised as almost inevitable that the participation of particular year 10 students would become known and that students would likely discuss their participation with each other.

Despite the protection of student identity, the possible risk of staff over-protection and condescending attitude toward participants was noted (Patton, 2002). Therefore, science teachers were not informed of student identities, the times or dates of the data collecting sessions. The arrangements of the interviews complied with agreements made with the principal and at a time of minimal disruption to the student’s normal learning. Each student participant was provided by the principal with a permission slip to leave their class at the appointed times.

The trustworthiness of data is inextricably linked to the trustworthiness and competence of the person who collects and analyses the data (Patton, 2002), therefore close attention to verification and validation procedures was necessary and essential. The comments of the year 10 students/participants were transcribed word for word and included in the report to support and validate the perceived accuracy and fairness of the investigation.

A rigorous and careful analysis of the data by a grid and group method was used in an attempt to transcend limitations of place-focused, single site ethnography (Smyth et al, 2008 p.18). The data was transcribed and then analysed in two stages. Firstly all transcripts were read to identify, by colour coding, common themes as they emerged in the thematic framework. This incorporated constructing a table to collate the questions of the interview matrix according to emerging themes. Second, the transcripts of student comments were gridded and grouped in connection to identify patterns and connections that might support the
thematic framework. Data from in depth interviews were validated by comparison with data collected from focus group discussions which had been transcribed and analysed in the same way as the in-depth interviews.

3.6 In-depth interviews

In-depth interviews of year 10 students in pairs, was used to collect information about student experiences, opinions and feelings regarding science and science learning. As part of this method, an interview question matrix was used to investigate what year 10 students had to say about their past, present and future perceptions of science learning. The aim, using the voice of the year 10 students, was to identify patterns that connected moments in the life of the student in the science classroom where they perceived they were learning science, and to make connections between these patterns and instances of engaging pedagogy. During in-depth interviews any emerging ideas or unexpected perspectives were addressed and drawn out in more depth. This helped to reveal a richer portrait of the student’s experiences and expectations of science learning. Here the voice of the student helped in identifying how they felt about science learning, and what was going on in the classroom when they believed they were learning science. Open-ended questions that allowed year 10 students to explain and elaborate their ideas were presented in a neutral manner to minimise any bias from the researcher. An attentive listening approach was adopted by the interviewer, being mindful of the need to avoid non verbal signals that might affect students’ responses and follow-up questions and probes were based upon student responses (Patton, 2002).

Carefully planned questions were structured on a time-frame question matrix adapted from Patton (see Patton, p.352, exhibit 7.3). Repetition and sequencing of questions was maintained throughout all interviews. Questions were asked in the present, past or future tense and the matrix included a set of options that helped in deliberating which information
was most important (Patton, 2002). By combining the time frame matrix with different types of questions the matrix generated 14 different types of questions. As such the matrix provided a set of options to help in the thinking and identification of what information was most important to obtain. The interviews were digitally recorded, and typed transcripts of the recordings were made to accompany the interviewer’s notes.

The use of truly open-ended questions permitted the year 10 students to follow a line of discussion in a direction of their choice. To find out what year 10 students had to say about science learning with regard to their images, words, themes, thoughts and experiences it was necessary to ask questions that allowed them to draw upon these experiences about science learning. Questions were phrased to avoid ‘yes’/‘no’ answers to ascertain feelings, experience, opinions and knowledge. For example:

- How do you feel about…?
- What is your opinion of…?
- What do you think of…?

Asking ‘what?’ questions allowed the year 10 students to reveal their feelings and ideas of science learning in the past, present and future. That is:

- What was going on when…?
- What is happening in…?
- What is needed for…?

The adoption of a constructivist paradigm, as previously mentioned, facilitated an attempt to obtain from year 10 students a sense of how they constructed their reality: in other words, what were their reported perceptions, truths and explanations, beliefs and world view of science learning at Bay View Christian School. Therefore, a constructivist approach
supported the exploration of how the year 10 students constructed their own reality in the science classroom. In search of further evidence to either support or refute emerging theoretical themes, student responses to questions during in depth interviews were further investigated during focus group discussions.

In seeking a theoretical thematic framework, and to maintain common and meaningful questioning, the following interview question matrix, table 2, page 65, adopted from Patton (2002), was used:
Table 2, Interview Question matrix

<table>
<thead>
<tr>
<th>Question Focus</th>
<th>Past</th>
<th>Present</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviours/Experiences</td>
<td>Describe your best lesson so far this year.</td>
<td>What are you currently working on in science? What experiments have you been doing recently?</td>
<td></td>
</tr>
<tr>
<td>Opinions/Values</td>
<td></td>
<td>What do you think science is about? What are the reasons for teaching science in schools? What do teachers do to make the lesson interesting? What, in your opinion makes the best sort of science lesson?</td>
<td></td>
</tr>
<tr>
<td>Feelings/Emotions</td>
<td>What were the best (coolest) (sickest) sorts of lessons for joining in with? What gets you involved?</td>
<td>How do you think joining in with the lesson affects you/others? What thoughts go through your mind when you know you a have a science lesson to go to? What is the least interesting sort?</td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td>What about you – how have you found science this year?</td>
<td>What about dislikes? What are some of the things you don’t like so much about science lessons?</td>
<td>Suppose I was with you at the start of a science lesson. What would I see happening during the first 10-15 minutes as everyone walks in? What would you be doing, what would everyone else be doing in those first 15 minutes?</td>
</tr>
<tr>
<td>Sensory/Interest/motivation</td>
<td>How if at all is science interesting to you? When do you learn best in science? What’s it like to be a student in these lessons?</td>
<td>What is it about you, personally – desires, ambitions whatever, that might lead you to become involved in science?</td>
<td></td>
</tr>
<tr>
<td>Prefatory &amp; summarising</td>
<td>How about attitude, what might have happened in a lesson that affected your attitude to participate in the lesson? How if at all has your awareness of science changed by your experiences in these programs?</td>
<td>What changes, if any have you seen in yourself as a result of participating in yr.10 science? What suggestions/possible ideas might you have changing the programs?</td>
<td></td>
</tr>
<tr>
<td>Summarising transition</td>
<td></td>
<td>What, good things, if any could happen in the science classroom that motivate you to get involved?</td>
<td></td>
</tr>
</tbody>
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I am interested in learning more about you as a person and your personal involvement in science.
3.7 Focus Group Interview

For triangulation purposes a separate group of six different year 10 students participated in an in-depth interview. As previously mentioned, all of the year 10 students who initially volunteered to participate in this investigation had some interest in science. Consequently year 10 students selected to participate in a focus group discussion were chosen according to gender, three boys, three girls and the science teacher/pedagogy to which they had been exposed as part of their involvement in the rotation of the science classes. Using the question matrix to maintain continuity of questioning and to compare the data from the in-depth interviews, discussions with the year 10 students in this group were used to obtain a large amount of information in a relatively short time. Taking place in the same environment as in-depth interviews, the dynamics of the group stimulated conversation and provoked a range of reactions, and this approach was appropriate in helping to identify group norms and discovering variety from student perceptions.

A digital Dictaphone was used to record the interview and this data was elaborated through researcher notes. The data consisted of digital recordings, transcripts of those recordings and the researcher’s notes.

3.8 Analysis and validation of data

The aim of the analysis was to determine the substantive significance of the data. The data was analysed to identify patterns, findings and conclusions regarding student perceptions of science learning, and conclusions drawn on the basis of this analysis. The analysis is intended to enable readers to make their own judgements about the findings and conclusions that form the basis of this report. In determining the substantive significance of this research regarding student perceptions of science learning the following questions were addressed (see Paton, pp. 467-468).
• How solid, coherent and consistent is the evidence in support of the findings?
  (Consider triangulation support from Focus Group discussions.)
• To what extent and in what ways do the findings increase and deepen understanding of science learning in the year 10 classrooms and support an identification/ratification of engaging science pedagogy?
• To what extent are the findings consistent with other knowledge regarding student interest, motivation and engagement in science learning?
• To what extent are the findings useful for informing the development of engaging science pedagogy?

As a qualitative analyst there is a need to use creative and critical faculties in making judgements about what is significant and meaningful in the data (Patton, 2002). Student participant responses and student voice was taken seriously. Consideration was also given to the responses and reactions of the research supervisor and co-supervisor as they read and reviewed the results. It has been commented that consensual validation will emerge when the analyst, those studied, and the reviewers have opportunity to agree (Patton, 2002).

For validation purposes three steps were taken to analyse and recognise critical significance in the data. First, all transcripts and digital recordings were analysed and reviewed. Emerging ideas and themes were colour coded on the transcripts using a highlighter pen. Emerging themes were logged and, in the first instance included:

• Teacher Performance
• Classroom environment
• Experiments
• Tiers of interest
• Relationships
• Emotional factors
• Current and future relevance of science learning

Second, to enrich the data, each separate interview transcript was revisited and more deeply analysed to accurately identify and connect student comments with the emerging themes related to student engagement in science learning. Student responses in each in-depth interview were carefully analysed, permitting the researcher to develop a rich appreciation and understanding of the year 10 students’ perception of the classroom situation and the ‘learning’ experience. Data collected from the focus group discussion were analysed similarly in seeking to validate the input of the year 10 students participating in the in-depth interviews. Each participant response to each question for each interview was carefully analysed to identify data about student perceptions. Responses relevant to student perceptions and engaging pedagogy were then cut and pasted onto a ‘Question/Answer’ Matrix for further analysis.

Third, student responses to specific question were analysed. The use of pictograms, balloon charts, tables and matrices were used to gather, construct and collate fields of commonality that would be used in the recording, reporting and final analysis of the investigation findings (appendix 7, pp.161-205).

The process and completion of the analysis and validation process yielded four key themes with regard to engaging pedagogy in science learning:

• Hands on learning
• Relevance and ownership of science learning
• The role of knowledgeable, passionate and committed teachers
• Relational learning
The data to illustrate aspects of year 10 students’ experiences of science and learning support is provided and unpacked in the next chapter.
Chapter 4

Student experiences and responses to science learning

Introduction

This chapter reports on the results gathered from a case study of year 10 students’ understandings of and responses to their science learning experiences at Bay View Christian School. Located within the context of three sets of issues: economic productivity, scientific literacies and schools under pressure (see Chapter 1), this case study of engaging pedagogy seeks to investigate the phenomenon of student engagement in science learning in a real life context by addressing the question:

_How do year 10 students understand, experience and respond to science teaching in secondary school?_

The intent of the research has been to gain a detailed understanding of what year 10 students believe constitutes engaging pedagogy in the science classroom. An understanding of how year 10 students in an independent Christian school learn best in science may further add to science educators’ understanding of year 10 students’ experiences of and attitudes to science in Australian schools; in particular, other independent Christian schools.

Analysis was made of all student comments to reveal a common thematic framework. As guided by the question matrix, the data provided by the transcripts from focus group interviews was used to validate themes that emerged in the transcripts from in-depth interviews. Emerging themes from student comments included the following thematic framework:

- Hands on learning
- Relevance and ownership of learning
Teacher qualities: Knowledgeable, passionate and committed teachers

Relational learning

Commencing with a brief section regarding student perspectives as to what science is about and what makes the best sorts of lessons, this chapter will continue by using the above thematic framework to unpack and discuss student perceptions of engaging science pedagogy.

4.1 What is science about and what makes the best sort of lessons?

In seeking an appreciation of student voice and gaining a richer understanding of their perceptions of engaging pedagogy it was necessary and important to recognise Bay View Christian School year 10 students’ ideas as to what science is about. Some individual year 10 students shared their points of view regarding this matter:

* I think science is about discovering new ways to do things and find out how things work and why things happen and what certain events would cause something else to happen and more and more things are being discovered as science is being developed (Kim).

* Basically trying to find the reasons for things and explaining them, like how the world works, like the reasons behind things and what the actual story is. Why do apples fall out of the tree and hit the ground instead of just hovering in mid-air? (Steve).

* [Science] it’s just like the basis of human life. It’s like conducting research and hypotheses about certain things and how they work and how they came to be and (science is) just humans trying to make sense of what we have and how we can use resources best to our advantage (Ann).

Conversations regarding year 10 students’ experiences in the science classroom revealed that some individuals recognise the purpose of science learning and choose to become engaged in its processes. These year 10 students demonstrate levels of sophistication in understanding why science is taught in school. For example:

* . . . [science] educates children to make them grow up to be possible scientists and help discover new things . . . learn about it and just passing down
information that is already known for helping learning and stuff ... teach people to grow up in the science line and have jobs there which will be a part of the society that’s important for a running country and it will just keep everything good (Bruce).

Year 10 students were critically aware of the values and importance of engagement in science learning. This is demonstrated by their acknowledgement of the importance of and need for the development of science skills for both themselves and the wider community. They are able to recognise that enhancement of scientific knowledge can support their future roles in society, facilitate their aspirations, and help them understand their place in the world. The responses of some year 10 students indicated they have some understanding of the importance of learning science knowledge. Some year 10 students appreciated that their understanding of scientific processes and development of knowledge can nurture skills that are necessary for further study and future employment.

There were some year 10 students who also recognised that engaging in science learning supports a maturing awareness of personal health, social and community needs. When year 10 students were able to connect their learning experiences with some understanding of personal, social and political concepts that relate to their current and future lives they become engaged in learning in the science classroom.

Because it’s [science] necessary to who we are as people. Like it’s improving our life better and better. Even technology now, it is improving our life a lot more. Like even this recording thingy [points at digital Dictaphone], we wouldn’t be able to do this if we didn’t have science and it’s improving our life a lot more. Even machines in hospitals and stuff, it’s improving our health and some technology isn’t good, like some technology we have is really good, like computers and other stuff that helps benefit humans and stuff, but some of it doesn’t. Yeah, even basic science and stuff that they teach at school like Chemistry. . . (Ann)

In discussing reasons for science education, some year 10 students reinforced the idea that science education can lead to a better world in which they and others live. Such year 10
students have a socially critical awareness of the value of science education with regard to community capacity building. These year 10 students recognised the importance of raising local, national and global awareness in respect of social and environmental health, technological development and biomedical issues and the impact such issues might have on the communities in which they live. Where engaging science pedagogy is in place, science learning and capacity of young people to contribute to their life world are enhanced.

Opportunities to discuss and unpack how things work and how science knowledge may be related to future lives augments student understanding and nurtures a shift toward engaged science learning and participation in classroom activities. Year 10 students like Steve bring together the qualities of science learning and science education when he says:

_The reason for teaching science in school I reckon is because probably, although all the other subjects are really important, you can find Science hiding inside every single one of them. I mean like in English and SOSE and even geography, that’s science basically. It’s another version of science and science can be found anywhere so it really helps if the year 10 students actually know what it is and where to find it and how to use it to their advantage._ (Steve)

In continuing to recognise the importance and value of science education student comments reveal that the level of their engagement in science learning can change in accord with a variety of influencing factor/themes. Focusing on their past experiences of science learning activities year 10 students were asked to consider and discuss their perceptions of the qualities of the best sort of science lessons. Some year 10 students shared experiences of moments of engagement when they were enjoying success, and when they were participating in strategies that were flexible and fun. A fun learning experience has been recognised as enjoyable and includes participation in new and novel activities that are exciting, interesting and motivating, and provide some opportunities of ownership of what and how they investigate and learn science.
Elizabeth shared her view of the value and importance of the knowledgeable and skilful science teacher who provides relevant science learning that connects with meaningful hands on activities:

*I think teachers make a big difference. It [Science] has been something that everyone’s been involved in and you can really understand how it relates to you and your life and the outside world especially. It becomes easier to understand and you can see how it relates to everything so it’s just interesting because you know you can see now the connections between you and Science and your future and stuff, and also we did a lot more experiments this year, a lot more hands on kind of work. Last year it was just theory the whole entire time so it makes it a lot more interesting when we have something practical to do and something that we can base our theory on. So we are not just doing theory, and it’s good to see how it works in real life.* (Elizabeth)

Student voice highlights moments of science learning where they perceive themselves as having been participants in a relational classroom led by knowledgeable and passionate teachers. The year 10 students at Bay View Christian School demonstrate some capacity to recognise the best sort of science lessons and using their conceptions of science, make informed decisions to choose to engage in science learning.

The conceptions of science brought by year 10 students into the classroom affect how and what they learn (Tytler, 2007). There is every possibility that student experiences of a science learning program may result in understandings different from those of the teacher (Tytler, 2007). Year 10 students construct new ideas by reshaping prior experiences (Driver, 1989; Fensham, Gunstone & White, 1994, in Tytler, 2007). Data from interviews with year 10 students, with support from the literature review, reveals a research based thematic framework of engaging science pedagogy that connects with the best sorts of science lessons: lessons where year 10 students perceive they are engaged in learning new science knowledge and skills. Four themes of engaging pedagogy in science learning were revealed:

1. Hands on learning
2. Relevance and ownership of learning

3. Passionate and committed teachers

4. Relational learning.

Acting as a “sieve” (Fowler, p. 51 cited in Anfara and Mertz, 2006) or a “lens” (Harris, p. 130; Hendstrand, p. 12 cited in Anfara & Mertz, 2006) this theoretical framework will, first, provide some structure for supporting the process of sorting through the data, and second, help to “frame emerging perspectives of engaging science learning, revealed from the questions asked” (Anfara & Mertz, 2006, p.192,) in the question matrix (see pp. 65).

4.2 Hands on learning

Hands on learning activities in science provide opportunities for participants to participate in experiments. For example, from an experiment provided by the teacher in a conservative orientation to the curriculum, hands on learning activities involve year 10 students following teacher led instructions. This involves the year 10 students collecting, recording and analysing data in a given format, and reporting accordingly. In other circumstances and in pursuance of a more liberal or socially critical curricula orientation to learning, year 10 students become involved in open ended investigations emerging from classroom discussion. Here, year 10 students engage in social constructivism where they may be required to work cooperatively as a team, interacting socially to investigate an agreed question based on a science or scientifically based hypothesis. In either case, year 10 students have an opportunity to have fun by using and manipulating science equipment and engaging in novel ways of learning doing science. Novelty according to neuro science greatly enhances learning (Science Daily, 2006). These learning activities demand students to think individually and share ideas. They are required to talk to each other and the teacher about science and
scientific matters and to act accordingly. The purpose of hands on learning is to engage year 10 students in the scientific process and nurture science learning. As one student puts it:

*I enjoy the experiments because you’re actually a part of something, doing it[Science experiments] makes me remember the lesson more.* (Rose)

During discussions of what helps them engage in science learning, year 10 students at Bay View Christian School differentiate three aspects of the theme of hands on learning affecting engagement in the science classroom:

1. Doing experiments

2. Variety and fun

3. Thinking, talking and acting

Year 10 students enjoy being a part of practical activities where they actually get to do the experiments. Through hands on activities such as manipulating equipment, measuring and recording year 10 students become emotionally involved and inspired to follow instructions and to engage in science learning. The affective domain of learning tends towards attitude and interest (Lindahl, 2003). Attitude comprises affect, cognition and behavioural intention. Interest in science becomes a phenomenon which in part emerges through engagement with the scientific process of planning and carrying out an investigation. Krapp, Hidi and Renninger (1992) have commented that interest is a phenomenon that emerges from an individual’s interaction with the environment.

4.2.1 Doing experiments

Doing experiments and investigations in science provide opportunities for year 10 students to engage in activities that provide experiences for learning, reinforcing and applying science knowledge and for developing and practicing science laboratory skills. Year 10 students doing experiments and practical science investigations require hands on learning activities
that facilitate their engagement in the scientific process. The scientific process follows a common pathway comprising a question, hypothesis, identification of all variables, manipulation of variables, measuring collecting and recording data, recognising patterns, drawing conclusions and an evaluation of the overall process. Curricula orientations to teaching and learning as reviewed in the literature are significant in these learning activities.

In a conservative curricula orientation to teaching and learning, questions, hypotheses, equipment and procedures are decided upon by the teacher. The teacher in a position of authority unilaterally decides what the experiment is about and strongly connects with the teacher prescribed learning program.

In order to underscore an important distinction, curricula orientations to science that pursue a more liberal or socially critical orientation to teaching and learning, may to a greater or lesser degree provide opportunity for year 10 students to engage in classroom relationships that facilitate some ownership of the learning process. In a liberal/progressive or socially critical science classroom students share ideas and/or questions that they may have thought of, encountered either in or out of school and/or brought to the lesson. In these situations year 10 students will be encouraged to engage in science through scientific discussions, relational team work and investigations that they may have planned and negotiated with the teacher. Year 10 students are then supported by the teacher as they pursue the scientific process for trialling their investigations accordingly.

During discussions that focused on experiments and engaging hands on science learning activities that they had experienced, some of the year 10 participants from Bay View Christian School focused on some limitations and opportunities to participate in hands on activities during year 10 chemistry and physics lessons:

... [In] chemistry we were mainly doing theory work this year and in physics we did some experiments. (Steve)
...the physics one I think where we had to do the speed test where we got this trolley thing and we went on a ramp and like measured its speed and the time and that was pretty interesting. (Rose)

Chemistry and physics in year 10 provide for investigative hands on activities that permit a relational pedagogical orientation. Here student interest may be fostered as teacher and year 10 students work together as learners. Student comments indicate that hands on activities nurture interest in science learning and some year 10 students will participate in science learning through instruction, involvement and inspiration. As Chad explains:

Because it’s [science] involved, doing the experiments, instead of doing the written work, cos its hard for me to read and pay attention to text books and things like that, so I’ve found the more interactive things better for me (Chad).

The comments of Ann, a student who is intrinsically interested in science support the notion that hands on learning is valuable in both supporting student interest and nurturing cooperative teacher pupil relationships that are conducive to supporting year 10 students’ understanding of science:

My favourite lesson would have to be dissecting the lamb brain and for chemistry, because it’s generally interesting to me and my teacher is very cooperative and explains to us really well what we are doing, I can understand what we are doing really well (Ann).

Pohl (cited in Catholic Education Commission of Victoria, (CECV), 2004), in highlighting the value of experiments and hands on activities in school science states that:

Laboratory work is useful ... collecting data, analysing, evaluating and synthesising it, is vital. (p. 177)

Both in depth interviews and focus group discussions permitted year 10 students to talk openly about doing experiments at Bay View Christian School. One student Chad reveals from his experiences that while some year 10 students learn from practical hands on engagement in science, not all people learn by the same methods, and that hands’ on activities may not necessarily meet the learning needs of all year 10 students:

Actually I enjoy science but I reckon not everyone learns the same. Some people learn practically and some people learn naturally. I reckon as teachers
they need to make it as good as possible. Obviously we’ve got to make it good for ourselves as well, but some teachers don’t seem to like to have a system for all learners. Some people are practical so they don’t seem to learn very well because of the way they (teachers) teach and I just reckon they should have experiments every now and again but still do written work... I’ve enjoyed it just as long as the teachers do experiments every now and again I suppose to make it fun for us at the same time, it’s interesting and you’re still learning. (Chad)

Chad, whilst highlighting that experiments should be done now and then, suggests that every lesson does not have to involve an experiment, but learning science can take place when year 10 students have opportunity to engage in experiments that are fun and interesting. Some year 10 students perceived that relevance of school science is connected with hands on learning; for example, they view hands on learning activities as relevant to their effective learning and understanding of school science that stimulates their interests.

Full on practical testing of what we know, for example Chemistry. I do know that previously at the school they literally made small explosives which is always keeping students interested, just really practical stuff. They can get people hands on doing their thing like making things, testing things, seeing how things react with other things; basically really practical stuff. (Steve)

Year 10 students Kim and Ashlee, explained their interest in science and science learning supported the value of hands on science learning, which allows people to see what is happening and support the understanding of science, through engagement in learning.

Yeah I would agree. The more experiments that you actually get to explain what’s happening instead of like diagrams and stuff; actually looking at and being able to touch without the notes and stuff because most people don’t go back and read their notes so they’re just writing it down for nothing. (Kim)

Yeah, like what they’ve said. If you’re shown how something works you learn easier because you can understand it I guess. (Ashlee)

4.2.2 Fun and variety

Science learning can be fun and varied in how it is taught. During my science teaching experiences covering three decades, I have observed that science activities that include fun and variety will stimulate student interest and motivation to engage in science learning in the
classroom. First, fun activities in the science classroom may be described as enjoyable learning activities and is supported by neuroscience (see EurekAlert, 2006). Whether year 10 students work alone or participate with their peers, it is likely that year 10 students will engage with novel hands on activities that are fun and include excitement. These elements of a learning activity in science stimulate intrinsic interest and lead into extrinsic interest and autonomous motivation. Elizabeth shared her perception of the importance of novel, exciting and hands on learning in science with regard to interest in science learning:

*With the experiments, it makes it good if it’s something that you can’t do at home like something that you can only do at this time and it’s really exciting, cause you’ve never before and also if you understand the material that you’re studying really well you get more interested because you know exactly how it works and it makes you want to go see the practical side of it.* (Elizabeth)

Year 10 students in these circumstances socialise and share positive attitudes and become willing to participate with learning activities. It should not be difficult to have fun in year 10 science learning. Fun moments may be brought into science through simple activities and projects that involve investigations and experiments that connect with year 10 students’ lives and are relevant to their needs. Some biology learning activities at Bay View Christian School were perceived by some year 10 students to be fun. During a discussion about fun experiments and learning activities in biology, two year 10 students, Chad and Steve, described their hands on participation in dissection and genetic modelling at Bay View Christian School as fun.

*Dissecting of the kidneys and the brain in human bio? It was really fun. It was more hands on.* (Chad)

*Recently in the biology class, we’re using a strip of paper and paperclips to simulate the genetic code with the different bases, the four of them and just to figure out what assets that would make and how it would form an organism and in the past.* (Steve)

Since the teacher has responsibility for meeting the needs of all students, the perceptions of these year 10 students support the notion that planning for classroom management and
providing learning activities that are novel engage year 10 students to participate with experiments. Importantly, hands on activities that are fun and interesting was continually being reinforced by some year 10 students.

Second, hands on learning events that are varied may include investigations of science phenomena that include the scientific process, hands on practical learning activities using equipment that is new and or novel to the student or an amalgamation of both. For example, year 10 students may be asked to discuss and consider human impact on the water cycle. The problems of acid rain may emerge from such discussions which lead to experiments regarding ways of testing the strengths of acids. These investigations and experiments may include either the use of sophisticated measuring instruments that link with IT systems. Or, year 10 students working in groups may use chemicals and novel science equipment, as used in industry, for determining concentrations of acids and alkalis. In these situational examples year 10 students are able to socialise and share their learning experiences, and are encouraged to take ownership of their learning.

If science learning is to be fun and varied for all year 10 students and teachers, pedagogical considerations need to be built around the building of science practical skills, stressing the importance of experimentation to engage a variety of intelligences; practical classes act to aid cognitive development and are an ideal means to introduce kinaesthetic learning practices into the curriculum (CECV, 2004). Practical works as well as fieldwork are perceived by some year 10 students as fun ways of engaging in science learning. The inclusion of practical laboratory and fieldwork encourages year 10 students to develop interest (CECV, 2004, p. 178). During an interview Danny and Tom, shared comments that supported the notion that science learning needs to include some visible elements of fun and relevance if year 10 students are to, “get into the lesson” and learn science by seeing the relevance of the topic:
For me personally I find that an experiment, more hands on kind of thing, is a more interactive lesson. (Danny)

... yeah, (fun) experiments are the best way to learn I think ‘cos that way you can actually remember what you’re supposed to be doing or what the point of it is, yeah. (Tom)

Some year 10 students may participate in a fun experiment where they become part of the learning process and feel empowered to learn. In these circumstances year 10 students have an opportunity to identify with a role of active society membership that enhances and leads to further community capacity building within and beyond the classroom. Whilst learning science may not be evident at first glance some hands on activities that provide variety and fun, and potentially nurture moments of ownership of learning are important. Tobin (1990) has written that:

“Laboratory activities appeal as a way of allowing students to learn with understanding and, at the same time, engage in a process of constructing knowledge by doing science”. (p. 405)

It has been acknowledged by Tytler (2007) that science becomes harder and more academically abstract in the developing middle school years. Consequently, as secondary students get older, their interest in secondary science tends to wane as they discover that secondary school science is less fun (Tytler, 2007) than they possibly expected as well as demonstrating less ownership, fun and variety. The limitations of time for planning and development, availability of resources, access to new technologies and availability of professional development, could be factors that contribute to teachers choosing to manage more conservatively-traditionally oriented classrooms, where the learning is teacher centred and text book driven (Tytler 2007). In this conservative curricula orientation to teaching and learning the environment for science learning for some year 10 students becomes increasingly unattractive and less engaging (Tytler 2007). In my role as Head of Senior School, I have observed that the burgeoning pressures on teachers for ‘producing’ enhanced science literacies, managing accountability and feeding expectations of graded performance criteria
of year 10 students impacts the role and function of the science teacher. In turn such factors influence teachers’ choice of curricula orientations to science teaching, as well as the subsequent pedagogy that influences student engagement in science learning. As two year 10 students explain:

Well basically if we just spend every lesson reading from text books and doing questions, it just really doesn’t get us involved. (Chad)

When I was back at [previous Secondary School] the teacher always made us do notes and questions out of the book and you just couldn’t get into it, there was no fun in it... when I came here at least we’ve been able to have chances to do things [experiments] like that. (Danny)

Some year 10 students like to ‘do’ science; they are interested in and engaged with science and scientific matters. Other year 10 students are open to becoming interested and engaged in the science lesson as a consequence of teacher quality, doing novel hands on activities, having fun and experiencing variety of learning activities. Science learning that is fun excites both year 10 students intrinsic and extrinsic interest and motivation, constructs new knowledge and leads to a richer understanding of the topics covered. When provided with the possibility of doing hands on activities, the comments of one female student, Ann, support the notion that engagement in science learning is enhanced when they are interested and motivated to learn science.

What motivates me is if something is interesting like anything is motivating because I like to do Science and because I want to learn more about life as we know it ... what motivates me is if we are going to do an experiment or something or if we’re learning something new that I haven’t learnt before. It’s interesting to learn about. (Ann)

The perceptions of some year 10 students highlight the idea that the promise of participating in something new through investigations or doing something new or novel that includes using science equipment can trigger student interest and motivation that leads them to choose to engage in science learning. Year 10 students who are extrinsically interested in
science learning may become intrinsically interested in science learning. Whilst others who are not interested in science learning may become extrinsically interested and motivated sufficient to engage with fun and varied hands on activities for the period of the lesson and so engage in science learning during the learning event. Ann’s comment supports the idea that year 10 students make decisions to look for more science to learn when their interest has been stimulated. This evidence suggests that hands on activities comprising variety and fun nurture a continuation of topical research where year 10 students are engaged as constructive learners in the classroom. Engagement through variety and fun connects with science concepts that mediate the extent to which a student is actively involved in the education process (Wehlage, Rutter, Smith, Lesko & Fernandez, 1989, cited in Cothran and Ennis 2000, pp.107-108). As Ashlee has observed for herself:

*If you’re shown how something works you learn easier because you can understand it I guess.* (Ashlee)

Year 10 students’ active engagement is absolutely pivotal to the science knowledge learning process. Engagement in investigations and hands on practical work is also connected with learning additional science skills such as measuring, data collection, processing, analysing and evaluating. These are skills that mediate the extent to which a student is actively involved in the education process. Student involvement through investigation provides opportunities for student ownership of their own learning. As a science teacher I have sometimes considered the value, worth and usefulness of expecting students to ‘write up’ experiments and investigations which are ‘not theirs’. Experiments that the teacher has provided or which appear in the next section of the text book do little to offer ownership of hands on learning for the student. Activities for year 10 students that offer little if any relevance to their lives or do not arise from year 10 students’ curiosity do little to support intrinsic interest or generate extrinsic motivation. It is important however to recognise that
such pedagogical approaches may occasionally nurture extrinsic motivation, particularly if
the activity is novel and or includes a visual attraction or loud noise (explosion). I have
observed over time that ‘doing stuff’, or facilitating hands on activities that result from
student questions and/or ideas, have been the more valuable tools for raising interest and
awareness and for stimulating positive attitudes to science learning. Returning to Elizabeth’s’
point (p. 80), hands on approaches to science learning support the notion of moving year 10
students from a naive to a scientific view. The considered problem lies in the ongoing
challenge of conceptualising how to support year 10 students to make this transition. Tytler
and Peterson (2004) comment that the notion that student conceptions are stable have been
shown to be context dependent and dependent on individual variations (cited in Tytler 2007).
It is important not to ignore the complex motivational and attitudinal factors involved in

Year 10 students should be actively involved in science learning. Personal classroom
observations have occasionally highlighted that there are few year 10 students who are
prepared to ‘sit back and ‘listen’ or who are prepared to sit and write copiously, thinking that
they are doing ‘science work’, year 10 students like to be engaged with meaningful hands on
learning. Focus group discussion draws attention to year 10 students’ perceptions of the value
of hands on learning:

*but if we do experiments every now and again for a couple of weeks maybe or
just like really getting in depth rather than just doing questions but actually
like discussing a bit or rather than just taking notes or just taking questions
just apart from that. I still reckon its okay to do some questions but not just
that, just mix it up a bit. (Chad)*

*Yeah I would agree. The more experiments that you actually get to explain
what’s happening instead of like diagrams and stuff; actually looking at and
being able to touch without the notes and stuff. (Kim)*

Some year 10 students have one way of working, others prefer other ways, but all dislike
doing it the same way all the time. Year 10 students enjoy variety and fun for stimulation.
Sometimes the whole class will engage in discussion, work together in groups, and pose their own questions. They experience interest in science learning when they are pursuing their own ideas and questions and working in groups. In other words, as suggested by Lindahl (2003), students want to have more influence on their learning as they may sometimes have in other subjects. The challenge in particular science classrooms and during science learning activities in the classroom is the facilitation of learners to take control of learning in order that enhanced learning in science might take place. For instance, the science teachers at Bay View Christian School may be encouraged to evaluate the rotation model as outlined earlier to identify opportunities in the current classroom pedagogy that encourages learners to ask questions, suggest hypotheses, and design investigations, that is minds on as well as hands on (Gunstone, 1991). Planning and providing fun and varied activities that might include feedback, reflection and modification of ideas may be of value during hands on learning events that enhance opportunities for thinking talking and acting. Student perceptions support the notion that experiments connect strongly with, and are precursors to the engagement of year 10 students in science learning.

*Good experiments I think, if there’s a good experiment and everybody thought it would go this way, and it goes the other way, and, you’ve learned something new you go ‘Wow! That’s really good, didn’t expect that’; from just reading text books we never would have got that. So, stuff that’s an extra bonus to what you’ve already learned. (Rob)*

Hands on activities incorporating variety and fun in classroom learning capture student attentions. When year 10 students are learning something new, participating in a novel and unexpected activity and/or hands-on activity, or a demonstration takes place, student interest and motivation to engage in secondary science learning is stimulated.

When year 10 students are engaged in hands on activities that are fun and varied they are thinking, talking and acting together and are socially engaged in science learning. Steve’s’
Some student comments support the notion that hands on activities at the start of a science lesson may promote thinking and acting in class, which foster engagement in science learning. Whilst some distractions may impact year 10 students’ attention, the use of experiments and demonstrations contribute to focusing student attentions more quickly:

_It’s the first 10-15 minutes, it takes quite a while for them all to settle down and get their focus up to attention. I think it could take the teacher quite a lot of effort to get them to settle down and pay attention but it just usually happen they focus a lot quicker when it involves an experiment or something like that._ (Kim)

### 4.2.3 Thinking, talking and acting

Personal observations as a secondary science teacher support the notion that hands on activities provide opportunities for year 10 students to work in small groups that involve thinking, talking and acting. These activities allow moments of sharing and discussion where students perceive that they have equal parts to play. Facilitating opportunities for year 10 students to work socially and cooperatively and to think about science, share ideas and understanding through thinking, talking and acting is a critical quality of engaging pedagogy:

_I think when everyone works together as a team and it’s something that everyone enjoys, there’s no one left out, everyone has an equal part in working together. I still think that would be the best lesson where everyone worked together, there’s no ‘differentiation’ between different people and stuff._
Kim’s’ comments about year 10 students working together as a team draws attention to the importance of providing a pedagogy that supports the class to operate socially and relationally. Engagement in science learning is enhanced when year 10 students are thinking, talking and acting by participating in open discussion and/or working together in cooperative groups (Goodrum et. al., 2001). Science lessons are better when students are working together and sharing their own ideas and questions (Goodrum, 2001). Lindahl (2003) has commented that some students want to have more influence and control of their learning.

Hands on learning in science promotes interpersonal interaction; students socialise and relate with each other (Goodrum 2001). Year 10 students who engage in hands on science learning potentially become ‘thinkers’ and ‘doers’ as they work together and interact. In these circumstances they openly think and act about sharing their science views, ideas, knowledge and explanations of science. Providing time for year 10 students to engage in class discussions about science may allow some year 10 students to rationalise their learning experience and adjust prior science or scientific knowledge and or construct new science knowledge. Contrary to pouring knowledge into empty vessels year 10 students in this environment can learn by thinking, doing and acting.

When asked about past experiences in school science student perceptions reveal that investigations and experiments that support thinking, talking and acting are necessary for establishing some foundations of science learning. As commented in the literature review, helping students to achieve desired outcomes and developing ideas from practical experiences is a complex process (Hofstein & Lunetta, 2004; Gunstone, 1991). Meaningful learning in the classroom requires time and opportunity for interaction and reflection (Champagne, 1990). The current emphasis on NAPLAN data and productivity in the Australian science classroom may not be conducive to providing time for more
liberal/progressive or socially critical orientations to science learning. Year 10 students require time and opportunities to express their interpretations and beliefs about the meaning of their science experiences, investigations and enquiry.

Year 10 students report on the value of group discussions, community participation and personal goals as essential qualities necessary for learning science. The teacher who manages classroom time that incorporates a more liberal/progressive or socially critical pedagogical orientation to learning incorporating thinking, talking and acting provides year 10 students with an opportunity to participate in the scientific processes of discussion, sharing ideas, hypothesising and planning investigations. When asked to share their perceptions of what the teacher did to make the lessons interesting, Steve’s comments support the notion that the best lessons are those that are exciting and quickly incorporate some sort of hands on activity:

Well when we did the experiment with the cars, as soon as you see the cars people are into it, and crashing a car into a barricade that would get most people interested and they would really want to do that and they’d try to set it up to see if it would go as far as possible. If you asked a question and they (students) find that interesting they would, they might, invoke their curiosity so, and curiosity is usually what drives people to learn more. (Steve)

Year 10 students at Bay View Christian School connect past and current experiences for engaging in hands on activities where they see practical science in a wider sense. Participating in the culture of the scientific process potentially may incorporate more thought for discussion and include encouragement, imagination and creativity in analysing. By participating in and practicing science culture, year 10 students may be positioned to give creative expression to the talking, thinking, and acting of science. Contrary to a conservative orientation to the curriculum, a more liberal/progressive or socially critical orientation to science learning may create opportunities of creativity that can help year 10 students improve critical-thinking skills, motivation, and engagement in science learning and help them to
understand the role of creativity in developing new scientific knowledge. A discussion with Kim highlights the importance of a connection between creativity and science learning:

*When I have a science lesson I always think that it encourages more thought than most lessons instead of just writing, copying from another book, it encourages creativity and stuff like that which I really like being creative. People get into the lesson the more experiments that you actually get to explain what’s happening. (Kim)*

Engaging pedagogy that provides hands on learning activities and opportunities for thinking, talking and acting allows year 10 students opportunities to experience ownership of their science learning (Goodrum, 2001). Investigations and experiments provide a lens for year 10 students to look at and recognise relevance of some aspects of the science curriculum. Hands on learning that includes variety and fun, thinking, talking and acting nurtures student engagement in science learning, and helps in connecting science at school to their current and future lives.

**4.3 Relevance and ownership of learning**

Conversations I have had as a science teacher with some middle school students have revealed to me that everyday life experiences such as rainbows in raindrops collecting on the tips of leaves and the changing colours in the sky at sunset after a bushfire become more relevant to students than topics such as the rectilinear propagation of light and optical instruments. Whilst some research of science learning reveals that science in school for some students has little relevance to their lives outside school or to their future lives (Wolter, Lundaberg & Bergland, 2013), I have observed during some science lessons that as student curiosity is stimulated connections are made by the student between science and relevance to their lives. Such connections may be in regard to a learning topic for a test, future career avenues and personal and social reasons. Year 10 students who connect the relevance of their studies at school with their current and future roles in society are be more likely to engage with science learning. During discussions with a group of Bay View Christian School year 10
students, the idea was raised regarding attitude, lack of relevance and pointlessness of some science lessons:

When it’s not something that you really want to know it kind of makes it boring and you kind of think oh do I have to do this; I’m never gonna use this again in the future; I don’t really want to know why this happens or how it happens so I think just with the topic it changes your attitude. (Elizabeth)

My attitudes would generally change if we did an experiment I felt pointless; or started learning something pointless, then I would tune out, I wouldn’t want to learn it, I think that’s when I started thinking about other stuff and getting off the topic and something like that. (Rob)

In pursuing these responses Rob was asked to consider if relevance of learning activity had any effect on his attitude toward science in school.

Er well if it’s not relevant you don’t, know that you’re never going to use it again so there’s no point in learning it. So yeah, if it’s irrelevant to what you’re learning or anything you’re doing, you automatically switch off because you know that you don’t need it, that it’s a waste of time. If it is relevant then you want to learn it ‘cos you think that its important, you need, I might need this for the rest of my life so you want to engage more and you want to focus on the question that answer.... (Rob)

When asked to consider what qualities of a science lesson were perceived as relevant or otherwise Rob continued:

... if the topic changes quickly, like focusing on say a tree or something like that and suddenly you start focussing on a monkey, then it would be irrelevant to what we’re learning because I know that the test, it would be on plants and not on monkeys. So also if we’ve done it before, like I can remember doing it before, say year 9 and we’ve re-done it I think it would be irrelevant. It would be good to revise it but if you spend a long time on it and a lot of wasted time just revising it instead of just 1 or 2 lessons jogging your memory, yeah, I think that’s about it. (Rob)

Rob’s comments, regarding rapid changes between disconnected topics, repetition of ideas and excessive time spent on learning activities, support the notion that some year 10 students are making decisions to engage based upon their perceived relevance of some aspects of their science learning experience. When some aspect of science learning is seen by year 10
students as relevant and connects in some way with their current and/or future life they will decide to engage in science learning. The desire to learn, take ownership of and engage with interest connects with how the topic might relate to their lives such that the learning activity and the purpose of achievement have some significance.

Ones that I can relate to where it’s on a subject that I suppose, yeah, I can relate to. It might have had some significance in my life. (Bruce)

In asking year 10 students to share experiences of relevant science learning some year 10 students highlight issues regarding health, family, friends and community emerged:

In biology when we were talking about diseases and when we were talking about motor neurons because we did an assignment on different diseases like motor neuron disease and one of my friend’s mum had motor neurons disease and she died from it so I thought it was interesting to learn about it and also was relevant to my life. (Bruce)

Year 10 students become engaged when tasks are cognitively challenging, meaningful and include relevant activities and investigations. Year 10 students perceive relevance and ownership of learning when the topic connects with issues/matters that they recognise, identify with and from which some satisfaction is gained.

Well I suppose if it’s something you want to learn and something interesting, something that might be useful, some facts, it makes you just feel good when you finally figure it out and it’s just really satisfying that you’re finally getting there. (Chad)

I think that like when they (teachers) try to engage us, provide us with an activity when it is quite relevant to our everyday life therefore we can find it interesting. Whereas when they talk about things that we don’t really relate to it its quite boring when it’s like that. (Sue)

Some year 10 students comment that their view of the relevance of science learning is influenced by social interaction and peer group relationships. Rebecca, a friendly and sociable student recognises that the people around her can positively or negatively affect her attitude toward the relevance science learning.
I think if the people around you have a bad attitude towards it, it rubs off on me so I’m more like if people around me are just like oh my gosh this is boring I’m just like Yeah and I think that has a lot to do with it. (Rebecca)

Rebecca’s comment reveals that the attitude of fellow year 10 students influences perceptions of the relevance of a science learning activity. In this circumstance peer group influences may render the learning topic as having importance and relevance in the minds and/or opinions of some other year 10 students in the group for social reasons. The notion of peer group influence on student engagement is supported by other year 10 students in the investigation:

I think the people around you play a big part as well. (Elizabeth)

I think everyone has really a big effect on you like, if they’re not paying attention you don’t actually feel you want to work as well, so. (Rose)

Yeah, when everyone’s talking behind you think like what’s the point of you doing it too? (Sue)

Yeah, but when everyone’s quiet and they’re doing the work you think that since everyone is doing the work it must be important for you to do your work as well, so you actually do it and everyone around you really affects you. (Elizabeth)

Year 10 students at Bay View Christian School reveal that whilst year ten sciences have been a lot harder, complicated and more challenging, success through challenge has lead to a desire and attitude to want to learn more. Year 10 students appreciate opportunities to engage in challenging work and are able to perceive the risk of becoming discouraged if the work is too challenging:

Yeah, it’s good like having a bit of a challenge but you don’t want it like too challenging that you just don’t get it, if you don’t understand it at all that well like, you know nothing about it then you don’t really want to do it and that’s when you don’t feel like doing any of the work but if it’s just that slight bit challenging for you, but you know as well you could do it then it will sort of help you wanting to do the science work. (Danny)

Year 10 students in year 10 at Bay View Christian School highlight student capacities to identify the qualities of a lesson and make decisions accordingly:
In physics the experiments seemed to be very childish, like you've done in year two or something like that, make a circuit, that kind of thing. Experiments are good but only if they're related to what you're doing and yeah generally if experiments feel childish like you know you've done it in year two or something like that you don't pay attention you start to mess around and stuff like that, yeah a lot of people in the class when we've had to make the circuit stuff like that we knew how to do it so it felt irrelevant to do it again, so yeah. (Rob)

With regard to textbook centred learning activities student perceptions indicate that some writing activities are less likely to be recognised as having relevance. In the context of a textbook focused activity some year 10 students may be less likely to take ownership of their learning.

Well basically, if we just spend every lesson reading from text books and doing questions, it just really doesn’t get us involved, but if we do experiments every now and again for a couple of weeks maybe or just like really getting in depth rather than just doing questions, but actually like discussing a bit, or rather than just taking notes, or just taking questions just apart from that. I still reckon it’s okay to do some questions, but not just that - just mixed up a bit. (Chad)

Student voices provide comments that support the notion that science lessons and science teaching should be more varied, less repetitive and relevant. Effective planning and development of engaging pedagogy will recognise the importance in connecting engagement with year 10 students’ personal and social future lives.

4.3.1 Connecting to future lives

When year 10 students are in a situation where they are able to connect the topic to their future lives they choose to engage in learning and become more interested with the lesson.

If it’s [science] not relevant you don’t, [you] know that you’re never going to use it again so there’s no point in learning it. If it is relevant then you want to learn it ‘cos you think that its important, I might need this for the rest of my life so you want to engage more and you want to focus on the question, that answer. When I’m in the mood with something that I’m interested in, I like to learn it. I just find it interesting. I want to know more about it, naturally just like anyone else would want to know if they like it and are interested in it but also it’s a good qualification to have these subjects, yeah. (Rob)
Two perspectives of some year 10 students arise regarding relevance of science learning. First, they see relevance to science learning that is connected, scaffolded and organised cognitive learning. The second relevance of science learning exists when year 10 science year 10 students perceive connections of science learning with their future role in the community.

Like the line of work that I want to do when I leave year 12 is pretty much based around science. I need science to be able to get into the courses that I want to get into. (Kim)

Providing opportunities for year 10 students to consider their future role in society enhances the relevance of science learning in school (Goodrum, 2000; CECV, 2004). Engaging science pedagogy that makes connections with year 10 students’ future lives has potential for nurturing interest in science learning and motivation to engage in classroom activities (Tytler, 2007). A science pedagogy that adopts a liberal/progressive or socially critical orientation to science learning, one that includes social value and community relevance, will cultivate interest and motivation that lead to engagement in science learning (Tytler, 2007; CECV, 2004).

Some year 10 students had differing expectations and levels of interest. For example, year 10 students wishing to enhance their science knowledge and/or understanding are interested in science and have expectations of science lessons that include participation in hands on activities, science discussions, planning investigations, solving problems and working with the teacher. Kim, Rebecca and Elizabeth make their connections between relevance and experiments, working socially, the skills of the teacher and desire to learn science

When I have a science lesson I always think that, ‘cos science lessons are usually the most practical ones with the experiments, where maths, SOSE and English don’t usually have as much physical work, its’ [in maths. etc.] more writing and listening and text and stuff like that, I think science encourages more thought than most lessons instead of just writing, copying from another
I reckon it’s a pretty good one, people get into the lesson. (Kim)

I quite enjoy my science lessons – you know some classes your just like oh great I don’t want to go but I think I enjoy my science lessons because you know our teacher’s really good and there is good people in there and we all get along and yeah and I think I might look forward to it a bit, yeah. (Rebecca)

Science lessons are my favourite lessons so I actually really enjoy Science and I think it makes a good class when everyone tries to work together and everyone else wants to be there and wants to learn so Science is definitely one of my favourite subjects. (Elizabeth)

Year 10 students’ expectations of science lessons include some anticipation of socialising, peer group interactions, expectations of novel activities and interaction with the teacher. Here year 10 students use these ideas and expectations of classroom activities that are of some relevance to their lives. Year 10 student engagement in science learning takes place when students attach relevance to constructing and developing their science literacy. Here, as elements of personal relevance, year 10 students might include preparation for tests, personal desires to succeed, peer group competition and personal ambition and when science lessons are logical and include relevant connections between what they are learning and future career avenues (e.g., electric circuits and electrician trades; the human body and careers in health).

My attitudes would generally change if we did an experiment I felt pointless. or started learning something pointless, then I would tune out, I wouldn’t want to learn it, I think that’s when I start thinking about other stuff and getting off the topic and something like that.(Rob)

Engaging pedagogy that provides a richness of relevance for year 10 students’ future lives stimulates interest and motivation in science learning. Developing richer understandings of science concepts nurtures a positive shift from scientific to science literacy.

This year particularly it (science) has been something that everyone’s been involved in and you can really understand how it relates to you and your life and the outside world especially, and I think just as we’ve matured it becomes easier to understand and you can see how it relates to everything so it’s just interesting because you know you can see now the connections between you
and science and your future and stuff. So we are not just doing theory and it’s good to see how it works in real life. (Sue)

Well when I’m in the mood, with something that I’m interested in, I like to learn it. I just find it interesting. I want to know more about it, naturally just like anyone else would want to know if they like it and are interested in it. (Chad)

In a conversation with Ashleigh the idea was raised that it is unlikely that a science teacher can regularly and frequently construct fun lessons that have significance for year 10 students’ current and future lives, lessons that year 10 students can relate to.

Ones that I can relate to where it’s on a subject that I suppose, yeah, I can relate to. It might have had some significance in my life, but that’s just by chance. The teacher can’t really construct a lesson to do with that, but just fun things always get me interested. (Ashleigh)

Under the current pressures of accountability as referred to in earlier chapters teachers are under pressure to produce science and scientifically literate year 10 students. There is a conflict between academic/vocational curricula and socially critical orientations to teaching and learning.

The research of Tytler and Symmington (2006) cited in Tytler (2007), p. iv, reports that science teachers felt that science in schools should ‘focus on engaging young people’. Teachers perceived school science [curriculum] ‘to be an outdated and discipline bound’ (Tytler, p. iv, 2007). Driven by corporate management policies that focus on equity, funding, grading and accountability, pressures are on schools, science teachers in particular to not only provide suitably equipped and knowledgeable young adults, but also nurture and provide a populace that is literate in scientific issues (Tytler, 2007). Such a populace would comprise citizens equipped to make informed decisions regarding national and global issues such as environmental sustainability and energy production and consumption. These accountabilities of teachers do much perhaps in disempowering or stopping, the imaginative Australian science teacher striving to provide contextual learning experiences (Tytler, 2007) and so struggle to enhance student engagement in science learning. Peacock (2007), cited in Tytler
(2007) comments that, ‘We need to re-imagine [Australian] science education, accepting a
shift that is occurring and must occur in the way we think of its nature and purposes” (Tytler,
2007, p.iii). In my experience I have learned that a teacher who seeks to engage year 10
students in science learning and meet their life needs will provide an engaging science
pedagogy that is relevant to student’s current and future lives. Some year 10 student voices in
this research support the notion that when they recognise the relevance of science learning
they are more likely to take ownership of their learning and accept responsibility for making
plans to succeed.

In my line of work I really need Physics mainly and Chemistry to do what I
want to do. I want to become a nanotechnologist and I really need hard maths
and really hard science to be able to do that because it’s impossible to do it
without it and it’s just entertaining me, because I really like the way stuff
works and just learning about science because it’s really interesting. (Ann)

Here this year 10 students connects her science learning with her current and future life and
is motivated to plan to engage in science learning at higher levels. Year 10 students who are
engaged in science learning become aware of the importance of planning, they may study at
home to gain new knowledge and seek ways of improving their understanding of science
concepts. As such, these year 10 students engage further in classroom learning activities that
include discussions and hands on investigations to support the ongoing development of their
scientific knowledge and skills.

Kemmis, Cole and Suggett’s (1983) orientations to the curriculum, academic/vocational,
liberal/progressive and socially critical, offer an appreciation of how some year 10 students
reject academic/vocational orientation to science learning, because it fails to connect with
their lives or capture their interests in science learning. Unless engaging pedagogy facilitates
year 10 students making connections with their everyday lives and life experiences,
detachment and continued disengagement from science learning will continue. There are
some year 10 students at Bay View Christian School who connect their attitude to learning
science with some elements of the science curriculum that some may find relevant or otherwise. When asked what might happen in a science lesson Bob shares his thoughts:

If it’s not relevant you don’t, know that you’re never going to use it again so there’s no point in learning it ... so yeah if it’s irrelevant to what you’re learning or anything you’re doing, you automatically switch off because you know that you don’t need it, that it’s a waste of time. (Rob)

It may be of value for teachers to have an opportunity to recognise and respond to student perceptions regarding the importance and value of connecting real world science to their current and future lives. Better links are needed with the real world of science (Tytler, 2007). Year 10 students are more likely to engage in science learning when a liberal/progressive and or socially critical orientation to science learning includes year 10 students’ access to real world science that utilises and engages with industry, commerce, the environment and personal health (Tytler, 2007).

The year 10 student voices reveal that an engaging science pedagogy that has relevance and nurtures conceptions and perceptions of future roles in the community will include learning adventures that are fun and pleasurable. Planning engaging science pedagogy requires teachers to have an awareness that goes beyond the demands for grades, rote learning and canonical ability. Where personal and social relevance is recognised and appreciated, the intrinsically interested student engages in the learning activity. Intrinsically interested year 10 students will engage for as long as the topic and pedagogy continue to capture their interests or external rewards (Hidi & Harackiwicz, 2000). In these circumstances year 10 students want to do more, seeking success and accomplishment, in the classroom. When year 10 students become interested in science, experience enjoyment and success in learning further reward, for some of them may emerge as one of personal satisfaction by taking home their stories and sharing their experiences with their family:
I enjoy science when I achieve, I know that I’ve done well, what I have learnt has benefited me. I just love the idea of being able to know how everything works and being able to understand. And also it’s something you can use in everyday life. I find that really interesting your finding out how things work and you know when you find out it, you know you’ve got the excitement of going home and telling your family too. I mean, you know, it’s all that kind of stuff. (Rob)

Year 10 students enjoy achievement in learning. Passionate and committed teachers who provide pedagogy that is of relevance to the student nurture engagement with science learning that year 10 students recognise. Engagement in science learning is critically connected with relevance of the learning activity (Tytler, 2007; Goodrum, 2000). Relevance of science learning is sought by teachers who are passionate and knowledgeable, and are committed to engaging year 10 students in science learning, a theme to which I will now turn.

4.4 Teacher qualities

During discussions regarding engagement with science learning some year 10 students drew attention to the qualities of the ‘good’ science teacher. Here student perceptions reveal teacher qualities that include experience and knowledge of both the teaching subject and of the year 10 students themselves affects their science learning. Teachers who know and understand their year 10 students with regard to their needs and who they are recognised as qualities that significantly affect student interest in science learning. Furthermore, teachers, who know their subject well, are passionate about science and science teaching. In addition, teachers who actively seek to engage relationally with year 10 students and learn more about who they [year 10 students] are, and get to know them or their lived world, foster student engagement in science learning.

4.4.1 Knowledgeable and experienced teachers

An experienced and knowledgeable science teacher is one who knows and understands both the characteristics and needs of their students and significantly understands their science
teaching subject and how it connects with the real world. First, a science teacher who has worked with and gained experience of serving year 10 students, either over a number of years or in other schools and communities, has had opportunity to continue to construct and extend their knowledge of year 10 students as individuals and groups. Experienced teachers who have knowledge of year 10 students and their communities, to which schools are accountable, have potential to develop liberal/progressive and/or socially critical orientations to teaching and learning (Tytler, 2007; Goodrum et al. 2001).

Second, a science teachers’ knowledge and understanding of their subject may emanate not only from formal studies at secondary school, university or post secondary training, but also from other life experiences that may be attained by working in industry. During their professional career, some teachers may have pursued professional development pathways to enhance their knowledge of science and its application. These rich and diverse experiences of science teachers will strengthen their awareness and knowledge of socially critical science matters, and make relevant connections between science in school and the world of work.

A teacher who is experienced and knowledgeable and understands the needs of the year 10 students will be committed to passionately create an engaging science pedagogy that relates to year 10 students in a meaningful and positive way (Cothran & Ennis, 2000). In discussing teacher led reform Tytler (2007) comments that quality teaching is critical both to successful outcomes for year 10 students and to the creation of innovative and engaging programs. Science teachers, however, have struggled if not failed to provide relevant and engaging science experiences for their year 10 students (Goodrum, 2006, Rennie, 2006; and Goodrum et al., 2001).
During discussions regarding the ‘best sorts of lessons’, some Bay View Christian School year 10 students supported the notion that the quality of teachers affects the extent in which they become engaged in science learning, for example:

*I think that teachers try to interact more with the students and they sort of look for people who aren’t really interested and they ask them questions to sort of encourage the brain to start working or something like that and they’ll mainly focus on the people that aren’t doing anything.* (Kim)

*Oh when teachers try to engage you and like they keep asking questions, and make sure you understand it other than like writing it on the board, copy that down make sure you revise it for the next lesson. Like if they are going through it with you it um it helps a lot; makes it more interesting.* (Rose)

*You have to have an enthusiastic teacher I mean, not just a teacher who is very monotone – they’ve gotta like you know you have some teachers that are just so monotone they just go on the same thing and they repeat themselves over and over again I mean up to a point where you can remember it but after a part it just gets really annoying and you just want to tune out, you just don’t want to listen.* (Tom)

*Ah, I think a teacher has to go into the class with an attitude that someone like us would have. Going in with an attitude like “Can I engage with the class a bit more?” And then like you’d be able to have the whole class join in and all have a bit of a laugh and just really enjoy the lesson.* (Rose)

*Oh it depends what science really, some sciences you think – ‘oh no we’ve got that teacher’, like they can really throw the lesson out completely and then other sciences you go ‘oh we’re doing this today and we’ve got that teacher and they are really nice’, and it really depends on the teacher.* (Rose)

*Yeah I agree it’s not so much the science it can really be the teacher, I mean, any science can be fun depending on what you’re doing like.* (Tom)

*They could use like pictures and diagrams, and like interactive programs with the computer like computer programs on the board things. With the flash cards, I think was really good, that helped us a lot and letting us learn in groups, we were able to learn together and that really worked.* (Rebecca)

*Also starting discussions, like class discussions with everyone kind of stimulates your ideas and you get thinking a lot more and you are a lot more interested when everyone has something to contribute.* (Elizabeth)

*If the teacher’s like, I don’t mean to be rude but if the teacher is quite boring then you don’t want to go to that teacher so if you’ve had a busy day and all of a sudden you’ve got that teacher yeah and you really don’t want to have to put up with them you just want to leave you don’t want that. So it’s not so much science, I mean like science all the way round, it just depends on what type of teacher you have.* (Tom)
Some year 10 students perceived that they learn science more effectively when they have teachers who are knowledgeable and are committed to passionately creating learning relationships and who nurture interactions that seek to capture student interest. Such teachers were reported to demonstrate a capacity to demand attention and nurture engagement in year 10 science learning. Year 10 students claimed that teacher quality enhanced their connection and engagement with science learning. Some year 10 students were influenced by passionate committed teachers who were recognised as confident and competent in the way they used techniques/styles of teaching and made use of resources (e.g. audio-visual resources and interactive information technologies). These science teachers nurtured student engagement in science learning. Furthermore, science teachers who provided learning activities that included interactive IT activities, or flash cards, relational peer group discussion and problem solving, enhanced student engagement in science learning. In this liberal orientation to teaching year 10 students were encouraged to engage relationally with purpose (Kemmis et al, 1983). Year 10 student comments supported the notion that liberal and/or socially critical orientations to teaching promote science learning.

During a discussion regarding likes and dislikes about their current science lessons some year 10 students once again draw attention to the qualities of the teacher. Cothran and Ennis (2000) have suggested that the teacher rather than the content of the lesson contribute most to student engagement/disengagement. According to year 10 year 10 students:

*I reckon those days when the teacher just really bores you to death and don’t discuss it, and at the same time sometimes the teachers seem to discuss it too much and we just tune out and aren’t remembering any of it but if we discussed it and get it in depth and don’t speak about it for too long, we’d learn a lot better.* (Chad)
The days that we just do note-taking and don’t discuss it, it’s just on the board and copy it into your workbook and that’s it. There’s no discussion or anything so you don’t really get your head around what’s been put on the board because no-one explains anything. (Kim)

In my case study student voice reveals that teachers who know year 10 students well and who are recognised and respected as passionate and knowledgeable about science may be more likely to provide an engaging pedagogy for year 10 students.

4.4.2 Science teachers who know year 10 students well

A science teacher who knows their year 10 students, who they are as well as how they interact socially, will nurture engagement in and foster science learning in a fun and enjoyable way. A science pedagogy that adopts authentic and enjoyable activities, such as, modelling, analogies, drama and music for creatively describing/illustrating will minimise stress and enhance year 10 students’ engagement in science learning. A knowledgeable science teacher with a rich understanding of year 10 students’ needs, can engage year 10 year 10 students in conversations in a way that allows year 10 students to visualise science in a more understandable, relevant and meaningful way. Year 10 student comments support the notion that engagement in science learning is enhanced when they are led by a teacher who makes significant interpersonal connections with them. The teacher who seeks to develop opportunities for raising their awareness of year 10 students’ needs and aspirations becomes knowledgeable about year 10 students lives, develops a rich understanding of their learning needs, and endeavours to know who they are, where they live and what is important to them. When year 10 students are provided opportunities for sharing science ideas and engage in scientific discussion is appreciated by year 10 students who seek to ask questions, share knowledge and exchange ideas about science. Several year 10 students shared their ideas regarding the best sort of science lessons:

The best sort, [of science lesson would] be when you come in the teacher explains [the topic] for 10-20 minutes, asks questions and then just sets
down...[so] we can get down [and on with it] ...[so] towards the end, if we’ve got enough time or something like that, we can have an experiment to just confirm what we’ve learned. Cos that way I know the entire science lesson hasn’t been wasted. (Rob)

I think that like when we ask questions, [both] ourselves and the teacher is able to give us the answers. Also when we do experiments and then afterwards [the teacher] explains it to us, what we have done and everything, that makes it better... when teachers try to engage you and like they keep asking questions, and make sure you understand it... if they [teachers] are going through it with you it helps a lot; makes it more interesting. (Rose)

[Teachers] construct a good lesson and try to make it interacting and something that the students can relate to and try and make it educational as well as fun so that the students enjoy doing it and therefore they want to learn and want to do the Science test and experiment, yeah. (Bruce)

Yeah, I’d have to reckon it’d be the teachers, like the way how they teach the lesson is the way how I reckon it (science) gets learned. (Danny)

When year 10 students feel that they are known by the teacher, they play an active role in the lesson, and they may take a more active ownership of science learning.

Some year 10 students will ‘tune into’ a teacher who is perceived by them as knowledgeable of their subject, who knows students and recognises their interests and needs. Here the knowledgeable teacher is able to connect school science with the real world (Tytler, 2007). In the science classroom, teachers who seek to relationally engage with year 10 students during the lesson demonstrate passion and enthusiasm for their subject. Though student engagement in science learning may vary, the key factor regarding interest and motivation to engage in the science learning comes as a consequence of teacher qualities (Tytler, 2007; Goodrum et al, 2000). Year 10 student perceptions support the notion that engaging teachers are those who communicate, care and enthusiastically present active learning opportunities, (Cothran & Ennis, 2000).

4.4.3 Passionate and skilled teachers

The very best science teachers who impact student lives are those equipped not only with a high level of knowledge of the subject they wish to share with their year 10 students, but with a passion that is supported by skills necessary to foster student interest in science; nurture and
inspire year 10 students to engage in science learning activities and find out more about science and scientific matters. During this time of great change, e.g. rapidly changing global technologies, climate change, energy resources and sustainability; socially critical impact of science in the world, how to make science in school ‘cool’ is a problem. Some of the teachers at Bay View Christian School are regarded as ‘cool’, ‘fun’, not ‘too strict’ and pretty ‘laid back’. The learning environment is not too stressful. It is a place where year 10 students recognise that the science teachers make a difference, have a big impact on their science learning and are seen as knowing what they are doing.

_The teachers are pretty cool, I think the subjects are a bit more interesting this year and the teachers have a big impact._ (Rebecca)

Whilst discussing feelings and emotions about their science lessons year 10 students were asked what are the best (coolest) (sickest) sorts of lessons for joining in with? What gets you involved?

Year 10 students identify a passionate and engaging teacher as someone who makes connections with students both as individuals and as a group. Year 10 students draw attention to the science lessons where the teacher provides new and interesting activities, which enhance student participation in science learning.

_Oh definitely things that you don’t have every day. I mean, if you have some things that you do everyday- it’s not so interesting but when the teacher brings in stuff like dry ice like you get your into it because you haven’t used that kind of stuff before and your all fascinated at the idea that the gas is frozen and all that kind of stuff I mean you get into it. I suppose it’s just things that you don’t see everyday – so it sort of gets me into it._ (Rebecca)

Whilst the passion at times may seem exhausting, teachers need to be the primary driving force in creating an educationally engaging environment (Cothran & Ennis, 2000). Year 10 students respond to passionate and skilful science teachers who provide activities that
cultivate and nourish intrinsic and extrinsic interests and motivation (Cothran & Ennis, 2000; Hidi & Harackiwicz, 2000).

The knowledgable and passionate science teacher includes real world science matters to enhance student engagement in science learning. In so doing, the teacher fosters a socially critical orientation to learning that feeds student interest in science learning from a real world science perspective. With regard to their present experiences of science teaching and learning and to find out more about teacher quality, year 10 students were asked to share their perceptions regarding what teachers currently do to make lessons interesting.

*I think that like when they try to engage us, provide us with an activity when it is quite relevant to our everyday life therefore we can find it interesting. Whereas when they talk about things that we don’t really relate to it its quite boring when it’s like that.* (Sue)

*Generally asking people questions and putting it into examples is quite good. Putting enthusiasm into what they’re saying to make it look like they’re enjoying what they’re saying, makes you feel like it must be good or something like that generally. How they say it, put it across is what makes it interesting cos you want to tune in.* (Rob)

Year 10 students choose to ‘tune in’ because the skilled science teacher is seen as someone who ‘knows about’ the relevance of science and the applications of science in industry, the community and the environment will connect science and scientific ideas with student lives and the needs of the wider community. The teacher who is tuned into who year 10 students are and where they live may be better equipped to provide a learning classroom that fosters attitudes of engagement in science learning. In these classrooms passionate and skilled science teachers stimulate student interest and nurture enhanced engagement in science learning.

A skilful teacher is one recognised by year 10 students as one who is ‘keeping a lid on’ what is going on in the lesson; being in control of what is going on in the classroom. Student perceptions support the notion that a science teacher who is in control enhances student engagement in science learning. The knowledgeable teacher who is perceived as ‘in control’
is seen as one who gives a friendly greeting, re-caps the previous lessons, sets class work, actively encourages year 10 students to start working, writes on the board and explains tasks.

Well the teacher we currently have for science lessons uses a wide variety of ways of doing that. Sometimes the class will settle down pretty quickly because the teacher is asking questions or the teacher will present a task sheet that gets everyone to sort of get to it straight away. (Steve)

Some student comments indicate that teachers who skilfully use ‘attention catchers’ capture student attentions such that year 10 students make decisions to engage in science learning. Science teachers who are skilful in capturing the attentions of their students enhance student engagement in science learning:

Ah for me a (science) teacher has to be grabbing if they want to grab everyone’s attention... be appealing to everybody ... (Danny)

Whilst having a conversation with a group of year 10 students regarding their thoughts as they make their way to a science lesson, some of their shared ideas support the notion that the qualities and nature/type of the science teacher influence engagement in science learning.

Oh it depends what science really. Oh some sciences you think – ‘oh no we’ve got that teacher’, like they can really throw the lesson out completely and then other sciences you go ‘oh we’re doing this today and we’ve got that teacher and they are really nice’, and it really depends on the teacher. (Rose)

Yeah I agree it’s not so much the science it can really be the teacher I mean, any science can be fun depending on what you’re doing like if the teacher’s like, I don’t mean to be rude but if the teacher is quite boring then you don’t want to go to that teacher so if you’ve had a busy day and all of a sudden you’ve got that teacher yeah and you really don’t want to have to put up with them you just want to leave you don’t want that. So it’s not so much science I mean like science all the way round it just depends on what type of teacher you have. (Tom)

My discussion with Rebecca reveals her intrinsic interest in science. Science is a subject which Rebecca enjoys because her teacher creates an engaging and positive classroom environment.
I quite enjoy my science lessons – you know some classes you just like ‘oh great I don’t want to go’ but I think I enjoy my science lessons because you know our teacher’s really good and there is good people in there and we all get along and yeah. I think I might look forward to it a bit, yeah. (Rebecca)

A knowledgeable and critically effective teacher will endeavour to nurture the interests of all students. Intrinsically interested year 10 students who are generally focused at the start of the lesson will follow teacher instructions, with text books open waiting to start. Some year 10 students however draw some attention to the overuse of text books.

The note-taking is boring if you get a task to do like five or six questions [from the text book] which is boring to do and when you do it afterwards you do the experiments, then you do the questions again, you’re not actually going into depth about what you’ve learnt. It’s just on the board and you’re copying it down and you haven’t really gone over it at all and you might not understand certain things. (Tom)

Here, Tom spotlights some dangers that the incorrect or over usage of the text book can create. For example, copying notes from the text, lack of opportunity to explore depth of meaning and discussing questions. Learning activities that are text book centred may be at risk of not allowing year 10 students to engage in problem solving, construction of new knowledge and sharing ideas. As Tom indicates, year 10 students are at risk of finding the science lesson ‘boring’, they choose not to engage in science learning. The risk of year 10 students tuning out of the lesson is high. Year 10 students readily ‘tune out’ in situations where they perceive a lack of opportunity for engaging in classroom discussion, questioning and idea sharing that may support their learning needs and knowledge construction.

The teacher who is passionate, knowledgeable and aware of student interests both plans for and permits in-class discussions that are relevant and pertinent to the learning content and to the current and future lives of the students. Year 10 students have a capacity to identify and recognise teacher qualities and skills that create and support effective learning environments. When some year 10 students were asked to share anything that might have made science a bit
more interesting or engaging this year some identified and discussed the rotation model that the had adopted. The comments of some year 10 science students support the notion that when science teachers who know and understand their subject, and are aware of student capabilities and interest, they can plan engaging pedagogy that incorporates a menu of experiences that are challenging, interactive and relate to students’ lives.

Yeah, we change subjects three times, different science subjects. We changed the teachers, what the subjects were, like the different categories of science that we were learning. With the change of teachers comes a change of different styles of teaching so students react differently to different styles of teaching. Some enjoy it more than others; I enjoyed Chemistry even though it was probably the hardest one to remember the stuff. (Bruce)

Some year 10 science students at Bay View Christian School perceive that their science learning has been ‘a bit more interesting’ and engaging. Year 10 students indicated that the rotation model facilitated student access to three differently knowledgeable and skilful science teachers who were able to nurture and support a better understanding of science.

You get the different teachers that specialise in that area of Science so you get a better understanding of what it’s all about. (Kim)

Access to knowledgeable and enthusiastic teachers provided through the model resulted in some year 10 science students perceiving that they had done ‘more work’. Exposure to different classroom methodologies provided opportunities for engagement across all abilities.

I think it’s [science class] changed for the better, and we’re doing a lot more work. In previous years it’s been very basic, now that it’s split up into 10.1, 10.2, and 10.3, [ability groups] you know that you don’t have to worry about people not understanding and having to constantly go over it. So being in 10.1 they [the teachers] can just go [proceed with the lesson] and they’ll know that you understand and that way everyone in the class gets a lot more done. Cos if one person is behind the teacher, the teacher has to go and help that person [get] up to speed, and that might drag everyone down. (Rob)

For some year 10 science students the idea of a rotation fostered enhanced engagement in science learning by providing access to passionate, knowledgeable and skilled science teachers.
Maybe because we actually get to go into three different subjects in much more detail, we actually get to know it more than just last year how we just like, oh we had that chapter and we just went through it and that’s it. This year the teachers are more specialised in what they’re doing. I think it’s good, like when you have a problem in chemistry you can go straight to the teacher who teaches chemistry, whereas like in middle school you just have one science teacher, an’ there might be stuff about chemistry that you want to know but it’s deeper an’ the teacher might not know the answer. (Rose)

Bay View Christian Schools’ strategy to address student engagement in science learning included the adoption of a rotation model for year 10 science lessons, as identified on page 52, that facilitated science pedagogy for enhancing, for some year 10 students, a shift in student participation and engagement in science learning. In these lessons some year 10 students at Bay View Christian School perceive themselves as active participants in the learning experiences. One student, Matt suggested that he found the work easier and was able to see the ‘whole story’ of some of his science lessons.

This year has been pretty good. I have found it a lot easier than it was last year because this year I have found that teachers explain things a lot more thoroughly than they have done in previous years so you actually understand the whole side of what they’re trying to explain to you instead of just like the basics. If you get the whole story then you completely understand what they are talking about. (Matt)

Another student, Rob who commented earlier regarding the rotation model indicated that for some year 10 students there might be some advantage in having the same teacher and learning approach all year but qualified his idea in saying that was provided the teacher is ‘alright and fine’.

The only thing about that (the rotation model) that was different was that we had different teachers. In previous years we’ve done the three sciences but we’ve had the same teacher. So that way we can stick with the same teacher style, or her or his learning styles. [In] changing teachers you might like one teacher and do really well in that [subject] but then in another subject, not like the teacher and not do so well in that. Changing the teachers is like a bit different but altogether, so long as the teachers are alright that’s fine. (Rob)
Student comments support the notion that a teacher who might be ‘alright and fine’ is one who is passionate and committed, plans for and provides experiments and provides theory, work and learning. First, a passionate and committed teacher manages their time to explain things, being mindful not to go too fast or too slow. These teachers may plan to avoid overuse of reading information from the text book whilst endeavouring to become skilful in ways of helping year 10 students to understand science. These teachers have the necessary knowledge of their subject and are prepared to allow year 10 students who are ready to go into more depth of science study. The passionate and committed teacher encourages discussion and questioning about science. Second, the teacher who plans for and provides experiments uses classroom time effectively and productively. Experiments are more frequent, have meaning and relevance to student lives, and also include student ideas. Third, with regard to theory, work and learning, the passionate committed teacher provides learning activities that are novel, varied and challenging.

The knowledgeable teacher who is aware of the interests and talents of year 10 students will provide engaging pedagogy. Year 10 students are influenced by the teacher who knows their subject and who provides authentic and novel activities, class discussions and hands on learning activities in a socially critical classroom. In these circumstances year 10 students recognise the value of a passionate and committed teacher who fosters a relational classroom.

4.5 Relational Learning

A relational science classroom might look forward to imaginative action in science teaching styles and pedagogy, recognising that year 10 students coming from different backgrounds may see things differently and have something to say about how things should be (Green, 1995). Relational science classrooms might provide learning activities that allow meaningful involvement of year 10 students, enhancing their personal contentment with science learning and self worth. In relational classroom, year 10 students as participants have
opportunities to learn, know and share how to exist in the world. A science pedagogy that nurtures democracy between year 10 students and teachers facilitates them to encounter and observe that what they and others have to say can facilitate student understandings as they construct an awareness of global and societal needs (Kincheloe, cited in Tobin 1990; Tytler, 2007; Goodrum et al, 2000 & 2001). In a relational science classroom students are not conceived as human resources moulded by modes of assessment, increased rigour and altered authority structures for private interests (Green, 1995). Relational science classrooms encourage freedom to search and articulate intellectual thought. Year 10 students at Bay Biew Christian School have had opportunity to share experiences, their interconnectedness and communion.

Discussions with year 10 students at Bay View Christian School connect two elements of relational science learning:

1. Relational teachers

2. Relational pedagogy

4.5.1 Relational teachers

Student comments reveal that learning science is dependent upon the teacher they have for science.

*It[ learning science] just depends on what type of teacher you have. (Rose)*

Comments by some year 10 students from Bay View Christian School connect relational teachers with enhanced engagement in science learning. Butler-Kisber and Portelli (2003, p. 210) support the notion that when teachers negotiate with year 10 students and they are able to share their ideas and questions, year 10 students have ownership of what is going on in the classroom and experience a stronger sense of membership in the learning process. As a science teacher I have learned that endeavouring to understand year 10 students’ perceptions about science learning is important, particularly in view of the often content-driven nature of
science teaching and how it connects with their lives. Student ownership of the science learning process may be enhanced when the teacher is more relational and endeavours to focus on and listen to what students have to say. Year 10 students may become better learners by having opportunity for active involvement in the science lesson where they experience self-worth, are respected and are valued (Ruduck & Demetriou, in Butler-Kisber & Portelli, 2003).

The teacher who engages in conversation with year 10 students and who takes an interest in who they are may be better positioned for creating opportunities that nurture richer understanding about student interests, what they may be thinking about and what interests them. Student engagement in science learning is observed in combination with enjoyment and interest and genuinely recognised relationships.

Enhanced engagement in science learning comes about when the teacher relates in friendly and open conversations that discuss and explain topics they [the students] find interesting: topics other than or in relation to the subject matter (Cothran & Ennis, 2000). When teachers talk with students a personal dialogue is established, which can be a prerequisite to the development of an educational dialogue (Cothran & Ennis, 2000).

I work best when the teacher is interested in what I have to say and what my opinion is about the subject, like the teacher is actually wanting to expand our knowledge and stuff and actually is interested in teaching us and discussing things. (Ann)

It is the view of some year 10 science students that teachers should enter a class as partners in learning, with similar relational attitudes and intentions as those of the students.

I think a teacher has to go into the class with an attitude that someone like us would have... going in with an attitude like can I engage with the class a bit more and then like you’d be able to have the whole class join in and all have a bit of a laugh and just really enjoy the lesson. (Danny)
In providing opportunities for relational learning between the teacher and year 10 students, such as discussion of science and scientific ideas and investigations, a socially critical classroom adopts pedagogy of engagement for science learning through shared expectations that involve social interaction and participation in relational learning activities. In these classrooms, teachers and students mutually engage in hands on investigations and, as partners share the excitement of science learning.

It is important for the teacher to recognise and acknowledge the value of a relational culture in the classroom. The science teacher who seeks to engage with the way year 10 students may be thinking and who participates in a professionally caring and relational manner becomes actively connected with students as a co-learner in investigations and other learning activities. In this way, a socially critical orientation to teaching science learning enhances a shift in engagement in science learning.

The ways teachers relate to year 10 students plays a significant role in the engagement of year 10 students with the learning process. During the school day year 10 students participate in a variety of learning activities and come into contact with a variety of teachers. Student expectations of science learning as they make their way to the lesson reveal that there are connections with what the teacher is like, how enjoyable the lessons may be and the possibilities of working in groups. When asked how year 10 students ‘feel’ while making their way to the science classroom some student’s once again draw attention to teacher qualities and relationships.

*Oh it depends what science really. Oh some sciences you think, ‘oh no we’ve got that teacher’, like they can really throw the lesson out completely, and then other sciences you go, ‘oh we’re doing this today and we’ve got that teacher and they are really nice’, and it really depends on the teacher.* (Rose)

*Just have an easy going teacher that is always willing to give help and is open for your suggestions or not suggestions but like questions, even though sometimes questions might not be relevant to the particular part of that subject that we’re doing at the moment and yeah.* (Bruce)
The comments of these year 10 students support the notion that the quality of the science teacher sets the tone and influences students’ expectations of how the science lessons might commence and continue.

*Depending on who the teacher is you know if it is somebody quite strict, and then you’ve got some teachers who are a real lenient, you know you can get away with a little bit, more here and then you know you can do a little bit, you can go and sit wherever you want, you can go sit up the back, you haven’t got any worries and all that kind of stuff yeah.* (Rose)

Student perceptions provide links between engaged learning, interest, motivation, and the role and performance of the teacher. Year 10 students reiterate the importance of an interesting and relational science teacher who can be fun and prepared to share a joke.

*Being interested in the teacher, you know, not getting sidetracked or carrying on about the same thing, being fun or funny every now and again not so serious all the time. If a teacher can have a joke as well as being fun at the same time a lot more people pay attention as well.* (Tom)

Year 10 students learn best when they become interested and engaged in learning by interacting with a relational teacher who is prepared to provide surprising and unexpected learning activities that nurture discussion.

*I learn best when I’m being actually engaged by the teacher in that she’s interacting with the students and me. Teachers sometimes try to put a new side to things like they might add something that is interesting or they weren’t expecting, or they might do something unexpected toward the experiment.* (Kim)

Teachers who listen to year 10 students and try to understand their perceptions and interests will be in a better position to engage students in science learning. Relational classrooms that provide opportunities for listening and sharing require a more liberal or socially critical approach/orientation to the curriculum. Relational pedagogy nurtures engagement in science learning.
4.5.2 Relational pedagogy

Year 10 students find value in a relational classroom environment where they are able to engage in learning that brings together ‘good people’, people who get along well and work together.

*I learn best when the whole class is being cooperative and there’s silence in the classroom and the teacher doesn’t have to spend most of the lesson trying to get everyone to be quiet and cooperate and when we are going into in-depth conversation about the topic that we’re learning about.* (Kim)

*When I have a science lesson I always think that it encourages more thought than most lessons instead of just writing, copying from another book. It encourages creativity and stuff like that which, I really like being creative and stuff.* (Kim)

In such a social constructivist classroom, students’ capacity to understand science may be stimulated and challenged. Here year 10 students’ conversation and cooperativeness may stimulate each other to think about what is going on in the lesson by solving problems, thinking creatively and becoming engaged with what is going on. Year 10 students choose to engage when the wider significance of science is recognised, and when the class as a whole is engaged.

*I work best when everyone else is interested as well but if no one is interested and they are going to muck around then you won’t be able to focus. You won’t be able to learn.* (Ashlee)

During some of my experiences as a year 10 science teacher I have observed that hands on laboratory activities and science lessons that are positioned in a liberal and/or socially critical orientation to teaching and learning create classrooms that foster relational learning. In these classrooms the teacher and year 10 students work as researchers and co-researcher. The teacher and students engage cooperatively as researchers and co-researcher together on an agreed investigation or class research topic. In these lessons the teacher and students develop
and share some understanding of science, and engage in activities that enhance student engagement in science learning. The science laboratory provides opportunity for varying the learning environment in which year 10 students experience opportunities to construct and develop their understanding of science concepts and processes (Hofstein & Lunetta, 2004). Settings may be provided that permit year 10 students to have opportunity for engaging in cooperative learning where students share ideas, get information from each other and learn together. A continuing feature of science learning is its capacity to provide opportunities for group work and doing experiments together. Relational laboratory activities have the potential to enhance constructive social relationships as well as positive attitudes and cognitive growth (Hofstein & Lunetta, 2004; Hofstein & Lunetta, 1982; Lazarowitz & Tamir, 1994). The environment of the science classroom potentially provides informal opportunities for movement and discussion, possibly more so than other core curricula subjects. Learning activities in science lessons provide occasions for socially cooperative interactions. As such, these interactions potentially promote a positive learning environment (Hofstein & Lunetta, 2004). Relational pedagogy that is sensitive to students’ expectations for learning encourages year 10 students to join in with the learning environment and nurtures a socially critical learning climate. Relational pedagogy nurtures a classroom where everybody works together.

*Joining in is the right thing to do to contribute to the lesson or activity and joining in helps others or influences others into whether they choose to do work and join in themselves.* (Bruce)

Year 10 students’ perceptions support the notion that the ideal science classroom is characterised by enjoyment, fulfilment, ownership of and engagement in learning with mutual respect between students and teacher (Goodrum, Hackling & Rennie, 2001). Year 10 students at Bay View Christian School report that their participation in science lessons facilitates other people knowing what you are thinking and as a relational listener/participant you in return get to hear what other people are thinking. Science learning accompanied by
feelings of group membership may increase students’ engagement’ (Olitsky, 2005, p. 35).
Interactions that enhance group membership in support of effective learning may be related to emotional energies (Collins, 2004). When students ‘invest their emotional energies and share ideas they influence their student membership in the class in association with the construction of concepts and knowledge’ (Olitsky, 2005, p. 36). Year 10 students are able to identify when moments are taking place that encourage involvement and opportunities to test their own knowledge and to see if they are getting it right. Year 10 student Rob was asked to consider how joining in with lessons affects both him and others.

Well if you get involved and other people can see what you’re thinking and all the different possibilities of what’s in the class and what other people are thinking the different things like that and if you get involved you could put your knowledge to the test and make sure that you’re getting it right, you’re not saying, you’re not writing down something that’s wrong, it’s an easy way to check what you are doing. So, if the teacher asks you a question and she goes ‘Well that’s not quite right you need to do this’ and you go ‘OK’ and when you write it down you know that you’ve got it right. And that’s the same with other people, they might think that they’re on the right track and then you ask the same question and they’re slightly wrong and they can change the answer as well. So, that way not everyone has to ask the same question if she/he [the teacher] goes round [the class]. (Rob)

Robs’ comments support the notion that during a science lesson, opportunities for year 10 students to talk, ask questions, and share scientific matters can nurture and confirm science understanding. Year 10 students perceive that personal and common reward and assurance can be achieved by asking questions that everyone gets to hear. Year 10 science students will have opportunity to recognise that their thoughts and ideas are shared by other year 10 students and recognise that they are not thinking alone. Year 10 students become more confident in their own thinking and their capacity to learn and explain scientific phenomena may be enhanced. When asked about their best lessons, year 10 science students described a relational and cooperative classroom. Year 10 science students liked the idea of working together in teams and they appreciated the diversity of involvement that fellow students may contribute to the lesson.
I think when everyone works together as a team, and it’s something that everyone enjoys, there’s no one left out, everyone has an equal part in working together and although that’s kind of hard to do because everyone has their own thoughts and opinions of science of that sort of certain topic, they might have other preferences they want to do, there might be other distractions stopping them from doing this so it might be difficult to do that, but I still think that would be the best lesson where everyone worked together, there’s no ‘differentiation’ between different people and stuff like that, they all just got their heads down to work together, to find out something. (Kim)

Engaged learning takes place when relational pedagogy facilitates activities that allow year 10 students to develop an awareness of their peers. Opportunities to socialise and work in teams on something they all enjoy contribute to the best sort of science lesson. Year 10 students acknowledge that joining in is the right thing to do. Year 10 students realise that by joining in they too contribute to helping and influencing others to join in. Year 10 students value of the effect of relational learning on themselves and others and choose to engage in a lesson where joining in and encouraging each other influences student choices to engage in the activity.

Joining in on it affects me personally with my learning which will then help me just all round with my education and also keep me in the school behaviour-wise because joining in is the right thing to do. To contribute to the lesson or activity and joining in helps others or influences others into whether they choose to do work and join in themselves because they might see me not joining in and then think that it’s okay for them not to. Then you end up having no students doing any work. Or if I did join in then it could be encouraging for other people who don’t feel like joining in to join in and just do the work and yeah, that’s it. (Bruce)

In drawing this section to a close, it can be emphasised that student perceptions of their science lessons indicate that relational science learning activities contribute to enhancing engagement in science learning. Student comments support the notion that relational teachers and a relational pedagogy that permits and plans for participation in relational learning fosters fun, success and accomplishment for all students. Communication through relational pedagogy is a key factor for capturing interest and stimulating motivation for engaged learning. As students engage in a relational setting their awareness of the classroom culture
and relationships within the classroom setting is used to filter past experiences, perceived teacher characteristics/qualities and classroom relationships. Feelings and emotions of enjoyment and interest may ensue when students decide and choose whether or not to engage in the lesson.

Year 10 students at Bay View Christian School have found their science classrooms to be relational and enjoyable, and that the science learning experience has been good.

**Yeah I have to agree science is definitely the best subject this year and I think because you wanna be there you do well in class so and I think that the people around you also make a good atmosphere to be around and it helps you to get on with your work and really think things through and so yeah.** (Elizabeth)

Student engagement in a relational pedagogy has contributed to the idea that science in year 10 has been the best science learning so far in their experience. Student comments support the notion that the science learning content has been more detailed and comprehensive in context and content and that they have learned a lot more science this year.

**Um yeah, like we have learnt a lot more[science] than what we have[previously] – it’s been quite interesting.** (Rose)

As some year 10 students engaged in a science curricula orientation that nurtured a relational pedagogy they recognised opportunities for enhancing their awareness of the relevance of science learning that they perceived as good and enjoyable. Furthermore their science learning experiences had facilitated some connections with goal setting and future career avenues.

**Setting a goal of like what you want to do when you leave school, that puts you in the mind set of what kind of subjects you want to take and once you’ve got that down you know that you’re gonna enjoy that lesson or you are gonna enjoy that subject.** (Rose)

The cultivation of engagement through relational pedagogy raises the horizons of student expectations and enhances the cultivation of engagement in the science classroom. Students are aware of each others’ behaviour highlighting some awareness of each others’ interest and
participation in the lesson. Year 10 student comments support the notion that the behaviour and participation of others (and themselves) has an effect on how they might feel about joining in with science learning.

_I think that it [joining in with the lesson] has a huge effect, like when I join with the lesson, like I kinda expect everyone else to join in as well, which makes the lesson really interesting, and when other people join in I feel like I also want to join in, yeah._ (Sue)

_I mean you might feel that I don’t like this, I don’t want to do it but somebody else in your group might want to do it and you’ve gotta sort of think about them as well you can’t just think you know it’s all me you’ve gotta do it._ (Matt)

Collins, (2004), comments that over the course of time a series of interaction rituals accumulate in forming students’ feelings of group membership within the classroom. In this respect relational pedagogy will seek to enhance student engagement in science learning and facilitate future participations in other groups where the science learning activity is perceived as relevant to students’ current and future lives.

4.6 Conclusion

The perceptions of some of the year 10 students at Bay View Christian School on the subject of engaging science pedagogy support the notion that engagement in science learning comprises four major themes that contribute to and foster success and accomplishment in science learning. First, participating in hands on learning that provide variety and fun and that challenge thinking, talking and acting are recognised by year 10 students as effective qualities of engaging pedagogy. Second, year 10 students highlight the importance of doing science work that is relevant to their current and future lives. Year 10 students identify the relevance of the learning topic recognising avenues that connect science learning with their goals and aspirations. Third, the provision of and access to passionate, committed and knowledgeable teachers as recognised by year 10 students is critical to their understanding of science. Teachers who know their subject and endeavour to know their students enhance not only their
own capacity to teach well but also to recognise the needs of their students and the 
community as a whole. Providing relevance of learning using relational pedagogy will 
capture student imaginations and enhance engagement in science learning. Fourth, relational 
classrooms, as indicated by some year 10 student comments have revealed that their best 
science lessons have been those where everybody works together. In the more liberal or 
socially critical and relational classroom students and teachers work together engaging in 
cooperative learning that includes, sharing knowledge, curiosities, expectations and 
aspirations.

Setting a goal of like what you want to do when you leave school, that puts you 
in the mind set of what kind of subjects you want to take and once you’ve got 
that down you know that you’re gonna enjoy that lesson or you are gonna 
enjoy that subject. (Rose)

Engaging science pedagogy demands ongoing development and evaluation of flexible and 
relevant learning activities. There is a need for classroom investigations to be interesting and 
to motivate students into choosing to engage in science and scientific learning and for having 
opportunity to take some control and ownership of their learning needs and engagement.

Students are able to make informed decisions about what might interest, motivate and engage 
them in science learning. Choosing to engage, becoming motivated and participating in 
science learning occurs as a consequence of relationships and random combinations of 
science themes/topics that capture year 10 students’ tiers of interest and imagination.

Engaging pedagogy is critically connected with hands on experiments, relevance, teacher 
quality and relational learning environments. Listening to student voice and actively 
recognising and responding to student perceptions of engaging pedagogy will serve to 
enhance science learning in Australian schools. Rebecca and Elizabeth provide a final word 
in closing this chapter:
I find that what’s going on all around you really interesting your finding out how things work and you know when you find out it’s like, Wow I never knew that! like it opens your eyes to how these things work and it makes you realise how amazing the world really is and everything that was created how amazingly it fits together. (Rebecca)

It’s interesting, the logical side of it, I enjoy science when I achieve, I know that I’ve done well, what I have learnt has benefited me. I just love the idea of being able to know how everything works and being able to understand and also it’s something you can use in everyday life. (Elizabeth)
Chapter 5
Final Discussion

This research project originated from a personal interest to find out what is going on during science lessons when year 10 students affectively engage with science learning activities. One of the greatest difficulties of summarising research on the affective dimension of science learning is the lack of mutual theoretical frameworks, concepts and instruments (Gardner, 1985; Ramsden, 1998; Schibeci, 1985; Schiefele, Krapp, & Winteler, 1992; Simpson, Koballa Jr., Oliver, & Crawley III, 1994). Many studies on student perceptions of engaging pedagogy in science learning have been completed, but it is difficult to extract a coherent view from them as the question is very complex (Lindahl, 2003). Ramsden, (1998) summarizes some much earlier research regarding perceptions about student engagement in science learning:

[The] widely held perception of science being difficult and not relevant to the lives of most people, of science causing social and environmental problems, that science is more attractive to males than females; that interest in science decreases over the years of secondary schooling; that these more negative views are associated with the physical sciences rather than the biological sciences. (p. 125)

According to Ramsden (1998) interest in questions of attitudes towards science decreased since each study gave the same results and nobody knew what to do to change the students’ attitudes. The aim of this investigation was to identify and discuss year 10 student perceptions of affective aspects of science learning and to make connections between engaging science pedagogy and curricula orientations to learning.

This study reveals that, for some year 10 students at Bay View Christian School, there is no single pedagogical theme that captures their interest and motivation priming an attitude that may lead to student engagement in science learning. Choosing to become engaged in science learning comes about through a variety of interconnected classroom activities and teacher qualities that may influence the differing levels of student interest in science. As a
consequence of what goes on during the lesson, some students will be intrinsically interested while others may become extrinsically interested. Engagement in science learning, as perceived by year 10 students from Bay View Christian School, is connected with interest in science that is nurtured by hands on learning, relevance and ownership of learning, teachers’ personal and academic skills and qualities, and relational learning classrooms. The voices of these year 10 students support the notion that knowledgeable, passionate and committed teachers who seek to provide a relational classroom will nurture and enhance science learning. Furthermore, the engagement of students in science learning in year 10 is enhanced by science teachers who seek ways of considering how engaging pedagogy stimulates young people’s interest in science, not just for social, economic, or politically driven reasons but for the students’ own sake. When students find science learning exciting and enjoyable they may be more likely to engage in the lesson. I know, from personal experience, that when year 10 students are engaged in the learning activity the teacher may also inhabit the experience of personal and professional satisfaction. A science teacher in this classroom may be more likely to actively engage with students in a professionally meaningful and relational way that critically engages students in science learning.

By listening to the voices of students this investigation has given some authority to student perceptions of engaging pedagogy. Analysis of student comments reveals a thematic framework that constitutes four pedagogical themes that enhance engagement in science learning at Bay View Christian School - hands on learning, relevance and ownership of learning, knowledgeable, passionate and committed teachers and relational learning environments. This thematic framework influences students’ interest in science, their attitude and motivation to engage in the learning, and also their personal and social responses. Students make decisions to engage with a science learning activity according to what has happened in the past and in connection with their current and future learning needs. Students
engage with hands on activities that are fun and relevant. Such lessons will be novel, enjoyable, permit ownership of learning and meaningfully connect with their current and future lives. Students become engaged in learning science when they are taught by knowledgeable, passionate and committed teachers who introduce new ideas and where they have opportunity to construct new knowledge facilitated by engaging learning activities.

Relationships with the teacher and peers are frequently recognised as important qualities of an engaging learning classroom. A relational classroom led by a teacher who is genuinely interested in and engaged with both the class and the individual student, augurs well for providing engaging science pedagogy. Engaging science pedagogy that actively develops relationships may combine science teaching leadership, community and science learning that transform the quality of science learning and teaching as a consequence of the development of stronger relationships within the classroom, within the school, and between the school and the community. Relational science learning is personal, practical and playful and addresses the development of the whole person with regard to their science and scientific literacy’s. (Relational learning, 2011).

5.1 Engaging Pedagogy

The hope of citizens, invention, experimentation, imagination and design are at the heart of developing a wider and more socially aware community. The voices of the year 10 students from Bay View Christian School have provided a view of engaging science pedagogy and how the community and its peoples may be affected. Networks of engaging pedagogy in science learning, as perceived by year 10 students at Bay View Christian School are highlighted in figures 1 and 2.
Figure 1: Starting something new, draws attention to the ideas that students believe they are learning best when they are starting something new, the teacher is fun, the pedagogy reflects well planned lessons and when the class is committed to the subject of discussion.

Figure 2: Relational classrooms, demonstrates links between students’ perceptions of how a relational classroom nurtures understanding and the expansion of personal science knowledge. Year 10 students at Bay View Christian School perceive that science learning is taking place when the whole class is paying attention and is actively involved with the learning activity. Students engage in, and want to know more about science when they are collaboratively participating in something new. The engagement of students in relational science learning fosters an understanding of science matters and enhances students’ science
and scientific literacy. In these classrooms year 10 students indicate a desire to know more about science.

Figure 2: Relational classrooms

Superimposing figure 1 over 2 further reveals other possible inter-relationships of engaging science pedagogy. For example, when the teacher is perceived as having engaging qualities the class becomes involved with learning. When it’s the start of something new and the topic is interesting the teacher is fun and the class become committed to the lesson.

Planned lessons expand student knowledge; engaging pedagogy motivates students to learn new things.

Therefore, understanding science and constructing new science knowledge takes place when the lesson is taught well by a knowledgeable science teacher who makes use of flexible
teaching and learning orientations that facilitate student engagement in relational science learning because the students have become interested in the learning topic and want to know more about it; students become socially and critically engaged in the world of science.

Either liberal/progressive and or socially critical orientations to science teaching and learning may embrace flexible learning activities that include student-led discussions to reveal science and scientific issues that students have some knowledge of, care about and are relevant to students’ lives. Furthermore, when students have an opportunity to share ideas and discuss interests investigations might emerge from whole class or smaller peer group discussions that raise questions for individual and class research and development. It is in these circumstances that the knowledgeable and skilful science teacher might consider science pedagogy that encompasses alternative orientations to teaching and learning.

5.2 Orientations to teaching and learning

Student perceptions support the notion that liberal and/or more socially critical orientations to science learning and teaching provide engaging science pedagogy. A socially critical orientation toward science learning enhances the creation of a supportive learning environment that makes connections with the student, school, home and wider community (Jones & Baker, 2005). The advancement of interest in student lives, respect and trust contribute to ownership of behaviour and learning. Engaging science pedagogy provides visual relevance and variety for learning. It involves active encouragement through engagement in reflective thought making available opportunities to connect with prior learning experiences that permit further discussion to generate and support new ideas and construct new knowledge.

Building relationships in a socially critical classroom is an important quality of engaging pedagogy. Students engage in science learning in an environment where they feel valued and known. Developing a culture of value and respect and using strategies that build skills of
productive collaboration create and support the influence and application of engaging pedagogy. Engagement in learning is enhanced using strategies that promote student self-confidence and willingness to take risks with their learning; students are encouraged to take responsibility for their own learning.

Engaging pedagogy makes use of activities that challenge and support deep levels of thinking and application. A more liberal and/or socially critical classroom permits students to engage and participate in social groups as researchers and co-researchers engaged in relevant science topics where they can discuss, promote and share knowledge. Opportunities for recognising and developing their ideas and questions to problem solving and plan relevant and meaningful and enjoyable investigations are identified by students as valuable for learning science. Engaging science pedagogy that facilitates enjoyment requires planning to include opportunities for collaboration and fun. When this happens students may more likely view science learning as fun and relevant and promote sustained science learning. Collaboration and fun in lessons may be perceived by students as relevant to their learning needs. For the teacher seeking engaging pedagogy this discussion generates an interesting question: Can teachers regularly and frequently construct lessons that have significance for student current and future lives? Furthermore in an Australian educational environment that pursues traits of intensive accountability, what scope is there for the science teacher to connect science learning to students’ lives by engaging their professionalism with regard to some adaptation of different orientations to teaching and learning other than conservative/vocational, that best meet the needs of their students? The pressures of corporate accountability and the possible impact of de-professionalism on teachers may impede the flexible equitable delivery of the Australian Curriculum for Science across the states. Connecting science learning to student’s lives is a strong influential element of engaging pedagogy. Learning connects strongly with communities and practices beyond the classroom.
and school. A science learning environment that reflects this principle endeavours to engage students with present day knowledge and practice and may be perceived by students as modern and up to date and make some connection with their current and future lives.

Student engagement in science learning may be further enhanced through a socially critical orientation that acknowledges and makes use of the local and broader communities. Bringing students into contact with real world science through industry visits, community projects and environment related activities contribute to the provision of engaging pedagogy in science. In these circumstances both teachers and students have opportunity to attain some enhanced awareness of the applications of science in current and everyday lives. Meeting scientists and engineers in the work place is of value. Raising student awareness to professional and community practices and the applications of current new technologies that permit reflection and discussion may capture student imaginations and nurture a more creative and fun science classroom.

Engaging pedagogy and engagement in science learning may be achieved when science teachers, schools and states recognise the importance of bringing relevance and meaning through a broad background of experiences and a change in curricula orientation. Student voice at Bay View Christian School supports the notion that a change in curricula orientation from the conservative to the socially critical will enhance student engagement in science learning.
Chapter 6

Conclusions and recommendations

6.1 The Rotation model at Bay View Christian School.

The Science Department at Bay View Christian School endeavoured to make changes to enhance student engagement in science learning in the upper middle school years by introducing a rotation model of science delivery. Teachers had agreed to consider the adaptation and use of a different year 10 science pedagogy that included both liberal and/or socially critical orientations to teaching and learning. Through the voice of the students this investigation reveals that engagement in science learning through the rotation model at Bay View Christian School is dependent upon teacher quality and performance. Comments of some of the participants support the notion that student engagement in science learning during year 10 is enhanced through access to and engagement with knowledgeable and passionate teachers with different teaching styles and personalities, who provide opportunities for students to participate with some ownership in relevant and meaningful hands on activities and who encourage students to participate in relational learning.

The rotation model at Bay View Christian School has raised student awareness of science and scientific issues and critically contributed to enhanced engagement in science learning. Students identify with having done a lot of work responding to teachers who recognise the needs of changing adolescence. Adopting a more liberal/progressive and/or socially critical orientation to science learning and teaching at Bay View Christian School has nurtured enhanced learning in the science classroom. Student interest and motivation have been raised leading to enhanced engagement in science learning. In this environment year 10 students have participated lessons that were designed to challenge different levels of ability from a more equitable perspective.
6.2 Further considerations and recommendations

Discussion is required that highlights a focus on the way evidence interacts with ideas (Osborne, 2006). The enhancement of scientific literacy is more likely to be supported through science programs where engaging pedagogy incorporates community based projects (Rennie, 2006), and develop relational classrooms that focus on enquiry (Bybee, 2006) and student interest (Fensham, 2006). Student interest fluctuates according to changes in the learning experience, a student's personal emotions at a given time, teacher moods and qualities, peer group issues, family pressures, classroom activities, personal reward and relevance of learning topic. In identifying the value and importance of student perceptions and listening to their voices this investigation highlights the importance of liberal and socially critical curricula orientations to teaching and learning with student engagement in science learning. Teacher qualities and classroom leadership skills influence student engagement with science learning. The establishment of a relational learning environment and access to meaningful and relevant learning activities contribute further to student engagement.

For further development of ideas and orientations to teaching and learning science it is necessary to also consider how teacher knowledge and skills might be enhanced either during training or as part of an ongoing effective professional development program. The discussion and review of teachers’ conditions of service, that includes relevant professional development and evaluation processes to identify and support the enhancement of teacher knowledge and skills, may support the ongoing planning and implementation of engaging science pedagogy. Seeking to enhance the interpersonal skills of teachers in schools may further nurture the development of relational classrooms.

Providing a bridge to enhance student engagement, whilst new to some teachers, is an important role and responsibility of teachers (Cothran & Ennis 2000). For teachers to acknowledge and accept a role of bridge builder skills, time and resources are necessary
precursors. Under the current hegemonic driven restrictive structural and systematic conditions, teachers, talented, fresh and idealistic or otherwise, cannot sustain the required effort (Weiner, 1993, p. 77). Both the mandated Australian National Science Curriculum and the detached nature of endemic school systems contribute to establishing and maintaining conditions that undermine teachers’ ability or opportunity to meet the needs of their students (Weiner, 1993). The interpersonal skills of the science teacher are crucial in the provision of engaging learning programs. Critically engaging interpersonal skills of teachers are a necessary prerequisite in the establishment and maintenance of imaginative, creative, meaningful and enjoyable relationships with students. I agree with Cothran and Ennis (2000), when they argue that engaging pedagogy requires teachers with good communication and caring skills. Students engage when there is a personal connection with a teacher.

In coming to a close and considering ways of moving forward the following questions emerge for future investigation and reflection in schools:

In a given school:

- How is the science teacher’s role manifested in the school?
- How can science teachers best comprehend their role?
- What, if at all, do science teachers perceive as engaging pedagogy?
- How can science teachers apply improvement strategies that enhance student engagement in their unique school cultures? (i.e., Bay View Christian School)
- How, if at all, does the introduction, organisation and management of the Australian Curriculum: Science enhance student engagement in science learning and scientific literacies?
- How might the Australian Curriculum: Science allow teachers to develop, and implement, the necessary skills and knowledge permitting the development of engaging pedagogy in Australian schools?
Specifically, science teacher professional development programs need to consider ways of:

- Enhancing the importance of identifying, providing and accessing relevant professional development activities for science teachers.

- Communicating models of good practise widely.

- Developing and maintaining school science activities and systems, that raise the awareness of science within the school, connects science to student’s interest, recognises student achievement, highlights career avenues and connect with the wider community.

- Connecting science learning to students’ everyday lives.

- Making good use of community resources and connections with local real world science industry and career providers.

- Investigating place based pedagogy that takes into account wider settings of applied science and technologies, considering new ways of approaching learning opportunities.

- Seeking research collaborations to investigate levels of student engagement and outcomes for students of innovative student centred programs.

As an experienced science classroom teacher the opportunity to pursue this investigation and listen to the voices of students and their views and perceptions regarding engaging pedagogy has been both challenging and rewarding. I have learned the important lesson and value of talking about, reviewing and seeking engaging pedagogy from the student’s perspective.

*Everything falls into place, irrelevancies relate, dissonance becomes harmony, and nonsense wears a crown of meaning. But the clarifying leap springs from the rich soil of confusion, and the leaper is not unfamiliar with the pain* (Steinbeck, 1955).
REFERENCES


Levin, B. (1999). *Putting students at the centre in education reform*. Winnipeg, Canada: University of Manitoba, Continuing Education Division.


Prime Ministers Science, Engineering and Innovation Council (2003). Science Engagement and Education: Equipping young Australians to lead us to the future., DEST, Canberra.


Tripp, D. (1994). Case study, published in unit *EDU634 reader, Research Methods 1A*, Murdoch University, Western Australia, ch.5.


Appendix

App. 1: Letter to school for permission

Mr. X, Principal and College Board,

Dear Mr. X,

I am writing to seek permission to pursue a qualitative research activity with year 10 students regarding engagement and learning in science.

The research incorporates a case conference methodology using in-depth interviews and focus group discussions with students. I have attached copies of letters to go to parents and students wishing to volunteer. Maintaining and protecting the integrity of the individual student, the teachers and the college will be a priority.

Participants will be invited to volunteer for the project and steps will be in place to protect students from any adverse consequences. Every effort will be made to maintain and secure the personal integrity and worth of students and staff; identities will be confidential. At any time a participant can withdraw from the project.

Students’ answers to the questions will remain strictly confidential and will be seen only by myself. Students will not be required to disclose their name, however to facilitate the analysis of the information collected each participant will be allocated a pseudonym which I will safeguard.

After I have collected, collated and analysed student perceptions and answers to the questions it will be reported as part of a thesis for my Masters degree; I intend to write about my findings. When I do this, I will not reveal the names of students, teachers or your school. A file of the recorded interviews and written copies of the conversations will be stored on a CD which will be kept in a secure place at Murdoch University. All electronic recordings and other computer files will be erased and deleted.

The results will be made available to you as Principal for further consideration of forwarding an appropriate summary to parents and staff. The time taken for the completion of the project may take six to eight months from the time of the interviews.

If you are prepared to grant permission for the school to participate in this study, could you please complete the details below? If you have any questions about this project please feel free to contact either myself, Philip H. Jones, telephone 9360 7116 or email philip.jones@murdoch.edu.au or Professor Barry Down, telephone 9360 702 or email b.down@murdoch.edu.au

I am happy to discuss with you any concerns you may have on how this study may be conducted, or alternatively you can contact Murdoch University's Human Research Ethics Committee on 9360 6677.

Yours sincerely, Philip H, Jones, 25 September 2009.
**Reply Slip.**

I ………………………………………. have read the information above. Any questions I have asked have been answered to my satisfaction. I agree to Maranatha Christian College taking part in this activity, however, I know that I may change my mind stop the project at any time.

I understand that all information provided is treated as confidential and will not be released by the investigator unless required to do so by law.

*I agree for interviews to be audio taped.*

I agree that research data gathered for this study may be published provided names of all participants are not used.

Authorized Representative: ______________________________

Signed: __________________________

Date: _______________

Investigator: __________________________

Signed: __________________________

Date: _______________

---

**App. 2: Information to parents**

Dear Parent/Guardian,

The purpose of this project is to conduct an investigation of year 10 science programs at Maranatha Christian College. Prof Barry Down is working with Mr. Phil Jones (Med. research student) to investigate science at school. We hope to find out student perspectives with regard to interest, motivation and engagement in science and whether there is anything we can learn from students that will be of value to other similar programs. Phil Jones is interested finding out from students what factors affect students’ choosing to become interested, motivated and involved in science learning at school.

Students will be invited to participate in in-depth interviews in pairs, or a focus group of six year 10 students on (date) at (venue, time). Interviews and focus group meetings will last about 1 hour.
Care will be taken to ensure that normal classroom learning will not be interrupted and students will not be disadvantaged in any way.

The interview sessions will be run by Phil Jones, no other adult will be present. In these sessions students will be asked about their thoughts and opinions regarding science in school. If they do not wish to answer some of the questions or talk about stuff that is personal to them that is OK. They will not have to say or do anything they do not feel comfortable with. A digital recorder will be used to record their conversations and ideas and comments.

Student identity will be kept confidential and will be safeguarded. Answers to the questions will remain strictly confidential and will be seen only by Phil Jones. Student names will not be disclosed, however to help with the analysis of people’s responses each student will be allocated an alternative identity or code name which will be safeguarded. Teachers will not see any of the students’ answers.

After the information has been collected student contributions will be analysed and written about in the final thesis. When this is done student identity will not be revealed or the names of any other students, teachers or the name of the school.

A file of the recorded interviews and written copies of the conversations will be stored on a CD which will be kept in a secure place at Murdoch University. All recordings on the digital Dictaphone and other computer files will be erased and deleted.

A summary of the project will be made available to your school when it is completed. Your Principal will be provided with the results who will give due consideration to forwarding an appropriate summary to parents in the regular college newsletter.

You and your child can decide at any time to withdraw your consent to participate in this research. If students decide to withdraw, any material they have given us will be destroyed (sometimes data cannot be withdrawn or destroyed after a certain point, if so, indicate this to participants).

My supervisor and I are happy to discuss with you any concerns you may have about this study.

You can expect to receive feedback in six to eight months time.

Please be encouraged to discuss this project with your child. If as a family you agree to participate in this project please sign the attached form and ask your child to sign the consent form that they have already received from Phil Jones.
Sincerely

Signature

This study has been approved by the Murdoch University Human Research Ethics Committee (Approval xxxx/xxx). If you have any reservation or complaint about the ethical conduct of this research, and wish to talk with an independent person, you may contact Murdoch University's Research Ethics Office (Tel. 08 9360 6677 (for overseas studies, +61 8 9360 6677) or e-mail ethics@murdoch.edu.au). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

App. 2(a):

**Carer Consent Form**

- I would like my teenage child to be involved in this project.

- I understand that participants will be randomly selected from all students wishing to be interviewed.

- I know that he/she will be taking part in either 1:1 interviews or focus group discussion session as part of the project.

- I understand and agree to the use of a digital Dictaphone for recording my child’s responses to questions or contributions to the focus group discussions.

- I understand that my child’s identity will be kept confidential and recognise that all recordings and computer files, other than those on a CD that will be securely stored at Murdoch University will be erased and deleted.

- I understand I am free to stop and withdraw my child from the project at any time.

- I understand that participating in this project will not affect my child’s grades, their relationship with their teacher(s) or school.

- I understand that nothing about my child will be given by the researcher to anybody else except where the law says they must.

- I understand that I need to write my name in the space below, before my child can be a part of the project.
My child’s name: ______________________________________________

Parent/Guardian Name (print): ________________________________

Parent/Guardian signature: ________________________________

Today’s Date : _________________

Thank you for your support in this matter. Please return the signed forms to the College administration as soon as possible.
App. 3 : Information to students

Student Engagement in science – A case study.

Dear Student
My name is Phil Jones and I am from Murdoch University. I would like to invite you to take part in a research project that I am doing with Maranatha Christian College. The project is about finding out students perceptions about science at school. I am interested in finding your views about what makes science interesting, motivating and what factors lead you to becoming involved in science learning.

What would I be asked to do?
If you agree to take part, you will be asked to attend an interview session either in pairs or in a group of five with other students. Please note that in volunteering there is no guarantee of participation.

When will I be involved?
You will be given a week’s notice of the date of the interview which will take place during a school day. Care will be taken to ensure that your normal classroom learning will not be overly interrupted and you will not be disadvantaged in any way. These interview sessions will be run by myself, nobody else will be present. In these sessions you will be asked about your thoughts and opinions regarding science in school. If you do not wish to answer some of the questions or talk about stuff that is personal to you that is ok. You will not have to say or do anything you do not feel comfortable with. I will be using a digital recorder to record our conversations and your ideas and comments.

Do I have to take part?
No. You are completely free to say yes or no. As the researcher I will respect your decision whichever choice you make, and will not question it.

Participating in this research will not affect your grades, your relationship with your teacher(s), or your school.

What if I wanted to change my mind?
If you say yes, but then want to stop participating, that’s OK. Just let me know through your parent or guardian or your teacher and you can stop at any time.
What will happen to the information I give - is it private and confidential?

Your answers on the questions will remain strictly confidential and will be seen only by myself. You won’t have to disclose your name however, to help me in my analysis of the information that is collected each person will be given an alternative name which I will safeguard. Your teachers will not see any of your answers.

After I have collected what each student has given to the project and analysed all of it, I intend to write about what I found in a thesis, which is like a big assignment that will be marked for my University degree. When I do this, I won’t write or tell anyone your name, or the names of any other students, teachers or your school. A file of the recorded interviews and written copies of the conversations will be stored on a CD which will be kept in a secure place at Murdoch University. All recordings on the digital Dictaphone and other computer files will be erased and deleted.

A summary of the project will be made available to your school when it is completed. Your Principal will be provided with the results who may forward an appropriate summary to your parents in the regular college news letter.

Will you tell anyone what I say while I am contributing to the project?

In almost all cases no. If you tell me something that later I need to tell someone else because the law requires me to do so, then I will have to. I may also have to reveal something you say, if I think that you might be being mistreated by someone or if you are hurting yourself. If this happens I will discuss this with you first before telling anyone else and make sure you know exactly who I am going to tell and what I will say.

In all other situations, I will treat what you tell me as being private and confidential. Just the same way you will be asked to treat what other students say in the group as private and confidential and not tell anyone else. What is said in the group stays in the group!

Is this research approved?

The research has been approved by Murdoch University Human Research Ethics Committee, and has met the policy requirements of Maranatha Christian College.

Who do I contact if I wish to talk about the project further?

Please talk about the project with your parents or teacher first. Then, if you would like to talk with me more or ask some questions, please ask your teacher for my contact details.
**OK – so how do I become involved?**

If you **do** want to be a part of the project, then please read the Student Consent form and write your name in the space provided. Also ask your parent/Guardian to read and sign the Parent/Guardian Consent form. Return both forms to your science teacher as soon as possible, I would really appreciate this!!

This letter is for you to keep.

Kind regards,

Phil Jones.

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This study has been approved by the Murdoch University Human Research Ethics Committee (Approval 2009/142). If you have any reservation or complaint about the ethical conduct of this research, and wish to talk with an independent person, you may contact Murdoch University's Research Ethics Office (Tel. 08 9360 6677 **(for overseas studies, +61 8 9360 6677)** or e-mail ethics@murdoch.edu.au). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
App. 4: Student Consent Form

- I would like to be involved in this project.

- I understand that volunteering my involvement does not guarantee participation in the project.

- I understand that participants will be randomly selected from all students wishing to be involved.

- I know that I will be taking part in either 1:1 interviews, 2:1 interviews or as a member of five students participating in a focus group discussion session as part of the project.

- I understand and agree to the use of a digital Dictaphone to record my responses to questions or contributions to the focus group discussions.

- I understand that my identity will be kept confidential and recognise that all recordings and computer files other than those on a CD securely stored at Murdoch University will be erased and deleted.

- I understand I am free to stop and withdraw from the project at any time.

- I understand that participating in this project will not affect my grades, my relationship with my teacher(s) or my school.

- I understand that nothing about me will be given by the researcher to anybody else except where the law says they must.

- I understand that I need to write my name in the space below, before I can be a part of the project.

Your School: Maranatha Christian College

I would be willing to participate in:
<table>
<thead>
<tr>
<th>Method</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:1 Interviews</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2:1 interviews</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focus group discussion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Your Name: ____________________________________

Your signature: ___________________________ today’s Date: _____________
App. 5: Thank you letter re. Successful application to participate in Student engagement in science – a case study.

Dear (Name),

Thank you for your application to participate in the project regarding students views on science in school. The time you have put into considering getting involved, your discussions with your family and the completion of the form has been much appreciated.

It gives me pleasure to inform and congratulate you that through a process of random selection you have been identified as a participant in the project. I would like to take this opportunity of welcoming you as a participant onto the project!!

Please note that interviews will take place according to the following arrangements: (final arrangements to be made after consultation with Principal).

Date:

Time:

Place:

Regards,

Phil Jones

App. 6: Thank you letter re Un-successful Student engagement in science – a case study.

Dear (Name),

Thank you for your submission to participate in the project regarding students views on science in school. The time you have dedicated to considering involvement, your discussions with your family and the completion of the form has been much appreciated.

The names of all interested students have now gone through a process of random selection to identify the participants. As indicated through my initial presentation to students and in the information letter given to students there would be no guarantee of participation.

I regret now to inform you that on this occasion your name was not chosen. Please note however, in the possibility that a student may withdraw at any time your name will go onto a short list and will be forwarded with all other interested students for another process of random selection should it be required. If this does happen and you are selected I will contact you to allow you to consider if you would still like to join in with the project or not.
It is my hope that you have found this process interesting. I wish you success for the remainder of the year at school. Thank you once again for your help and support in this matter.

Regards,

Phil Jones
App. 7: Analysis/validation data and diagrams of participant responses

Past: behaviours and experiences,

Analysis of student responses with regard to subject specific concepts indicates a ratio of 0.65:0.20:0.15 biology:physics:chemistry. Students are able to recall predominantly hands on experiences in the area of biology. Comments of students during 1:1 and 1:2 interviews are validated by comments that emerged from the focus group discussions. Student comments regarding a current shortfall in experiments in physics, and in particular chemistry is significant. Both of these fields of science learning have the potential for serious researcher-co-researcher learning pedagogies which apparently have experienced under development. Whilst most of the biology experiments relate to biological modelling, student comments would indicate a greater student identity with hands on investigations with these activities portrayed as experiments:

Q2 (focus group) Steve: Recently in the biology class our experiments are more basically to discover what kind of stuff genetics, maybe like DNA coding is so it’s fairly small stuff. For example, we’re using a strip of paper and paperclips to simulate the genetic code with the different bases, the four of them and just to figure out what assets that would make and how it would form an organism and in the past, Chemistry we were mainly doing theory work this year and in Physics we did some experiments like Moses mentioned with crash test dummies in small carts and wooden planks etc."

Students make references to ‘stuff’, they are able to comment on what they are and have been doing which provides evidence for a high level of engagement. James, a member of the focus group and a student with good communication skills and a positive outlook comments:

Q1 James “Ah we’re working on inheritance like genes, DNA an’ chromozones and that’s about it. Um we are learning about Chemistry we are mainly memorizing things – you know all the putting the um the elements together and all that kind of stuff. It’s mainly memorization of ions and that kind of stuff.”

With regard to their best lesson so far this year students most commonly comment on concepts in relation to biology and chemistry. The breadth and scope of these comments outweigh those re. Physics. Mapping of comments in terms of items mentioned in relation to each science discipline produced a correlation of 21:20:6 (B:C:P). This observation may be a consequence of the student sample which had experienced physics much earlier in the year and so was not a topic of recent experience.

Students remember a limited diversity of experiments from each of the three sciences however chemistry due to its sparcity of opportunity to engage in experiments fails to generate a lasting memorable experiment for most students. Steve in the focus group once again provides valuable student insight and perception to this phenomenon within which most students experienced memorable moments of interest in their experiments:

Steve: “Okay. Well, that’s a bit of a competition between two in Biology and Physics. One in Biology where we got to chop up a sheep’s brain which is always fun, chopping brains up and then the other one being Physics where our basic idea was to run a cart down a ramp but my group decided it was a
bit boring so Chad and myself and two other students decided to use a bicycle on the basketball court instead to see how quickly we could stop. Yeah, that was kind of fun except when the brakes failed. Always good to have!”

Student J “Right Umm….The Physics one I think where we had to do the speed test where we got this trolley thing and we went on a ramp and like measured its speed and the time and that was pretty interesting

Student K “Umm mine was definitely the dissecting of the kidneys and the brain in Human Bio. It was really fun... It was more hands on – I mean, I’d rather that kind of stuff than Math so I thought that was more fun”

Student M “Erm, I don’t really have a best lesson ‘cos all lessons are equally good and they teach you different things and erm (I’m) pretty interested in chemistry so far but physics, which was the first sort of area that we worked on was quite interesting ‘cos I like how gravity works and em,..., how like the wind is affected and stuff like that and different slopes and stuff like that... Well we learned about inertia which was where we would have like a small replica of a car and a dummy inside it and roll it down into a barricade and when the car hit the barricade we would see how, if the dummy flew out of the car or if it er stayed in the car or slightly shifted and see how far it went.”

The student found this interesting ...

“Because it erm involved , I like the practical things more instead, of like doing the experiments, instead of doing the written work cos its kinda hard for me to read and pay attention to text books and things  ‘like that so I’ve found the physical, more interactive things better for me.”

Ann, an intrinsically interested science student further adds:

Q3(FOCUS GROUP)Ann: “’ My favourite lesson for Physics - it would have to be all the different experiments we did, and for Biology it would be dissecting the lamb brain and for Chemistry, it’s just in general I really enjoy what we’re doing at the moment because it’s generally interesting to me and my teacher is very cooperative and explains to us really well what we are doing and I can understand what we are doing really well.”

Past: Feelings and emotions: What are the best coolest/sickest sorts of lessons for joining in with, what gets you involved?
Finding out what sort of lessons have lead students to decide and what the factors have been that facilitated students experiencing an emotion to choose to become engaged are of interest.
Conversation within the focus group provides valuable insight to circumstances that students have experienced that lead them to get involved:

Steve: “Full on practical testing of like what we know, for example Chemistry.  I do know that previously at the school they literally made small explosives which is always keeping students interested I assume, like touch powders apparently – they made one of those; yeah, just really practical stuff. They can get people hands-on doing their thing like making things, testing things, seeing how things react with other things; basically really practical stuff.”

Chad: “Well basically if we just spend every lesson reading from text books and doing questions, it just really doesn’t get us involved but if we do experiments every now and again for a couple of weeks maybe or just like really getting in depth rather than just doing questions but actually like discussing
a bit or rather than just taking notes or just taking questions just apart from that. I still reckon its okay to do some questions but not just that - just mixed up a bit.

Kim: Yeah I would agree. The more experiments that you actually get to explain what’s happening instead of like diagrams and stuff; actually looking at and being able to touch without the notes and stuff because most people don’t go back and read their notes so they’re just writing it down for nothing.

Ashlee: Yeah, like what they’ve said. If you’re shown how something works you learn easier because you can understand it I guess.

Moses: My favourite lesson would probably have to be with a teacher with a car and drive it into a brick wall and see what the reaction is.

Steve: Seatbelt testing.

Moses: ...More practical stuff. More experience like we do quite a bit of experimenting but then we always have to refer back to the theory. The theory sometimes does get more complicated if you don’t do the practical side of it and so then it also gets boring and people just lose interest.

Ann: “For me I think everybody learns differently and for me, written work is the best because if I write something over and over again I just memorise it and also verbal communication like if my teacher actually talks to me and explains to me how something works I can understand it better. Experiments are also good sometimes but sometimes it gets a bit out of hand and you’re just doing it for the fun of doing it and you’re not really focused on what you’re doing and getting the entire class involved as a whole and explaining and asking other people’s opinions and ideas on different things and yeah, just talking about stuff really.”

Students report enjoyment with fun experiments that incorporate something you can’t do at home, something exciting perhaps? Discussions have also provided opportunity for nurturing intrinsic and extrinsic interests and motivation. Students have felt encouraged to make the decision to try and look for more:
S: Ones that I can relate to where it’s on a subject that I suppose, yeah, I can relate to. It might have had some significance in my life but that’s just by chance. The teacher can’t really construct a lesson to do with that but just fun things always get me interested? ... In Biology when we were talking about diseases and when we were talking about Motor Neurons because we did an assignment on different diseases like Motor Neuron disease and one of my friend’s mum had Motor Neurons disease and she died from it so I thought it was interesting to learn about it and also was relevant to my life.”

Knowledge – PAST- How have you found science this year? Pp 27-31

Students at Robin Hoods’ Bay school have found science to be an enjoyable learning experience. For some physics was not quite as good however students report doing a lot of work. Students report that the science experience has been good. Opportunities to socialise, to seek challenges, may have contributed to the perspective that science has been the best subject, to some, this year. The content has been more detailed, science is one of their better times in school and emotional satisfaction may be perceived through them feeling they may have learned more during the year.

C”I think um most of it’s been pretty good like most of it’s been pretty enjoyable in the things that we do apart from the Physics part of it but um yeah I think other that that it’s been pretty good like I’ve enjoyed most of it, yeah sometimes it’s a bit boring but you know you get that with any subject I think and yeah I’ve been happy with it this year it’s been pretty good

D ”Yeah I have to agree Science is definitely the best subject this year and I think because you wanna be there you do well in class so and I think that the people around you also make a good atmosphere to be around and it helps you to get on with your work and really think things through and so yeah”

The lessons in year ten science are recognised by some students as having been more detailed and globally relevant and pertinent to their current and future lives:

M “Erm, I’ve found year 10 science very important. It’s further helped me understand what’s going on in the world and why things happen and it would also help too for future thinking, like what will happen after such and such and the reaction of these things. Erm... I also think it’s very important for jobs that might not seem to have anything to do with science at all like erm...Well, usually in the previous years of science we would focus on one topic or some similar topic to the main topic. This year we’ve been divided into three classes, we’ve been divided into physics, biology and chemistry. Physics was mainly about gravity and power that worked and inertia and stuff like that and why things would always move downwards or towards the earth or how certain objects with increased density of mass would create gravitational pulls so other planets or the sun....In biology we mostly learn about like diseases and erm mutations and stuff like that and how, what, are the ethical complications of mapping out the genetic code. In chemistry we were learning about erm formulas of atoms and materials and erm how combinations of these can cause reactions or how they can cause the creation of new material.”

Present Opinions and Values:
When students are asked what they think science is about they provide a valuable and well set insight to the importance’s of science learning. Students have a clear appreciation of its value and necessity to
the socially, cultural and political whole-communities’ current and future needs. They have an appreciation of the relevance of science to their current and future lives.

M “I think science is about discovering new ways to do things and find out how things work and why things happen and what certain events would cause something else to happen and more and more things are being discovered as science is being developed,... so yeah...”

Steve: “Basically to me, Science is just seeing how things work, like how the world works, like the reasons behind things and what the actual story is. Why does this happen or why does something else happen? Why do apples fall out of the tree and hit the ground instead of just hovering in mid-air. Basically trying to find the reasons for things and explaining them.”

Ann: “Science to me is probably one of the most important subjects after Maths that is. I think it’s just like the basis of human life. Like if we didn’t have Science everything would just be messed up and it’s like conducting research and hypotheses about certain things and how they work and how they came to be and just humans trying to make sense of what we have and how we can use resources best to our advantage and stuff.”
Emerging diagram re. What students think science is about?

**Chemistry:**
- How chemicals are formed;
- Finding what stuff is made from;
- The way things react; Where things come from and how they

**Experiments**
The nitty gritty of processes and

**Biological:**
- How your body works;
- Humans and plants;
- Learning how things evolved around us

**Local, Global, Social, Cultural & Political.**
- Different aspects of everything; Finding something you don’t know;
- Going into more depth about stuff; Trying to figure it out; Making it better in the future, Trying to improve what you’ve got

**Physics:**
- The study of understanding how things work in the world;
- How objects respond to things;
- Where things come from and how they are made.

**It can be involved with maths**

What are the reasons for teaching science in schools?

Students indicate a comprehensive appreciation of the values of science learning personally, locally and globally. There is an acknowledgement of its need for the furtherance of their personal, social and
cultural knowledge. Students recognise personal physical and health benefits and are able to relate these truisms to social and political paradigms that are present in their lives. Student “S” has a clear appreciation of the importance of science literacy and scientific literacy perspectives when he says:

S: “(Science) To educate children to make them grow up to be possible scientists and help discover new things and just do Science and learn about it and just passing down information that is already known for helping learning and stuff... It could be useful for economics in that it could teach people to grow up in the science line and have jobs there which will be a part of the society that’s important for a running country and it will just keep everything good.”

Understanding the world in which they live and the importance of raising local, national and global community awareness to environment issues indicates recognition of the importance of science learning to their current and future lives. Understanding the world about them, how things work and career relationships concrete further an understanding of students’ construction of their recognised need for understanding and receiving further science knowledge from the school classroom. Steve provides a voice that facilitates a recognition of student opinion regarding the pervasive qualities of science learning and science education when he says:

Steve: The reason for teaching Science in school I reckon is because probably, although all the other subjects are really important, you can find Science hiding inside every single one of them. I mean like in English and SOSE and even Geography, that’s Science basically. It’s another version of Science and Science can be found anywhere so it really helps if the students actually know what it is and where to find it and how to use it to their advantage.”

Student perspectives regarding the reasons for teaching science in schools is pulled together by Ann when she thoughtfully makes the comment:

Ann: Because it’s necessary to whom we are as people. Like it’s improving our life better and better. Even technology now, it is improving our life a lot more. Like even this recording thingy (points at digital Dictaphone), we wouldn’t be able to do this if we didn’t have Science and it’s improving our life a lot more. Even machines in hospitals and stuff, it’s improving our health and some technology isn’t good, like some technology we have is really good like computers and other stuff that helps benefit humans and stuff but some of it doesn’t. Yeah, even basic science and stuff that they teach at school like Chemistry and stuff to teach you what’s poisonous or something or like even Physics.”

What do teachers do to make the lesson interesting? Student’s present experience allows them to voice an understanding of the lessons that they find interesting enough to desire to want to choose to engage in the activity. There is student recognition of moments when they want to “tune in” to the lesson as a consequence of the teachers’ personal enthusiasm.

When students feel a part of the learning process they are empowered to learn and perhaps recognise themselves as active society members which enhances and leads to further community capacity building both within and without the classroom. Students become active community learners; they enjoy the lesson and recognise for themselves that they are learning science.

J “I enjoy the experiments because when em, you’re actually part, your actually a part of something you are actually doing it makes me remember the lesson more”
Students are able to recognise teacher qualities and skills that generate an effective learning environment. Students make informed decisions to choose to engage with the science learning program, an emotional desire to want to join in develops as the teacher constructs a micro culture of tiered, fun learning experiences.

S: “(teachers) Construct a good lesson and try to make it interacting and something that the students can relate to and try and make it educational as well as fun so that the students enjoy doing it and therefore they want to learn and want to do the Science test and experiment, yeah ... one time in Science we were studying, I think it was Biology and Marine Biology and we just did some work and then watched a movie on sharks which was really interesting so it was like combining two different things. Probably a better example which I’ve just thought of would be when we were studying, I can’t remember the exact subject name but it was to do with rockets and we just studied the rockets and what made them fly – atoms and heat and stuff and then we did an experiment which was fun because we built a rocket and then I can’t exactly remember how we did it but we made it fly and that was fun, yeah.”

Students’ tiered interests are stimulated by a variety of strategies. The teacher operating enthusiastically by asking questions, encouraging, putting concepts into real world contexts and bringing students into a position where they want to “tune in” form part of an environment within which students choose to engage.

A “Generally asking people questions and putting it into examples is quite good. Putting enthusiasm into what they’re saying to make it look like they’re enjoying what they’re saying, em... makes you feel like it must be good or something like that em generally that, how they say it, put it across is what makes it interesting cos you want to tune in.”

Learning in groups really works, the use of flash cards, diagrams, interactive computer software and enjoyable activities relevant to their lives stimulate engagement and lead to learning:

C “...I think like I said before with the flash cards – I think was really good - that helped us a lot and letting us – like – my teacher let us learn in groups, we we were able to learn together and that really worked.”

Discussions that lead to activities that are relevant to everyday life nurtures and encourages interest in science learning.

I “I think that like when they try to engage us, provide us with an activity when it is quite relevant to our everyday life therefore we can find it interesting. Whereas when they talk about things that we don’t really relate to it its quite boring when it’s like that.”

D” Also starting discussions, like class discussions with everyone kinda stimulates your ideas and you get thinking a lot more and you are a lot more interested when everyone has something to contribute so”,

Students recognise the importance of lessons that are interactive, fun; provide opportunity to do things such as experiments that have a point to them and those that lead to learning.

F “ For me personally I find that experiments, more hands on kinda thing is a more interactive lesson, like before when I was back at [previous HS] the teacher always made us do notes and questions out of the book and you just couldn’t get into it, there was no fun in it. Well, when I came
here at least we’ve been able to have chances to do things like that, but then we could also still do the work from the books to learn about it.”

G “ umm... yeah, experiments are the best way to learn I think ‘cos that way you can actually remember what you’re supposed to be doing or what the point of it is, yeah.”

Teachers who provide a diet of experiences that invoke curiosity, are interactive and related to students lives catalyse a situation of curiosity where students choose to learn.

S: (they)Construct a good lesson and try to make it interacting and something that the students can relate to and try and make it educational as well as fun so that the students enjoy doing it and therefore they want to learn and want to do the Science test and experiment, yeah.

M “Well when we did the experiment with the cars, as soon as you see the cars people are into it, and crashing a car into a barricade that would get most people interested and they would really want to do that and they’d try to set it up to see if it would go as far as possible. And also if you asked a question and they (students?) find that interesting they would, they might, invoke their curiosity so, and curiosity is usually what drives people to learn more.”

What in your opinion makes the best sort of science lessons?

Students arriving at the school science classroom enter with different tiers of interest in science. M is a student with a clear personal perspective that the best sort of science lesson is a relational one:

M “I think when everyone works together as a team, erm, and it’s something that everyone enjoys, there’s no one left out, everyone has an equal part in working together and although that’s kinda hard to do cos everyone has their own thoughts and opinions of science of that sort of certain topic, they might have other preferences they want to do, there might be other distractions stopping them from doing this so it might be difficult to do that, but I still think that would be the best lesson where everyone worked together, there’s no ‘differentiation’ between different people and stuff like that, they all just got their heads down to work together, find out something.”

Other students identify more with lessons that reflect reward and satisfaction through experiments and by getting a lot of work done:

A “Science lessons, I think, having a lot of er work so getting a lot done but then er like also being able to do a quick experiment or something or er something practical and at the end if you’ve finished your work you can have a bit of a talk at the end...”

Student voice with regard to the best sort of science lesson highlights four fields for consideration:

1. **The Lesson.** The best lessons are exciting and interesting and incorporate some sort of experiment. Personal reward and achievement also comes from having a lot of work to do and getting it done in the lesson. More hands on stuff can be exciting and leads to interest. Doing a quick experiment, learning by doing help to confirm what is going on in the lesson; no time wasting in the lesson.

2. **The Teacher.** Students respond to an enthusiastic and knowledgeable teacher. Feeding intrinsic interests and nurturing extrinsic interests concrete student understandings of what is going on in the lesson. Teachers who seek to engage students ask questions, seek students’ understanding, go through and explain the work and confirm what the experiments are about.
3. **The Students.** Peer group work, class participation and opportunity to socialise lead to enjoyment. Team work on something they all enjoy contributes to the recognition of the best sort of science lesson.

4. **The Relational Classroom.** Students like the idea of working together. They also like to know they have a teacher that they can see as knowledgeable

**PRESENT: How do you think joining in with the lesson affects you/others?**

Student perspective on how participation in the lesson has an effect on students choosing to engage in science learning. The present program and pedagogy currently experienced by the cohort is investigated. Students report that their participation facilitates other people knowing “what you are thinking” and as a listener/participant you in return get to hear what other people are thinking. A moment is provided for involvement and opportunity to test “own knowledge” and to see if “you are getting it right”.

A “Well if you get involved and other people can see what you’re thinking and all the different possibilities of what em... what’s in the class and what other people are thinking the different things like that and if you get involved you could put your knowledge to the test and em... make sure that you’re getting it right, you’re not saying, you’re not writing down something that’s wrong, it’s an easy way to check what you are doing. So, if the teacher asks you a question and she goes ‘Well that’s not quite right you need to do this’ and you go ‘OK’ and when you write it down you know that you’ve got it right. And that’s the same with other people, they might think that they’re on the right track and then you ask the same question and er... they’re slightly wrong and they can change the answer as well. So em yeah, that way not everyone has to ask the same question if she/he goes round (the class).”

Seeking a common reward and getting the ‘work ‘done facilitate the student recognising a positive consequence and feels rewarded. Students are able to recognise that this can be achieved by asking questions that everyone gets to hear realising they may not be thinking alone. When the teacher replies everyone gets to hear the answer and has the opportunity to personally check the answer as they construct their own understanding.

Students are also aware of the causes of frustrations that emerge as a consequence of students currently not paying attention. Inhibition of learning, loss of teacher time from those who want to learn and honest recognition that the ‘distracting’ student becomes disadvantaged also! Students do not want to be behind!

C”Like if you don’t pay attention then you know later on it’s gonna back fire and you’ll have to do all the extra study and know it all without like if your class is at somewhere else and you’re behind it takes a bit to catch up and yeah like it can drag other people down as well you know, if you’re distracting other people down as well you know if you’re distracting other people they don’t want to be behind as well.”

Student interactions leads to them electing to choose to participate; there is awareness that non-participation brings consequences to themselves and others:
D “I think it depends….if everyone in the class is working, and everyone’s involved and everyone’s doing it – it only takes one person to start a distraction so I think it depends on the person because they might feel like ‘Ooh they better pull themselves in because otherwise they’re gonna get in trouble’ but if they feel that they can distract someone else to start doing it then they can get everyone involved and it’s not just them anymore so I think it just depends on the person”.

Student observations of peer group behaviours is leading to them make conscious decisions affecting their choice to participate or not to participate. They voice an awareness of the current effects of everyone, including themselves, joining in with the lesson. Students are recognising their personal needs for learning and the needs of others in the class. Students acknowledge they themselves and other students in the room have different interests and aspirations. An initiation of extrinsic interest is leading to an emotion of motivation for engagement.

I “I think that it (joining in with the lesson)... has a huge effect, like when I join with the lesson, like I kinda expect everyone else to join in as well, which makes the lesson really interesting, and em, when other people join in I feel like I also want to join in, yeah”.

G ‘Yeah, em... gets you more engaged so you learn more, you retain information, depending on what it is it can spark an interest, that’s me ‘cos I like the sciences so but then if you don’t, if it’s just not for you it could just put you completely off it, like dissecting the brain for example, some people enjoyed it, I did, some people didn’t ‘cos yeah some people just don’t like blood and all that sort of stuff.”

Further to recognition of personal learning needs and the needs of others students currently demonstrate an awareness of their learning environment, the presence of group conformity, lack of it and resulting consequences.

J “Um it gets quite frustrating when like others in your group or in the class don’t join in and say like oh I’m not gonna do this – this is boring and then your left all the work from the other people to do and then they think well why should I be doing it when others aren’t? And then they just give up and then the class or what we are learning about just doesn’t become interesting and there’s no point in learning it

2nd “Yeah like for me it’s like everybody has different opinions on what they like and what they dislike if you like something like if you like all the hands on work and your into it but somebody in your group might not like it and they might you know sit out and not want to do it and all that kind of stuff it really gets annoying because they’ve got their role to play just as much as you do and it’s the same for the bookwork you know if you’re getting ready to do the bookwork but you don’t like that and you want to sit out and not do it well all those people that do you are letting them down at the same time I mean you might feel that I don’t like this, I don’t want to do it but somebody else in your group might want to it and you’ve gotta sort of think about them as well you can’t just think you know it’s all me you’ve gotta do it”.

Pedagogical issues recognised by students that lead to everybody joining in are voiced by students to be:

- More freedom
- Some lee-way to learn
- A more lenient approach to teaching
- Avoid being so strict.
- Allow freedom for alternative avenues of interest
- Permit experiments in your mind.

2nd " More freedom I think – I mean a teacher might give you an instruction and you have to follow that to the letter and if you go the slightest bit off you are instantly in trouble- you gotta have some leeway – you know what I mean? like its gotta be a little bit more lenient it can’t be so strict I mean if your given an assignment or you're given an experiment you are gonna want to do that and if you’ve got something put in front of you might want to do something else with it you don’t want to do what you’re supposed to and all that kind of stuff so you want to do something else you don’t want to have to do it the way that you’re told you want to experiment yourself; it’s not the experiments in the book it’s just experiments in your mind as well

The teacher should go into the class with an attitude that the students might have. Perhaps the teacher needs to engage with the class and not the other way around:

J ”Ah, I think a teacher has to go into the class with an attitude that someone like us would have like dry ice yeah your gonna want to blow something up or something like something silly but that’s probably a bit ridiculous – a bit extreme but going in with an attitude like can I engage with the class a bit more and then like you’d be able to have the whole class join in and all have a bit of a laugh and just really enjoy the lesson”.

Students are currently aware that joining in is the right thing to do. It contributes in helping others and influences others to join in. Students are recognising the value of the effect of themselves on others with regard to learning as well as the impact of choosing to engage in the lesson:

S: “Joining in on it affects me personally with my learning which will then help me just all round with my education and also keep me in the school behaviour-wise because joining in is the right thing to do to contribute to the lesson or activity and joining in helps others or influences others into whether they choose to do work and join in themselves because they might see me not joining in and then think that it’s okay for them not to. Then you end up having no students doing any work or if I did join in then it could be encouraging for other people who don’t feel like joining in to join in and just do the work and yeah, that’s it”.

The relationship between them, effects of others and choosing to engage is strongly validated by the focus group discussions:

Steve: “ It really depends on how much I know them, like if they’re close friends of mine then maybe they will get involved or if they need help with it or if I’m involved in it I can help them out with it and then they would get involved too. If people around me are working I tend to find it a bit easier to work because then I’m not as distracted.”

Chad: ” Yeah basically I suppose you’re not distracted by other people talking and another thing is, if you’ve got a friend you usually talk to and if you are really getting focused then you don’t really talk to them much during class and he will probably think I’d better stop talking and I’d better get this done. So it could be peer pressure like most people like to and you don’t and naturally just want to”
Kim: “Pretty much if the rest of the class is interested, then you tend to be interested with them but often they’re not really into what has been discussed in class then you’re not going to feel that you should be in the class discussion; you shouldn’t be interacting with what’s going on.”

Moses: ” I would be interested if the teacher explains it pretty easily to me so then I can understand it so the rest of the class can pretty much communicate it but if it’s a really complex question and it’s like this really, really clever person answers it and they are like yeah, yeah, yeah, yeah, I don’t really understand what they are saying. Well, I probably would also get involved with it because it should be interesting if my friends are interested in it. Such friends should have the same interests. If I’m interested in it then they would probably be interested in it.

Ann: Somebody else in the class says something that I don’t know about then I would be interested in what they had to say; something I don’t know or if I said something that they don’t know about then they would want to get interested and want to start getting into the discussion and talking about things more.”

During the course of their school day students are required to organise themselves and be ready to move to their lessons and experience a variety of learning phenomena. On their journeys between lessons it was considered worthy to investigate what goes through a student’s mind when they know they have a science lesson to go to. Students at Bay View School are generally sociable, friendly and cooperative and on the whole approach this responsibility in a sensible and responsible manner. Whilst some students arrive late for their lesson most are on time and for most of the times arrive to their lesson where a teacher waits to greet them. Student voice has highlighted connections between emotions, teacher relationships enjoyment and group work with students’ thoughts that they have as they make their way to the science lesson. When asked this question the role and qualities of the teacher begin to emerge:

J”Oh it depends what science really...Oh some sciences you think – ‘oh no we’ve got that teacher’, like they can really throw the lesson out completely and then other sciences you go ‘oh we’re doing this today and we’ve got that teacher and they are really nice’, and it really depends on the teacher”

2nd “Yeah I agree it’s not so much the science it can really be the teacher. I mean, any science can be fun depending on what you’re doing like if the teacher’s like, I don’t mean to be rude but if the teacher is quite boring then you don’t want to go to that teacher so if you’ve had a busy day and all of a sudden you’ve got that teacher yeah and you really don’t want to have to put up with them you just want to leave you don’t want that. So it’s not so much science I mean like science all the way round it just depends on what type of teacher you have.”

Students also comment that at the moment they enjoy science which may highlight an attitude to choose to engage:

A “Er..., I quite enjoy science, I love going to science... positive feeling towards science.”

C”I quite enjoy my science lessons – you know some classes your just like oh great I don’t want to go but I think I enjoy my science lessons because you know our teacher’s really good and there is good people in there and we all get along and yeah.. I think I might look forward to it a bit...yeah

D”Science lessons are my favourite lessons so I actually really enjoy Science and I think it makes a good class when everyone tries to work together and everyone else wants to be there and wants to learn so Science is definitely one of my favourite subjects.
Emerging diagram bringing together some of the connections between emotions, teacher qualities, relationships, group work and engagement:

Emotions of connectedness and enjoyment are demonstrated through comments about love, like, ‘look forward to’, want to be there, fun and stimulating; these may be a necessary precursor to wanting to engage. Such engagement nurtures an emergence of enjoyment where students are currently identifying their science lessons as ‘favourites’, good class experiments, quality of teacher, fun and stimulating. Teachers, who according to student perceptions are good, really nice, not boring, provide experiments and who are fun are identified. Students are describing an experience of and for a relational classroom that incorporates ‘good people’, people who get along well, working together. Cognition is challenged and thought is stimulated leading to creativity, engagement. Students are choosing to engage in this environment, their tiers of interest are satisfied.
Engagement in Science learning filter:

M “When I have a science lesson I always think that erm..., ‘cos science lessons are usually the most erm practical ones with the experiments, where maths, SOSE and English don’t usually have as much physical work, its’ (in maths... etc.) more writing and listening and text and stuff like that, I think it’s (science)more, it encourages more thought than most lessons instead of just writing, copying from another book, it encourages creativity and stuff like that which, I really like being creative and stuff so I reckon it’s... pretty good one, people get into the lesson.... sort of forgetting what the question was...?”
What is the least interesting sort of science lesson?

The student’s in year ten at Bay School were asked to consider in their opinion what currently are the least interesting sort of science lessons. In relation to student interest and choosing to engage four fields of awareness emerged:

1. Teacher quality
2. Personal Satisfaction
3. Gender Interests
4. Lessons

Student perceptions re. Choosing to engage:

In these classroom environments students choose to disengage; the lessons do not engage with student expectations and may challenge intrinsic interest. Activities may not be extrinsically interesting.
Intrinsic motivation is nullified and is incorporated with minimal extrinsic motivation. Extrinsic interest and motivation to choose to engage comes as a consequence of teacher ‘quality’, making the lesson exciting, fun, interesting, and participatory and hands on contribute to motivating students to choose to engage. The voices of several students contribute to and validate each other:

F “‘This wasn’t any interest’, like with the lessons with Mr. M, like since we don’t like the way, how he teaches it seems it was almost like you could fall asleep sort of in the lessons, there was no many things to do, there was a couple of, like as I said, experiments things that we did but weren’t exactly exciting... she(Mrs X) seems, it’s like, she like helps us actually learn what the thing is, like she has little ways to remember things as well and that really helps to remember things.”

G “There’s humour, there has to have humour, otherwise it’s just not......”

J “Oh when you go into a lesson and you are told to open your text book and teacher goes right read 193 to 197 and then write down key ideas and then they sit down and they just say ‘oh no talking’ or ‘silence’ like you can’t even put your hand up to ask a question like just yeah.

2nd” Yeah definitely. Yeah I really agree with that one it’s the words that you don’t want to hear when you walk into the room is ‘open up your text book to such and such page answer the questions on this page’ and then you’ve got more questions for homework and if you don’t get them finished on this time then it’s you know, not so good but yeah definitely the book work is my least favourite type of lesson. You walk in there and it’s all book work, it’s all copying from one book into another and memorising it and all that kind of stuff - it’s really quite boring.

M “Usually when you have a large amount of text that have to be read and copied out or where there’s a lot of writing involved or things that can be quite repetitive. Cos if you’re writing out things sometimes you have to repeat yourself and stuff like that. And it’s also not as good as when people don’t join in or you have a person in the group that’s letting everyone down and erm they’re just causing problems for the rest of the, the rest of the other people and I don’t like it when that happens (interviewer nods in acknowledgement)...yeah.”

The least interesting lessons lack experiments and hands on activities. “Open your text books” approaches to the start of a lesson are quite boring for some students.
**Things students don’t like so much about science lessons?**

Continuing with their current experience students were asked to consider the things they don’t like so much about science lessons. Recurring themes emerged, once again in relation to teacher type, access to experiments, science theory and gender specificity:

During focus group discussions student’s perspectives about what they dislike are validated and clearly put across. The discussion flowed freely and students voiced a perception identified in diagram above:
Chad: I reckon those days when the teachers just really (26.59) to death and don’t discuss it and at the same time sometimes the teachers seem to discuss it too much and we just tune out and aren’t remembering any of it but if we discussed it and get it in depth and don’t speak about it for too long, we’d learn a lot better. Yeah I just don’t like those days when we just don’t go in depth.

Kim: The days that we just do note-taking and don’t discuss it. It’s just on the board and copy it into your workbook and that’s it. There’s no discussion or anything so you don’t really get to get your head around what’s been put on the board because no-one explains anything.

Ashlee: Yeah, I agree with what Kim said because you’re not actually going into depth about what you’ve learnt. It’s just on the board and you’re copying it down and you haven’t really gone over it at all and if you go over it later but you might not understand certain things. (Time constraints?? Are teachers under too much pressure to get through the program??)

Moses: The note-taking is boring if you get a task to do like five or six questions which is boring to do and when you do it afterwards you do the experiments and then (28.26) after that and then you do the questions again. (28.29) so it’s not really so much (28.34).

It is important to identify that some students, while agreeing with many of these comments do however have a strong alternative point of view, one that does not emerge frequently at Robin Hoods’ bay School but must be noted. Ann is a well motivated student; articulate and placed in the higher academic portion of the year ten cohort, she shares an awareness of issues regarding interest and engagement but her goals and aspirations may be the reward governing her intrinsic and extrinsic interests and motivation to engage in the science classroom:

Ann: I agree ...how we’re learning about one thing one day and then the next day we are just rushing on with something else. I think it’s hard because we have to memorise stuff all the time. I think we should focus more on memorising. It is boring and stuff but I don’t think that school is meant to be particularly fun like we are here to work. We’re not really here to have fun and I think we should just spend more time on memorising stuff and writing it out and doing whatever helps us memorise. (What in the minds of the students is the purpose of science learning in this situation?)

The first 10-15 minutes of the lesson, what would be seen to be happening?

Robin Hoods’ Bay school, not unlike many other schools of its type endeavours to maintain a neo conservative routine organisation and management structure. Students are expected to move from class to class quickly, quietly and prepared for their next lesson. The arrangement of the school timetable facilitates this with most lessons occupying double periods coinciding class changeovers with natural breaks in the day i.e. morning recess and lunch. Students are expected to arrive on time for their lessons and to line up quietly in lines outside the classroom where it is anticipated the teacher will be waiting to greet them. Upon entering the classroom students in the senior school are required to stand quietly behind their desks, be greeted by the teacher and asked to sit down. At this point the teacher commences the lesson. Teachers are required to submit comprehensive learning programs early in the year that are mindful of group and individual student needs. It is at the point of lesson commencement that this researcher is interested in the students’ perceptions of what takes place in the first fifteen minutes of the lesson.
As might be expected the student voice draws focus to themselves, other students and the teacher. Some students arrive to the lesson intrinsically motivated to participate in the lesson, they are choosing to engage in the lesson:

S: I’d sit down and put my books and pencil case down and depending if other students are talking or not, I will talk to other students but if everybody is quiet, then I will just stay quiet because I wouldn’t really talk to anybody because I know they wouldn’t talk back to me if they are already quiet and depending on what the teacher would be doing, if they made me do work then I would just do my work or if they were explaining something, I would most times try to understand it and listen really carefully, most of the time”.

Student A, D and C provide some insight to the start of some lessons:

A “Em... everyone walks in, most people stand behind their desks, em, get greeted by the teacher; for the first 5 minutes everyone is fairly looking or paying attention, but, especially if it’s something that everyone is interested in or just re-capping last lesson, em people start to talk amongst themselves, pass notes, that kind of thing. Yeah, then after that when the work is set, em...you’ve got a clear division of people who are working and who are not working. Generally the people who are not working don’t disturb the people who are, so em it’s alright and em yeah, most of the teachers try to keep, it’s hard to control completely, but they keep a lid on it so it doesn’t disturb anybody else and em tries to keep the people and get them working.”

D”Well in my class everyone walks in and we stand behind our chairs and sometimes it can be a bit noisy but most of the time we’re not that noisy and we say good morning to the teacher and we pretty much get straight into it ah straight into the lesson of the day or or we start off with a discussion or something that gets us interested within the first 10 minutes something that will grab our attention and maybe just letting us know what we are doing in the lesson so we can look forward to maybe an experiment or whatever that within the lesson  so...

C”In my class there would be a bit more noise and a bit more late comers and ...and you know we all drag in and then stand behind our desks; most of probably just sit down straight away and then the teacher would greet us and then she would probably tell us what we have to get on with and then she would write it on the board or just explain it to us and we would just get on with it”.

Students see themselves as walking in, finding seats, looking and paying attention with some general talking. Some students work while others don’t. Copying from the board happens, students arrive late, some lessons are too relaxed and some classrooms are rowdy. The classroom can be a bit noisy; generally student voice highlights the classes are not noisy. Students are engaging in class discussions with anticipations of interesting experiments. Students comment on distractions and indicate that they focus a lot quicker when an experiment is involved:

M “Erm, usually, and it’s the first 10-15 minutes it takes quite a while for them all to settle down and get their focus up to attention and usually it’s the focus rate or the male focus in the class is that it makes during the middle of the class and then so it’s a what were up????….. again towards the end and I think it could take the teacher quite a lot of effort to get them to settle down and pay attention but it just usually happen they focus a lot quicker when it involves an experiment or something like that. So yeah...”
Students demonstrate an awareness of a relational classroom that can be affected by the differing qualities of the teachers. The quality of the teacher sets the tone and governs student expectations.

J”Yeah - I think they (students) come in too relaxed thinking the teacher is gonna be a pushover or really passive and they just think they can get away with anything…”

2nd “Yeah you definitely get a few people – you know the class clowns mucking around or you know, or you get a very relaxed classroom, everyone would walk in there hoping that the lesson was going to be a breeze – hoping that it would be over quite fast and you know, depending on who the teacher is you know if it is somebody quite strict like I don’t know if I can mention names but there is a teacher at the school that everybody knows that once you go into their class you make sure you have done your work – you make sure you have got no homework overdue and you know, you go in there and you go in there and you don’t talk and that kind of stuff you are quite you know, proper with them and then you’ve got some teachers who are a real lenient – you know you can get away with a little bit –more here and then you know you can do a little bit – you can go and sit wherever you want, you can go sit up the back you haven’t got any worries and all that kind of stuff yeah.”

When asked what do teachers currently do to reduce this ‘settling-time’ M continued to comment:

M “Well the teacher we currently have for science lessons she uses a wide variety of ways of doing that. She’ll erm, sometimes the class will settle down pretty quickly because she’s asking questions or she’ll present a task sheet that gets everyone to sort of get to it straight away or she gives a.... or if this is not done in the period that it’s given it becomes homework and people don’t want to do that to, because their personal time being used up. She’ll say, sometimes reverts to returns to like screeching and stuff like sort of yelling at the class or anything but we don’t mind that we all know it’s not the way for doing it but we know, we know she doesn’t mean half the threats so yeah.”

The patterns of performance of the teachers as described by this set of year 10 students include friendly greeting, recapping previous lessons, setting the class work, getting students working, keeping a ‘lid’ on it, capturing attention, writing on the board and explaining tasks. Students highlight that teachers use a variety of ways to engage students:

- Asking questions
- Presenting task sheets
- Threatening with homework
- Yelling and screeching.

Choosing to engage/disengage in the first ten to fifteen minutes by a student has dependency on the teacher, tiers of interest, threats and other motivational phenomena.

S: I think depending on the teacher, they would most times talk for a bit until they decide to do work and then the ones that just don’t feel like participating in whatever work we are doing then they will just not do any work but generally be sort of quiet still so they are not disrupting the class but still sometimes talk and distract people but if the teacher is like really strict and threatening for Steps or whatever or detentions, then they would generally just come in really, really quiet but then there’s like a downside to that because you get students that don’t want to do work but will still be quiet. They don’t want to learn and are not enjoying the class or the teacher although you might get students coming in quietly and not talking. They are not going to want to do any work. It’s hard to make a
student do work to the best of their ability if they don’t want to. They just do a little bit just to make the teacher happy.

Focus group discussions validate these observations. Both Steve and Chad provide a portrait of the classroom situation in the first fifteen minutes:

Steve: Well first, probably you’d see a couple of people lining up outside. We’d go in and it would take us about five minutes to actually quieten down. They (the teachers) are usually yelling for us to not talk and even then there would be some people that keep on talking and over the space of the 15 minutes you might get the odd latecomer or two or three but apart from that, after about 10 minutes you’ve probably got everybody settled down fairly well and the teacher will start explaining to us what we need to do on that particular day or what we are going to be doing or start teaching.

Chad: Pretty much the same. Usually the talking thing, what I find usually – we usually talk as we go in. Not too much. We don’t go nuts or anything and then we say “good morning” and we sit down. We talk a little bit whilst the teacher’s getting ready but at the same time, in general we’re not going nuts and then yeah, the teacher just starts explaining what we’re doing and we get started and then – Then usually when she starts explaining we usually start talking. I have to admit half the people will be talking about the kind of stuff that has nothing to do with it at all, what they’re doing at the weekend or what they’re going to do after school...

Students were further asked in regard to their current science lessons, what they personally would be doing in the first fifteen minutes of their lessons. Intrinsically motivated students are generally focused at the start of the lesson. The student follows teacher instructions, text books are open; there is reliance in some classrooms on the text book. It provides the start to the lesson, experiment instructions, aims and objectives and lists equipment and ways of recording data and other results. Students indicate that they are drawn to attention through the teachers’ start to the lesson and the use of ‘attention catchers’ such as demonstrations, work sheets and click view (an intranet on line video library resource) extensively used across the school. The quality of the teacher is influential in this period of time. Students demonstrate an awareness of what lessons gain most attention in this start-to-the-lesson period:

2nd “Ah for me a teacher has to be grabbing if they want to grab everyone’s attention they’ve gotta be appealing to everybody not just the one or two that sit up the front you know they are the quick people, they wanna learn and all that kinda stuff they might be appealing to them yet the teacher might be really you know, quite intelligent and wanna teach this way but the people up the back would just be sitting up the back and don’t wanna know anything – it’s too hard for them and they’ve gotta be appealing to everybody not just the people who sit up the front or sit up the back you know they’ve gotta be appealing to everybody they’ve gotta grab everyone’s attention but I’m not too sure how they are gonna do that I mean there is gonna be a few people that aren’t gonna be happy there’s always gonna be one or two people so...”

Whilst Robin Hoods’ Bay school endeavours to percolate an active learning culture students are making choices to engage. Their engagement in the science classroom is affected by their moods, interests, support of friends; they choose to ‘zone out’ irrespective of a community recognised learning environment. Focus group comments once again validate student perspective on this matter:
Chad: “Like me, pretty much everyone talks a little bit before we go in but like I said, we don’t go nuts. I usually find when I’m in a good mood I usually pay attention to what the teacher is saying but when I’m in a bad mood, I just completely zone out when I’m in that mood. I really shouldn’t but after I start listening I like to talk to my friends and ask them to help me or just share our knowledge really but doing our work.”

Ann: “It depends what type of mood I’m in. If it’s just a regular day I’ll do the work and chat a little bit but if I’m in a bad mood or something I’ll still do the work but I know some days if I feel just really lazy, I’ll just not do anything, just sit there and talk... (34.14) until I’m made to do something.”

Navigating through the investigation questions and participant responses reveals that student replies are connected by the thread of current student interest. Students were asked how if at all science was currently of interest to them. Their responses indicate that students find science interesting for its logic and the reward received as a consequence of solving ‘hard’ questions or problems. Where social relevance is recognised and personal and social relevance is appreciated students demonstrate intrinsic interest, they want to do more, seeking personal satisfaction and achievement. In an attempt to provide a portrait of student perspectives regarding emerging tiers of interest in science a collection of student responses are collated below as a continuous dialogue:

“...... It’s interesting, the logical side of it.... I enjoy science when I achieve, I know that I’ve done well, what I have learnt has benefited me... before I just love the idea of being able to know how everything works and being able to understand... and also it’s something you can use in everyday life. Something you can use no matter what so I find it particularly interesting... it’s interesting to know like all these chemical reactions and stuff is going on around you all at once. I find that really interesting your finding out how things work and you know when you find out it’s like, Wow I never knew that... like it opens your eyes to how these things work and it makes you realise how amazing the world really is and everything that was created how amazingly it fits together so... it makes me more interested ’cos I want to know how, what happens and how it affects things and that sort of stuff... it’s interesting ’cos yeah I don’t know why I just do. I tend to focus more in science than say than SOSE. I’m not a fan of SOSE and yeah... it’s interesting cause you can’t do some things at home... you’ve got the excitement of learning something new. You’ve just learned you know how to do something, you’ve just dissected something- you know you didn’t know that something was there; you know you’ve got the excitement of going home and telling your family too. I mean, you know, it’s all that kind of stuff.... I think people gain a lot of satisfaction with themselves for discovering something that nobody had thought of ’cos they’d think of themselves as like ’I’ve done what nobody else has done before so I must be quite creative!’, or something like that and I think that’s quite motivating...”

Steve, an articulate and academically able member of the focus group provides validation to these general observed responses:

Steve: “Science is always interesting because sometimes, even if you’re not looking for it, you see something happening and you think oh, how does that work and often like once you get up into higher years like Year 10 and 11, by then with all of the years in school you would have known at least a lot of the things we wondered when we were younger how they worked so there is always new stuff to discover in Science. It never ends because new discoveries are being made every day and then we need to be taught about them.”

Students recognise themselves as part of human culture that is readily looking for answers and trying to understand an interactive world, the world in which they live. An acceptance emerges where
science is recognised as an ongoing creation and the desire for human understanding and knowledge is a continuum:

Ann “I think as human beings we’re always trying to look for answers and we are always trying to learn more than we already know and I think Science just gives us the answer to that and Science can just help us expand our knowledge of what we already know or what we’re trying to find out which helps us improve our life and discover new possibilities and answers as to why things they are the way they are. I think it’s just really interesting because Science isn’t something that just stops. It’s always expanding like you can always learn new things about it. Yeah it’s really interesting”.

With regard to the present classroom situation what good things if any happen in the classroom that motivate year ten students to get involved was investigated. As might be expected the role and behaviour of the teacher feature prominently. Teacher relationships and teacher disposition impact on peer participation, fun and laughter. Students experience intrinsic and extrinsic motivation when there is a sense of happiness and “everybody else is getting involved.”

2nd “Um, for me to come into a class and want to listen and all that kinda stuff – if the teacher comes in and is all bubbly and happy and all that kinda stuff – they are not in a bad mood – they are not gonna tell you off – and you know, then you might actually have fun this lesson – you know like a bit of laughter and all that kind of stuff- I mean – if you have a laugh and all that kind of stuff – then everyone’s laughing with you not so much at you if you know what I mean ? People want to listen to what you’ve got to say.

There is an emotional connection with student motivation and consequences of teacher mood, teacher motivation and interest and teacher practice (pedagogy).

Ashlee: I feel motivated when the teacher is like really interested in something that they’re teaching. Yeah, it just sort of makes you want to learn more.

Students are affected by the teachers’ disposition. Students are identifying with the genuineness of the teacher; there is an emotional desire within the student for human connection in the classroom:

Chad: “I suppose just the teacher really trying to do the best for us, making everything as best as they can be and fair for us and treating us nicely but yeah, just like you know the lazy teachers they just read from the textbook by itself and just expect you to do these questions and when they give you notes, it’s just stuff from the textbook. I don’t like that. I like it when teachers really explain it rather than just going straight from the textbook really.”

J “Um, well we have said that we don’t like it when the teacher comes in and says “Oh, open your books and do these questions, but I like it when I come in and then we’re given what we need to do, there’s a little bit of like leniency towards like doing all of it but like when you can come in and you know what you have to do and you can just focus on that and like you are allowed to get help from the teachers and you can like – like the teachers communicate to you and it becomes really easy and more enjoyable.

Constantly doing bookwork deserves serious consideration as a demotivating factor in the learning-science classroom. Hands on activities and variety in the learning menu capture student attentions. When students are learning something new and something unexpected comes along both intrinsic and
extrinsic interest is stimulated. Experiments feature strongly as precursors to motivation to get involved in learning science.

A “Erm... good experiments I think, er (if there’s a good experiment and everybody thought it would go this way, (&) it goes the other way, (&), you’ve learned something new you go ‘Wow! That’s really good, erm didn’t expect that’; from just reading text books we never would have got that. So, erm.. stuff that’s an extra bonus to what you’ve already learned.”

Year ten students at Robin Hoods’ Bay school are further motivated by personal achievements and rewards. Rewards can be as simple as a class prize for finishing early, recognition of effort. Successful preparation for future schooling and career avenues feature as does the emotion of pleasing parents and peer group competition. Students currently demonstrate an aptitude to be able to recognise the relevance of science learning to their current and future lives. Personal interest and awareness of relevance lead to motivation. A composite of comments provides further support to the portrait of student motivation in the science classroom:

”...I think when the teacher offers a prize or something you know the kids really get involved and want to do it or.... I get motivated in Science just ’cause I love the subject so I think it just depends on the person but mostly for me it’s just being able to get new knowledge about how everything happens.”

”I think when the people around me are getting into it it will get me into it and if the teacher compromises with you say like you know if you do so many questions I will give you a break or something like that...”Yeah I think peers your peers if they kind of not competitive but if there’s a bit of competition then everyone strives to get the best so yeah.”

“Probably when the teachers say like they have prizes for stuff.” (laughs)... “Like just getting out of the classroom, for if she says if everyone answers this question you can get out early, and also if they’re giving you prizes like a....., you think after all your hard effort you got something out of it.”

Some students are interested when they arrive to the lesson, motivated to participate:

2nd “It’s definitely more interesting , I find science quite interesting it’s not just one thing it can be all different types – I like science cause it can be quite interesting.”

J ”Um probably because I am going to be like a sports doctor like there’s some sort of science involved so definitely because I wanna do something with science in the future but um but also because there’s um there is all different sides to it.”

Ann: What motivates me is if something is interesting like anything is motivating because I like to do Science and because I want to learn more about life as we know it and stuff like that and also what motivates me is if we are going to do an experiment or something or if we’re learning something new that I haven’t learnt before. It’s interesting to learn about.”

It’s what happens after they arrive that deserves some consideration.

Emerging theoretical/thematic framework:
When asked what it is like to be a student in these lessons six fields of view emerge from interview and focus group discussions:

-Learning.
-Relevance.
-Relationships.
-Teacher action.
-Experiments.
-Emotions.

Students report that generally science at present is good fun and emotionally enjoyable. Most people join in and cooperate with good relationships where everyone is involved. Good classroom discussions take place and a lot is learned; getting to know more about science. The teachers are perceived as ‘cool’, fun, not too strict and pretty laid back. The situation is not too stressful. Students recognise that the teachers make a difference, have a big impact and are seen as “knowing what they are doing”. The lessons are not all writing and assignments can be enjoyable and not a ‘drag’. Intrinsic and extrinsic interest features strongly. Students report on relevance to their current and future lives and that the subjects they encounter are more interesting. From a hand-on perspective students I year ten at Robin Hoods’ Bay school see themselves as participants in more experiments this year which they perceive contributes to their current interest in science.

A “Erm... very good! If er,... it’s hard to explain.... but its good fun most of the time, most people get in and join in; we have good discussion and er a lot of stuff is learned, erm... but we have a lot of fun doing it as well; it’s not all just writing and boring lectures and stuff like that, it’s very much enjoyable, it’s quite good.”

C “I reckon it’s pretty good like you know it’s not too strict and its pretty laid back and...Yeah it’s pretty um like the teachers are pretty cool. Yeah I think it quite fun I reckon and yeah like I’ve had assignments this year that I’ve actually enjoyed researching and doing and...You know homework sometimes feels like a chore and you know this year I think I’ve actually enjoyed it and like I’ve wanted to go out and it hasn’t felt like such a drag to do it...I think the subjects are a bit more interesting this year. Yeah and the teachers have a big impact and with the subject the teacher teachers like last year we just had the same teacher – like one teacher – it didn’t really yeah but I think more the subjects are a bit more interesting

D”Its not very stressful because you’ve got your own work...Just getting to know more about the subject outside of school...It’s a bit strange to refer to homework as something that’s fun but this year particularly in Science I’ve actually enjoyed it and it’s not been such a drag and sometimes you find yourself doing homework that wasn’t even set for you so you go home and you do things that are extra and it doesn’t seem boring or bad....I think teachers make a big difference and my teacher last year she wasn’t bad or anything but it was just Science but it was just the subject but this year particularly it has been something that everyone’s been involved in and you can really understand how it relates to you and your life and the outside world especially and I think just as we’ve matured it becomes easier to understand and you can see how it relates to everything so its just interesting because you know you can see now the connections between you and Science and your future and stuff...And also we did a lot more experiments this year – a lot more hands on kind of work. Last year it was just theory the whole entire time so it makes it a lot more interesting when we have something practical to do and something that we can base our theory on. So we are not just doing theory and its good to see how it works in real life.”

Reference is made to the rotational model of delivery of the year ten science curriculum at Robin Hoods’ Bay school. Experiencing a change in science year brings student insight to this alternative approach to Robin Hoods’ Bay science. In the middle school pedagogy students received science lessons from the same science teacher all year. They now meet three different science teachers in the course of the year. This change in teacher and subject is currently regarded as good by some if not most students interviewed. Student perceptions of teacher ‘quality’ lead to an idea that the greater the
variety of teachers the more knowledge is available. The changeover of teacher styles brought a greater variety of ‘types of science lesson’.

S: “Yeah, we change subjects three times, different Science subjects. For me it was starting off with Chemistry, then Physics, then Biology and that was all through the year so we basically did a term and a half of each subject. That’s how it’s changed... We changed the teachers, what the subjects were like the different categories of Science that we were learning – that’s what we changed and obviously with the change of teachers comes a change of different styles of teaching so students react differently to different styles of teaching. Some enjoy it more than others depending on what their preference is... I enjoyed Chemistry even though it was probably the hardest one to remember the stuff but Physics and Biology was not very fun for me except for a few little things that I did in it that was okay.”

Steve: “Pretty good. I quite enjoy it. There is always something new to learn. As soon as you’ve finished one, you go onto the next section. It’s a new experience. It’s basically like the first day of school all over again because it’s a new class, new teacher, new lesson and its still Science but it’s like a different type.”

Kim: “Like I said before, you get the different teachers that specialise in that area of Science so you get a better understanding of what it’s all about.”

Ashlee: “Also because you’ve got the different sections, if you don’t really do that well on a part of Science then you might do better at a different one and then it will.”

Not all students have felt the change to a rotation model to be good. Some report that it is difficult trying to keep up and others share some frustration with the cyclical model and whether or not it prepares them fairly for year 11 and 12 study. The pressures of accountability and examinations on their lives is present:

Ann p.62: It’s been sort of frustrating and stressful to be in this cycle thing because now that I’m at the end of the year, I did the hardest Science at the beginning. I did Physics so now that we have our exams I just find it a bit stressful because I don’t remember any of it but I guess that’s sort of preparing us for Year 11 because we don’t have like a whole year exam? You don’t just do semester exams. Well it still prepares us for Year 11 and stuff but it’s just a bit frustrating how we have one subject at the beginning of the year and we just forget about it by the time we get to the end of the year.
The question matrix for this investigation endeavours to place student responses within a time continuum. In an attempt to obtain a portrait of student knowledge a question to identify how students feel about how they are and have been getting along in science was considered. Whilst this researcher recognises that some students may find science boring, cool and or irrelevant students were asked how they had found science during year 10.

In general students reported science to be enjoyable, a good experience where some subjects were not as good as others and that they had got to do a lot of work. Student response drew a focus toward:

1. Experiences
2. Lessons
3. Experiments
4. Teachers
5. Interest
6. Emotional
7. Rotation model

**Experiences**

Students report that the experience of year ten science has been good. They have appreciated opportunities to socialise that the lessons have permitted. Students have had opportunities to seek challenges and indicate that science has been the best subject this year:

C“*I think um most of it’s been pretty good like most of it’s been pretty enjoyable in the things that we do apart from the Physics part of it but um yeah I think other than that it’s been pretty good like I’ve enjoyed most of it, yeah sometimes it’s a bit boring but you know you get that with any subject I think and yeah I’ve been happy with it this year it’s been pretty good*

D“*Yeah I have to agree Science is definitely the best subject this year and I think because you wanna be there you do well in class so and I think that the people around you also make a good atmosphere to be around and it helps you to get on with your work and really think things through and so yeah*”

Steve, a member of the focus group brings validation to these elements of student perception. He also draws attention to the impact of the speed of delivery of the programs on student participation:

Steve(p.31): “*You get some days where you’re just really tired and you just want to zone out and not do anything but on like your average day usually you’ve got something to do. If you know you are accomplishing the work and getting it done at a good speed you actually feel better about it and you can actually do it even quicker and actually know what you’re doing as you do it. So yeah generally this year Science has been, as long as you can keep up with the stuff and figure it out then it’s pretty good.*”

**Lessons:**

In terms of learning content students with intrinsic interest report that science lessons have been one of the better times, information has been more detailed and there is a perception that they may have learned a lot more than perhaps in previous years and connect this new knowledge with possible career avenues:
G “For me it’s been good. I like the sciences that’s why I’m doing all them next year if I can and even when I was young I’ve always wanted to do something in science and that’s never changed its just the type of science is different, it’s always been chemicals for me......and yeah it’s been good, it’s helping me actually get the qualifications for uni. I need so it’s helping me along the way.”

J ”Um yeah, like we have learnt a lot more than what we have – it’s been quite interesting yeah”.

Students are able to report that the lessons, whilst being more detailed have facilitated an enhancement of their awareness with regard to the current and future relevance’s of scientific and science issues in their lives. The relevance of science to their understanding of how the world works, information about their bodies and the continuation of the species and possible career avenues are reported as important.

M “Erm, I’ve found year 10 science very important. It’s further helped me understand what’s going on in the world and why things happen and it would also help too for future thinking, like what will happen after such and such and the reaction of these things. Erm... I also think it’s very important for jobs that might not seem to have anything to do with science at all like erm... say if you had a mining operation or something and erm you wanted to dig up materials, you wouldn’t think that would have anything to do with science. But say to think you were digging up materials that reacted together that would be pretty bad ‘cos it could have a bad reaction, it could have a good reaction, you wouldn’t know, erm, so it could either improve or degrade the efficiency of that, so and if you know a lot about science it’s really helpful, you can think that through.... mmmm.”

In these discussions students make reference to their participation in the rotation, or cyclic model of delivery. Student M portrays the model to be a provider of a wide and varied set of science concepts:

M “Well, usually in the previous years of science we would focus on one topic or some similar topic to the main topic. This year we’ve been divided into three classes, we’ve been divided into physics, biology and chemistry. Physics was mainly about gravity and power that worked and inertia and stuff like that and why things would always move downwards or towards the earth or how certain objects with increased density of mass would create gravitational pulls so other planes or the sun....In biology we mostly learn about like diseases and erm mutations and stuff like that and how, what, are the ethical complications of mapping out the genetic code. In chemistry we were learning about erm formulas of atoms and materials and erm how combinations of these can cause reactions or how they can cause the creation of new material.”

Experiments:

Students are able to analyse, rationalise and reconcile their hands-on laboratory experiences. There is a demonstration of an ability to evaluate their situations and circumstances with a positive outlook. Students report that some of the experiments encountered during their science learning experience have come across as childish, not sufficiently challenging.

Ap (p. 27) “Em, chemistry we didn’t do any experiments, em yeah and physics the experiments seemed to be very childish like em you’ve done in year two or something like that, make a circuit, em that kind of thing em, but with chemistry I didn’t mind cos with year 10 it’s the basic thing to lay the foundations for year 11 and 12 and I know in that time we’ll be doing some experiment...”

Chemistry, whilst perceived as a subject with a high potential for hands-on experiences is reported as not providing any experiments at all. A consensus emerges through the student voice highlighting
how past experiences of investigations and experiments provide a basic necessity for establishing foundations of science learning. A focus is drawn toward the importance of activities bringing some form of relevant challenge to their needs:

“... and I know we’ve only got a short time like I think we’ve only got 12 weeks with each subject so she didn’t waste our time doing experiments that perhaps we didn’t actually need. Em, experiments are good but only if they’re related to what you’re doing and em yeah generally if experiments feel childish like you know you’ve done it in year two or something like that you don’t pay attention you start to mess around and stuff like that, ar... yeah a lot of people in the class when we’ve had to make the circuit stuff like that we knew how to do it so it felt irrelevant to do it again, so yeah.”

Teachers.

The influence of the teacher is well voiced in these interviews. With regard to the rotation model and the opportunities facilitated for encounters with teachers of differing skills and knowledge students were able to create a portrait of their science teachers. During year ten students experienced an enhancement in learning science and acknowledged science teachers who knew what was going on and got involved with the students themselves. Teachers in this model were perceived as more knowledgeable in their field, who explained things and who worked with different styles and methodologies.

J “Em, maybe because we actually get to go into three different subjects in much more detail, an’ that we actually get to know it more than just last year how we just like, oh we had that chapter and we just went through it and that’s it. This year the teachers are more specialised in what they’re doing... Em, I think it’s good like that cos when em, say when you have a problem in chemistry you can go straight o the teacher who teaches chemistry, whereas like in middle school you just have one science teacher, an’ em, there might be stuff about chemistry that you want to know but it’s deeper an’ she might not know the answer.”

In this respect a student in the focus group brings further focus to the observation regarding knowledge and opportunity for a richer understanding of science:

Kim: This year has been pretty good. I have found it a lot easier than it was last year because this year I have found that teachers explain things a lot more thoroughly than they have done in previous years so you actually understand the whole side of what they’re trying to explain to you instead of just like the basics. If you get the whole story then you completely understand what they are talking about.

The idea that students need to socialise more was catered for in some instances. Within this sub-culture of Bay View School laid awareness by some student of the challenges facing the classroom teacher. The importance of mutual goals, acknowledgement of different skills and talents and individual interests are among the student’s perceptions of the classroom and whole-school challenges influencing the effectiveness of the science teacher. Delivering a fun experience with discussion, hands on activities, knowledge acquisition in a socialising environment is a recognised challenge. Anne and Chad in the focus group share their points of view:

Chad(p.31): Actually I enjoy Science but I reckon not everyone learns the same. Some people learn practically and some people learn naturally just like writing down stuff so I reckon as teachers they need to make it as good as possible. Obviously we’ve got to make it good for ourselves as well but still the teachers sometimes – I’m not saying all or some but yeah some teachers don’t seem to like to have a system for all learners. Some people are practical so they don’t seem to learn very well
because of the way they teach and I just reckon they should have experiments every now and again but still do written work. I still think that’s important and yeah, still discussions... I’ve enjoyed it just as long as the teachers do experiments every now and again I suppose to make it fun for us but at the same time it’s interesting and you’re still learning.

Ann(p.31): Science would have to be my second favourite subject. I really enjoy Chemistry, Physics and Biology. Physics would have to be my favourite although Physics is a really hard subject. I think it’s the hardest science there is and the way it is taught to you is really, really important and I think that the teacher who teaches Physics, whoever teaches it, needs to get really involved with the kids that he’s teaching and has to explain it thoroughly so everyone understands and has to explain it really well for us to understand because Physics is a hard concept to grasp and yeah, I’ve just enjoyed everything really.

Interest.

The rotation model has made science more interesting for some students. They have had opportunity to see school science as necessary for future study and career avenues whilst at the same time seeking and recognising reasons to engage in the classroom e.g. teacher quality, hands-on activities and intellectual challenge.

Intrinsic motivation, with the reward of personal success, interest in the subject at that time, peer group co-operation and other classroom factors contribute to the foundations of tiers of interest within the classroom setting

J(p.27) “I think that this years’ science has gone pretty well (yeah) since we’ve had three different teachers it makes it quite a lot more interesting than the last year or the year before...Em, maybe because we actually get to go into three different subjects in much more detail, an’ that we actually get to know it more than just last year how we just like , oh we had that chapter and we just went through it and that’s it. This year the teachers are more specialised in what they’re doing.’

G(p.28) “For me it’s been good. I like the sciences that’s why I’m doing all them next year if I can and even when I was young I’ve always wanted to do something in science and that’s never changed its just the type of science is different, it’s always been chemicals for me.......and yeah it’s been good, it’s helping me actually get the qualifications for uni. I need so it’s helping me along the way.”

F(p.29) “Yeah, I’d have to reckon it’d be the teachers, like the way how they teach the lesson is the way how I reckon it [science] gets learned. Like some reason with Mrs.W’s class, em, I can get the things, at first like when we were just learning it takes me a while to get it, he [other student ] he gets it pretty quick, em, but then soon after like I get it and most of the time she’s [teacher] not even in the class! But like, even though we’re not being supervised or anything we still somehow do the work, for some reason.”

Students find science lessons interesting for its logic and the reward received as a consequence of solving ‘hard’ questions or problems. Where social relevance is recognised and personal and social relevance is appreciated students demonstrate intrinsic interest, they want to do more, seeking personal satisfaction and achievement:

“...... it’s interesting, the logical side of it... . I enjoy science when I achieve, I know that I’ve done well, what I have learnt has benefitted me... before I just love the idea of being able to know how everything works and being able to understand... and also it’s something you can use in everyday life. Something you can use no matter what so I find it particularly interesting... it’s interesting to know
like all these chemical reactions and stuff is going on around you all at once. I find that really interesting your finding out how things work and you know when you find out it’s like, Wow I never knew that... like it opens your eyes to how these things work and it makes you realise how amazing the world really is and everything that was created how amazingly it fits together so... it makes me more interested ‘cos I want o know how, what happens and how it affects things and that sort of stuff... it’s interesting ‘cos yeah I don’t know why I just do. I tend to focus more in science than say than SOSE. I’m not a fan of SOSE and yeah... it’s interesting cause you can’t do some things at home... you’ve got the excitement of learning something new. You’ve just learned you know how to do something, you’ve just dissected something- you know you didn’t know that something was there; you know you’ve got the excitement of going home and telling your family too. I mean, you know, it’s all that kind of stuff... I think people gain a lot of satisfaction with themselves for discovering something that nobody had thought of ‘cos they’d think of themselves as like ‘I’ve done what nobody else has done before so I must be quite creative!’; or something like that and I think that’s quite motivating...”

**Emotion.**

When students do the work they enjoy the feeling of “getting it done”. The completion of the work generates a positive emotion. Year ten students at Bay View School find the science lessons enjoyable and that the learning is good and that part of this enjoyment is a consequence of a personal mind set brought about by personal goals and expectations:

J(p. 29)”Oh um setting a goal of like what you want to do when you leave school, that puts you in the mind set of what kind of subjects you want to take and once you’ve got that down you know that your gonna enjoy that lesson or you are gonna enjoy that subject. So it really depends on what kind of mindset you go in with...Um yeah, like we have learnt a lot more than what we have – it’s been quite interesting yeah.”

**Rotation Model.**

Students comment that the main advantage of the rotation model was the teacher quality, different teaching styles, personalities and their experience of a variety of learning strategies including more hands on. The rotation model is fine so long as the teachers are ‘alright’:

A (p.32) “Erm... the only thing about that (the three teacher rotation) that was different was that we had different teachers. In previous years we’ve done the three sciences but we’ve had the same teacher. So that way we can stick with the same teacher style, or her or his learning styles. Em... changing teachers you might like one teacher and do really well in that [subject] but then in another subject, not like the teacher and not do so well in that. So em changing the teachers is like bit different but altogether, so long as the teachers are alright that’s fine.”

Some perceptions of the mode however did present some disadvantages for one student who preferred the same teacher throughout the year. Emotional anxiety stemmed from a perceived emphasis the college and wider community places on examinations. “2nd” experienced anxiety with regard to preparing and revising for examinations:

2nd “Yeah um I’m quite different – I didn’t like the idea of constantly changing a teacher, having Physics, Chemistry and Human Bio to do this year and we had a different teacher for each of those and we were constantly swapping and changing – moving from one teacher to another and you know one minute you are learning one subject and then the next and we’ve got our exams coming up and because we’ve swapped teachers we haven’t had the same teacher you know you have to hunt down the teacher you had in term 1 to get some questions off them so you can know what’s gonna be in your
exam to get some help on your exam. It’s quite hard, I’ve got my Chemistry teacher now but I had Physics at the beginning of the year so finding help on Physics cause Physics is gonna be quite hard whereas if we had one teacher, I mean that could at least go through it with us and they would know what they taught us and what they haven’t taught us they could give us revision sheets and all that kind of stuff. I mean, I think it would be a lot easier if we didn’t constantly swap teachers, mmm it would be a lot easier...some teachers will throw in a question and think we know it – they might not have taught us what that question is and then if we ask them about it they will pretty much say you know we taught you that and you know the fact that they haven’t I mean like, because of the swapping and changing I mean each is at different levels there is the top class and the bottom class and the middle and all those classes learn different things and a teacher has to write three separate exams or different you know questions on each you know we might get a question that the top class may have learnt but we didn’t or you know the other way around it can be hard yeah but we think it’s a weird way they do it.”

What if anything have you learned from science?

The science programs in the rotation model have been of interest to both intrinsically and extrinsically motivated students. Students who choose to engage with the programs report on how lessons have been interesting and helped to enrich deeper understandings. Students report of the relevance of their science learning experiences to their current and future lives and the community as a whole. Students demonstrate an awareness of their strengths, weaknesses and future needs which influence their choosing or not choosing to pursue learning pathways in science. A combination of individual student comments create a portrait that highlights student desire to learn science demonstrating some capacity for seeing the relevance to their current and future lives; feeding intrinsic and extrinsic interest:

(p.32-34) “I think from Science you understand that everything has not a purpose but everything leads to something else and just the consequences of what can happen so it really makes you think about the way you live your lifestyle and the way you do other things ...it really opens your eyes to how the world works and it shows you how you can contribute to the world so...Yeah I think it’s good to know you know everything fits in and it all runs perfectly it’s all made perfectly to do a certain job and yeah it’s good to know that everything just you know has to flow... I’ve learnt a lot basic stuff which has helped me em yeah, understand slightly more complicated stuff...I think I’ve learned heaps actually, than previous years ...I’ve improved quite a lot ‘cos I understand what I’m doing. .. how useful Science can be. We can use it for so many things and when you really get higher up and start on the more advanced stuff when you get to High School, it’s really interesting and just realise that it’s not a waste of time and you can use it. It’s good to know the sort of stuff like why you are left or right-handed, that genetic stuff. I particularly enjoyed that...I’ve discovered how much I have a passion for Science. I really like Science. Yeah, it’s really interesting and just learning about Science and how to practise that in your actual life and how to use it to your benefit and all sorts of stuff.”

In this situation students demonstrate awareness’s to community capacity building, they are starting to choose to learn and are recognising tiers of interest within themselves and others. Students in year ten are selective in their choices and are developing a capacity to filter personal and social needs. Students recognise the importance’s of planning, the need to study at home, gain new knowledge and improve understanding:

2nd Plan ahead I guess, I mean things like studying, cause I haven’t really been a big studier at anytime over the years but this year I have learned that you have got to actually study if you want to
learn I mean, you can’t just go into a test you know half hearted towards it you know only class time, definitely go home and study for it will really help, so yeah definitely study for it.

J "Yeah being prepared for anything that might come as well, like anything out of the ordinary yeah.

Students perceive personal and social relevance’s to science learning. This leads them to either maintain and/or nurture their intrinsic interests and to experience germination of extrinsic interest that promotes intrinsic motivation in the science classroom. Students may be highlighting through their voice an emotional position that tends towards choosing to engage in science learning.

**What might happen in a science lesson that affects your attitude to participate? Pp.45-48**

This question reveals how students sort out what is and what is not “of relevance”. Identifying that which is relevant and irrelevant is of value. Student voices from page 45 of the interview are quite revealing. Seeking pleasure, extrinsic motivations, realisation of relevance’s and value of the experience to current and future lives indicate a selective practice and are influential factors in student interest and attitude.

A “Erm… my attitudes would generally change if erm… change for the worse if we did an experiment I felt pointless… or started learning something pointless, then I would tune out, I wouldn’t want to learn it, I think that’s when I started thinking about other stuff and getting off the topic and something like that. Erm… it changed for the good if… they taught us..., we did an experiment or something that was good … it was unexpected… I came into the class thinking we would just be doing ‘work’ and we’d be doing quite a fun experiment, I’d become happier.”

A “… if it’s not relevant you don’t, know that you’re never going to use it again so there’s no point in learning it … so yeah if it’s irrelevant to what you’re learning or anything you’re doing, you automatically switch off because you know that you don’t need it, that it’s a waste of time…if it is relevant then you want to learn it ’cos you think that its important, you need, I might need this for the rest of my life so you want to engage more and you want to focus on the question that answer…..”

(23:11)

Students make their own observations, learn from their past classroom experiences and use this knowledge to sort out what they think might be relevant. Identification of personal relevance leads to an attitude of tuning in or out, choosing to engage or disengage.

A “Erm… if the topic changes quickly, like focusing on say a tree or something like that and suddenly you start focussing on a monkey , then it would be irrelevant to what we’re learning because I know that the test, it would be on plants and not on monkeys. So erm, also if we’ve done it before, like I can remember doing it before, say year 9 and we’ve re-done it I think it would be irrelevant. It would be good to revise it but if you erm spend a long time on it and a lot of wasted time just revising it instead of just 1 or 2 lessons jogging your memory erm… yeah, I think that’s about it.”

D”I think if it’s a particularly boring subject like when we are talking about in Physics you know why an object has momentum or whatever its not particularly interesting or you know when it’s not something that you really want to know it kind of makes it boring and you kind of think “oh do I have to do this; I’m never gonna use this again in the future; I don’t really want to know why this happens or how it happens” so I think just with the topic it changes your attitude.”

**Relevance and irrelevance** emerging from year ten student voices at Bay View School include:
The effects of other students and peer group conformity is strongly correlated to student attitude to engagement:

C (p.p. 45-46) "Yeah I agree cause umm also I think if the people around you have a bad attitude towards it- it rubs off on me so I’m more like if people around me are just like “oh my gosh this is boring” I’m just like “Yeah” and I think that has a lot to do with it, and with the subject as well, yeah.

D "I think the people around you play a big part as well”

J “I think everyone has really a big effect on you like, if they’re not paying attention you don’t actually feel you want to work as well, so.”

I “Yeah, when everyone’s talking behind you you think like what’s the point of you doing it too?”.

D: “Yeah, but when everyone’s quiet and they’re doing the work you think that since everyone is doing the work it must be important for you to do your work as well, so you actually do it and everyone around you really affects you.”

The results of student responses to this question of attitude are highlighted in fig. 6:

<table>
<thead>
<tr>
<th>Irrelevant:</th>
<th>Relevant:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing the topic quickly with little if any logical connection.</td>
<td>Learning topic features in future assessment tools i.e. exams.</td>
</tr>
<tr>
<td>Repetition of content.</td>
<td>Future career</td>
</tr>
<tr>
<td>Spending too much time on a topic</td>
<td>Personal interest</td>
</tr>
<tr>
<td>Wasting time revising/repeating work from previous programs</td>
<td>Topic related to current and future life requirements</td>
</tr>
<tr>
<td>Perception of boredom, lack of personal interest.</td>
<td></td>
</tr>
<tr>
<td>Of no current or future relevance.</td>
<td></td>
</tr>
</tbody>
</table>

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Continuum of attitude, relevance and pleasure to tiers of interest and motivation leading to choosing to engage in science learning.

Choosing to engage

Relevance...... ATTITUDE......seeking pleasure

- Life relevance, current and future
- Good experiments, ownership, pursuing own

Avenue to personal use and value

- Want to learn
- Fun, enjoyment intrinsic & extrinsic
- Community capacity building

Importance

- Fun, enjoyment intrinsic & extrinsic
- Community capacity building
- Peer conformity

- Career pertinence
- Teacher performance, boring talk, favourite students, relationships, unfairness and mood

- Something unexpected
- Rewards, personal & social
- Social respect

Avenue to lack of personal use and relevance

- Pointless experiments, repetition
- Tune out & Chill out

Pleasurable avenue of engagement

- Teacher performance, boring talk, favourite students, relationships, unfairness and mood
- Peer conformity

un-pleasurable avenue to disengagement

- Something unexpected
- Rewards, personal & social
- Social respect

- Peer conformity
- Teacher performance, boring talk, favourite students, relationships, unfairness and mood

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This diagram illustrates classroom learning relationships, as identified by the students that influence an attitude toward tiers of interest. Tiers of interest on a vertical axis become more connected (have relationships) through attitude. The greater the tiers or variety of interest then the more likely will the student attitude lead to engagement. As tiers of interest move negatively downward students choose increasingly not to engage. The relevance of the lesson tends towards higher tiers of interest where students perceive the lesson to have experiments, ownership, and relevance to current and future life thresholds. Similarly attitude is affected by pleasurable experiences. Pleasurable avenues of engagement are demonstrated in the upper right quadrant of the diagram. The learning content gains importance and students want to learn; when students want to learn the desire to engage increases with increasing tiers of interest.

The correlation between what goes on in the lesson and general classroom organisation and management is strong. Student attitude is affected by the attitude and performance of the teacher, elements of fairness are recognised by students and demand careful consideration in classroom management:

2nd (p.46) “Oh with me if the teacher calls an unfair call, I mean you might be in a point where a teacher is going round helping people with a few things – if a teacher hears somebody talking and they instantly turn around and they tell you off and you know for a fact it wasn’t you and you know you get in trouble, you get a detention or you got to pick up rubbish or sent out of class all that kind of stuff and you know it wasn’t you – that really – you know it’s not fair and you try to explain it to the teacher and the teacher instantly thinks you are back chatting they tell you off even more for saying things but you know that definitely gets on my nerves but then you have got the people who you know they did talk you know they are doing something wrong but yet they’ve still got the nerve to turn around and say it wasn’t them – you know they are gonna lie and you know it was I mean you gotta be careful. The teacher has got to be careful who they tell off and who they don’t. I mean yeah, that definitely comes into it, yeah.”

Students demonstrate astuteness in the recognition of relationships. Schools endeavouring to sustain a relational culture need to be aware of student perceptions on this matter and the levels of honesty that are required to maintain it:

J (p. 46)”Yeah, like you get some teachers who have favourites and they could tell you a hundred times over that they, I don’t have any favourites but you can tell and they could do one thing and they wouldn’t get say a detention for it but another person who like they really dislike could do the same thing and straight away it could be a detention – it could be a step so just – they really have to be fair, they can’t pick and choose when a detention is given or when they are gonna stand up and say something... um, it could be really picky, like really picky if one of the teacher’s favourite did forget their diary um – they left it in their bag it would be ok if halfway through the lesson or at the start of the lesson when everyone’s like, finally engaged , to go and get their diary, which disrupts everybody and then ten minutes later someone else realises they have forgotten their diary and straight away the teacher’s gone “Oh well, not prepared for class, here’s a detention”, like that, really puts you off but then you feel like well I can’t do anything now.

Relationships as recognised by students, social fairness/unfairness, and effective social translations are important, so too the teacher mood and attitude, students identify and note social respect, recognise marginalisationisms and the effects on community capacity to operate effectively:
"Yeah, definitely, I mean sometimes you'll go into a lesson and you've forgotten something completely by accident you might say something to the teacher and the teacher might be in a bad mood and if they are in a bad mood you don't want to make that bad mood any worse so you don't say anything, you keep it to yourself but then if they find out you haven't got it you know, it'll make both their attitudes even worse, I mean my attitude's definitely changes depending on the teacher's attitude so if I'm in a bad mood but the teachers in a really good one um I change compared to their attitude as well, depending on how they treat us. It's kinda like the respect thing, you give me respect, I give you respect type thing – it's the attitudes."

Students are engaging on different levels. They are making decisions related to an attitude that is affected by the classroom situation ie what the teacher is like and what they are doing. Students are influenced by what the teacher is doing, opportunity of meaningful experiments and investigations and the possibilities of rewards. Students respond when the situation is pleasurable. They will follow an avenue of engagement when they experience something of interest; there is something unexpected, fun. There exists a border of relevance's which affect their attitude to participate or not to participate. Career prospects, good experiments, desire to learn, and enjoyment:

S: Definitely how the teacher's attitude is towards me and students and the whole lesson. That would definitely be the main thing that would affect my attitude and also occasionally I might just have a bad day and not feel like doing anything and that would just be my attitude but that's a minor influence to my overall attitude. It's definitely the teacher and how their attitude is. Like for example just as I mentioned before, if the teacher is really strict and just makes the students do the work and everything and is just really strict about everything then my attitude would be not to do any work just because I don't want to learn in that environment. Yeah and even if the teacher is talking then I just automatically chill out and not listen because of the way they are.

The activities of the teacher are strongly influential with regard to affecting student attitude to participate. Further considerations identified include the subject of study, excessive theory, lack of clarity or understanding with regard to the teacher explaining or supporting tends toward diminished engagement. A student voice highlight concerns regarding the lack of sufficient experiment or practical work and draws focus toward their awareness of the impact of class restlessness on their own and peer group behaviours. Focus group discussions (p. 48) validate comments regarding teacher and other influences:

Steve: "...People like being silly or messing around in the experiments that they're not meant to, that affects everybody else because sometimes the teacher gets annoyed or something. If the teacher themselves is having a bad day, that often overflows onto us and we kind of get it and then we have a bad day.

Chad: Quite a number of things really, like maybe something had happened outside of school maybe. Someone really annoyed me or someone was being really mean or something like that or maybe the teacher is just not really getting in depth, she's just making us take notes. That really, really stops me from getting involved pretty much every time that happens. Yeah I suppose when the teacher gets annoyed and doesn't treat us fairly sometimes.

Kim: It depends whether or not the subject that we'll be covering that day is going to be of any interest to me or if like the class is just being really restless and you can't really understand what the
teacher is talking about and you have to get them to repeat it and they just get really irritated and then having to repeat what they’re saying but just tune out.

Ashlee: Distractions like other people not being part-focussed. If I don’t understand it I might not be so interested.

Moses: Well if we were told that we will only be doing practical work, I’d be there in class first so in my attitude I’d be really happy to do experiments and stuff and then if we’re doing theory, I’d rather chop off my hand (39.43).

Ann: People don’t have that much of an effect on me all that much. It’s mainly what the teacher is doing and if I don’t understand something and then it’s when it’s probably that I don’t understand I get really frustrated and angry and I don’t want to learn at all but if they explain it to me well and stuff then I will be fine (40.12).

Students’ attitude resulting in the enhancement of the phenomena of choosing to engage and participate in science lessons demands teacher considerations of the location of the student in the classroom, how they are operating in their daily lives, their needs and expectations, the rewards of engagement and an acknowledgment and recognition that they (the students) are making conscious decisions about their current and future lives based on their science classroom experiences.

The teachers’ general routine, organisation and management affects what goes on in the classroom. Attentiveness to relationships, partnership and classroom collaborations and an appreciation of social ethnography may lend support to the enhancement of pleasurable emotions. An examination of professional conduct may lead to an effective pedagogy that is less stressful, provides sharing opportunities within a culture of mutual awareness of the needs of all individuals. Teacher capacity may benefit from opportunities to cultivate cultures of professional association that are not policy bound but free to imagination and creativity. A culture of sharing professional ideas and resources founded on active engagement in reflective practices. It may be necessary to look seriously at the factors currently in existence in the Australian education model that may be inhibiting the developments of effective pedagogy that might provide experiences that are pleasurable for both students and teachers. An assessment bound and examination driven national education policy may be a contributing factor that brings stricture and limitations to the emergences of creative teaching in the science classroom. Students recognise the importance of an education to themselves and their futures and the rigours and machinations of testing and the subtleties of rewards:

2nd “Offer something to them, I mean if the teacher says, “If you do something good this lesson, everybody gets into it, everybody learns, all that kind of stuff and if everybody works really hard and if everybody gets over a certain percentage in the next pop quiz or whatever, then we can go outside and do sport or , you know offer them something, you know it’s not so much, you know, “You'll get an education” because that’s the thing that I don’t like to hear, you know “

They also have expectations that their learning experiences will be of interest and value to their lives:

( p. 47)”...(teacher)You are doing this for your benefit, for your education”, I mean we don’t really see that, we’re here because we have to be type thing so if we are offered something that we want to do, something that we really want to then we’re really gonna want to do what they are telling us to do, we’re gonna really wanna focus and get that at the end.”

Summarising Transition: How if at all has your awareness of science changed by your experiences in these programs?
The students perceive that their experiences of the year 10 science program at Bay View School have had affects on their awareness’s of science. Whilst finding that the work is a lot harder in comparison to previous years i.e. Yr 7-9, the science learning experience has “changed for the better”; they have enhanced appreciations of the three major science fields, i.e. Biology, Chemistry and Physics.

Students comment that, while participating in tiered key stage levels of science attainment groups within the curriculum framework for Western Australia, they have been doing, and that everyone in the class is doing, a lot more work. Students voice an opinion that in response to the teachers’ acknowledgement of their changing adolescences and individual needs they ( the students ) have been taking on board ( or rejecting) their own learning responsibilities in recognition of personal desires or goals tending toward interest, motivation and choosing to engage.

A(p.56) “Erm... I think it’s changed for the better, it’s got er, a lot more, and we’re doing a lot more work. In previous years it’s been very basic because people er..., now that its split up into the erm... 10.1, 10.2, 10.3, erm so you know that you don’t have to worry about people not understanding and having to constantly go over it. So being in 10.1 they can just go and they’ll know that you understand and that way everyone erm in the class gets a lot more done. Cos if one person is behind the teacher the teacher has to go and help that person,[get] up to speed, and that erm might drag everyone down, erm... The teachers seem to realise now as we’re getting older that it’s very much your own work, they don’t force you to do anything and that way you don’t get as many fights in school, in class, cos the kids, other children, aren’t erm.. if they really don’t want to do it they’re not going to be forced to and that way they won’t distract everyone else, they’re happy just to do their own thing.”

Students indicate that whilst year ten sciences have been a lot harder, complicated and more challenging, success through challenge has lead to a desire and attitude to want to learn more. Students have appreciated opportunities to engage in challenging work but are able to perceive the possibilities of demotivation if the work is too challenging and experience emotions of fear with regard to senior high school expectations.

2nd (p.57)”It’s a lot harder – definitely a lot harder. The way I’m looking at it right now, year 8 & 9 Science was quite easy, quite breezy, this year it’s quite book orientated – you are constantly in your books and it’s quite hard and to be honest I’m quite you know, scared to go into Year 11 if it was such a big leap from Year 9 into Year 10 is it gonna be even bigger into Year 11? I’m worried that it’s gonna be way harder and in Year 11 I’m just gonna struggle a lot more and if anything it’s probably put a little bit of fear in me of what’s gonna be install for us.”

G(p. 57) “Probably a bit harder than I’d expect, em...yeah, it’s harder material but I’m still getting it but its not like exactly hard to get otherwise, last year, I’m still getting it easy but its just more complicated material so, which is good, so...”

F(p.57) “Yeah, it’s good like having a bit of a challenge but you don’t want it like too challenging that you just don’t get it, if you don’t understand it at all that well like, you know nothing about it then you don’t really want to do it and that’s when you don’t feel like doing any of the work but if it’s just that slight bit challenging for you, but you know as well you could do it then it will sort of help you wanting to do the science work.”

Current and future life requirements have featured in the minds of some students. Recognition of the need to prepare for career avenues is indicated as a consequence of student attaining an enhanced understanding of how the world works. For some students this may affect their choice of Career
Avenue leading to an awareness of tiers of interest and contribute to influencing an attitude to engage and choose to participate in the lessons.

M “Well er, I’ve a bigger understanding of the world and erm it’s also opened up a lot of things like say jobs and careers and things like that that I previously did not understand or erm probably had no interest in before cos I didn’t understand what that job did and I believe that that’s quite a good thing for my life cos then I know there’s other jobs out there that I could I might have a gooder chance of getting. If I don’t get the job I want in the future there’s other a possibility or pathways that I can go towards or build upon. ”

This change in attitude is influenced by the performance of the teacher. Students identify values with regard to the cyclical model of delivery. The relationships with the teacher in the science classroom have a strong correlation with student perceptions regarding their enhancement and enrichment of learning and their attitude toward science. Students report noticing a change in the teacher, now regarded as more knowledgeable. The differing classroom methodology and pedagogical practices have helped students identify how they personally learn best. Identifying which teacher style best suites them makes a difference to how they participate and become interested in science.

Students indicate that the cyclical model has a greater potential for learning science, there is a greater chance of learning more. Teachers as facilitators in this model are perceived as having more knowledge,” they know more” than just one person. The model is seen as providing opportunity to find out aspects of science that may be personally preferred, which are more fun and to appreciate the opportunity to experience an improvement in personal understanding of science. The focus group discussion augments student comments and provides valuable insight and validation:

M “Well I think it’s (cyclical model) quite good cos you can have a teacher , I think, it might be a lot harder to find a teacher that’s skilled in all three subjects and just have them work with the same class over the year. Erm, and you could have one, it’s more likely to find that you have a teacher that’s been interested in one side like of a subject of science so, say one of my teachers was really good at chemistry cos she’s really interested at it in all years but she isn’t interested in biol and stuff like that, and that she’s made a focus n that and she probably have a lot more knowledge of that, if there was a person that just did all three of them cos they couldn’t devote all their time to exactly one then they’d have to divide their time to three different categories of science . But there’s also a down side to it cos if you had just one person working with the class all year they might , if you have just one person working all year with the same students, they get to know their strengths and weaknesses or their interests n disinterests so they could build on that. Whereas if the teachers are constantly changing it’s like getting you new students every couple of months or something like that and er it sort of, they couldn’t predict what the students like or dislike. ”

Focus group validation: (p. 58 )

Steve: It’s really open to how Science covers so many different things because up ‘til this year we’d done Science and it’s been different parts of Science but it’s all technically in our minds been one big picture of Science but this year because we’ve been separated to three different sections you can actually tell there is so much more to it. They are actually in their own little sections, basically their own sciences. In themselves they are all Science but they are all their own type, like they’re all different.

Chad: Well I suppose if there’s one teacher for individual subjects, obviously they are going to be better at it, more specialised and more qualified so they really know what they’re doing and just basically because they know what they are doing more. That’s pretty much what’s (56.37) I suppose.
Kim: Now that the Sciences are all separate, you get a better thorough understanding of what they’re actually all about, like what Chemistry actually involves and what it actually is. Last year it was all in one so you don’t really get to study it in-depth so you get the one teacher that knows what they’re talking about and just explains it and it opens your eyes to how many different things actually fall under Science.

Moses: Well coming in half-way I didn’t get the full revolution but it’s different to what I had previously. Previously we just had Science and that was it pretty much. Chemistry and that was it and now we have Physics, Chemistry and Bio so it’s a lot different and you get aspects of each one where you can see which one you actually prefer to do which is more fun. Ann: Well because I’ve had three different teachers I found some to be better than others and I can understand what they’re talking about now whereas if I had one teacher for the entire year and I didn’t particularly like their style of teaching, I wouldn’t understand any of it but at least this way I have been able to understand at least the majority of it and the way its separated in three different sciences really helps because it gives me a better understanding of each different one as a whole and then yeah, pretty much.”

Future Issues: Sensory/interest/motivation (pp.43-44)
What is it about you personally – desires whatever, that lead you to become involved in science?

Those factors that highlight student sensory interests and motivation provide triangulation points for planning and navigating an effective learning environment. Student voice indicates an enhancement in engagement in science learning comes through recognition that science learning is something you can get better at, bringing satisfaction to personal goals, intrinsic and extrinsic interest and motivation:

“Yeah I think ummm cause I ask a lot of questions and so I like more of the discussions and cause it jogs questions and I like it when everyone else says their opinions so then it makes me think more and like when everyone’s involved its more enjoyable and I like that its you know its good when everyone is enjoying it and everyone wants to get into it and ask questions.”

Students report on the values of group discussions, community participation and personal goals. The current and future relevance of science learning is highlighted and students are making informed decisions regarding current and future life relevance’s in deciding to choose to engage in science learning. Current and future career relevance is important to year ten students at Robin Hoods’ Bay school. Interest, motivations, and personal values recognised by students within the science learning classroom tends toward students deciding to choose to become interested, motivated and engaged in science learning. Connection with career choices and future education pathways is strongly connected to student decisions to engage in science learning:

A composite of comments from focus group discussions permits important inclusion of this phenomenon in planning effective science pedagogy:

“(p.44) Well with my personal career choice, Science is a fairly large important part. If you don’t do well in Science you basically can’t get the job. It’s kind of impossible. You really need to know quite a bit about Science and how it works and understand it well... “Well when I’m in the mood, with something that I’m interested in, I like to learn it. I just find it interesting. I want to know more about it, naturally just like anyone else would want to know if they like it and are interested in it but also it’s a good qualification to have these subjects, yeah”...” Like the line of work that I want to do when I leave Year 12 is pretty much based around Science. I need Science to be able to get into the courses..."
that I want to get into...” Well, next year I am doing pre-apprenticeship and what I want to be doing is going to be even more Science than I am doing at the moment because there is some Chemistry so it would be important for me to learn the basics now for next year... “ Also, as Steve said, in my line of work I really need Physics mainly and Chemistry to do what I want to do. I want to become a nanotechnologist and I really need hard maths and really hard science to be able to do that because it’s impossible to do it without it and it’s just entertaining me because I really like the way stuff works and just learning about Science because it’s really interesting.”

**When do you learn best in Science??**

Students learn best through experiencing random combinations of tiers of motivation and interests.

Student voice at Bay View School demonstrates learning engagements with new knowledge, interesting activities, inspiring and knowledgeable teachers, fun and enjoyment. Relationships with the teacher are frequently recognised as important as too class and peer group relationships. A collection of comments from 1:1 and 1:2 interviews demonstrate a strong correlation between effective learning emotions and the role and performance of the teacher:

(p.53)

2nd “Being interested in the teacher, you know not getting sidetracked or carrying on about the same thing, being fun or funny every now and again not so serious all the time you know some teachers can go in there and be quite blunt, quite serious can’t have a joke or if we joke around we get told off and all that kind of stuff so if a teacher can have a joke as well as being fun at the same time a lot more people pay attention as well...you know if a teacher comes in with no idea whatsoever of what they are going to teach – it could be a disaster but then if a teacher has got in their mind this is what’s gonna happen, this is what they are gonna try and teach then that can be just as bad because it can derail it anytime – you know, the teacher can get just as annoyed so planned but to a point you know you need you’ve gotta have some leniency of what’s gonna happen in the lesson... “I learn, I learn best when I’m being actually engaged by the teacher in that she’s interacting with the students and me... “I think teachers sometimes try to put a new side to things like they might add something that interesting or they weren’t expecting , or they might do something unexpected toward the experiment to make (like) it like say they were using you had to make such and such thing happen to this object, they might make the object something you don’t usually use in everyday experiments so that might get people interested, yeah.”

S( p.69): Just have an easy going teacher that is always willing to give help and is open for your suggestions or not suggestions but like questions, even though sometimes questions might not be relevant to the particular part of that subject that we’re doing at the moment and yeah, not give a teaching style that is personally boring, that I find boring which is yeah, writing stuff on the board and making me copy it down. Also, I don’t like teachers that make me sit up straight all the time – little obsessive things like that. Just easy going.”

Focus group discussions validate student perspectives in regard to figs. 7 & 8:

Steve: It kind of just springs on me really. It’s something that you don’t really see coming. This is like if you understand it and you understand it really well and it looks complex but it ends up being easy to understand for me, then I think this is really cool because it looks really hard and you’re doing it, it’s so easy then you feel really good about it. It keeps you going.
Chad: Well I suppose if it’s something you want to learn and something interesting, something that might be useful, some facts, it makes you just feel good when you finally figure it out and it’s just really satisfying that you’re finally getting there.

Kim: I learn best when the whole class is being cooperative and there’s silence in the classroom and the teacher doesn’t have to spend most of the lesson trying to get everyone to be quiet and cooperate and when we are going into in depth conversation about the topic that we’re learning about.

Ashlee: ” I work best when everyone else is interested as well but if no one is interested and they are going to muck around then you won’t be able to focus. You won’t be able to learn.

Moses: ” I learn something new and it’s like you learn something new and it’s something you like then you want to learn even more about it so you just want to know more and more about it or you know something that the rest of the class doesn’t so you just want to explain it to them so it’s like your expanding your knowledge with something”

Ann: ” I work best when like Kim said, the whole class is being cooperative. I’m not that fussed about the noise level of the classroom but it has to be a reasonable level so I can actually hear myself think and also when the teacher is interested in what I have to say and what my opinion is about the subject, like the teacher is actually wanting to expand our knowledge and stuff and actually is interested in teaching us and not having a bad day and getting grumpy at us and just writing stuff off the board and discussing things”.

Future: How do you think the program could be improved?

In general year ten students at Bay View School recommend the retention of the cyclical model. The flexibility of pedagogical approaches to science learning permits more engagement. Within this model students comment that the teacher has to be ‘good’, carry respect. The likelihood of enhanced concentration is permitted, particularly in regard to each of the three sciences, and students perceive they are able to take in more information.

Future reliance on text books is not a recommendation; a balance with experiments and practical activities is noted. Students suggest less text book centred activities. Whilst some students identify with and see the necessity of text book work there is a feeling that text book work in the future could be made more interesting:

2nd “Um, once again definitely more experiments, I reckon it’s a lot more fun, everyone gets into it when there is more experiments but at the same time, make those book lessons a lot more interesting it’s not just the fact of “we’re gonna read this and you’re gonna answer the questions in the end” You know if we are gonna read something then do something a little more interesting than just read questions you know every lesson, it gets quite repetitive and that’s one thing when you go onto a lesson, you know you don’t want to, you know you’ve done it before – you don’t want to do it again and all that kind of stuff so definitely don’t, have a little variety in there not so much just books, or just experiments yeah, even of each fifty-fifty of each.”

With regard to experiments student voice suggests that these activities should be more challenging and slightly more complicated though not too complex. New and more experiments, not extended repetitions of previous years, should be fun, not boring and more creative. Students further would recommend that more time be given to explaining what the experiments are about.
M (p.66)”Erm well I would probably suggest, though it might be hard in some lessons like some science lesson topics than others, that erm they should do more erm experiments or erm physical things like that. They should try to have, give like er an edge or put a lot more creativity into it, not just simple experiments, like a lot of thought and a lot of time would have to (go) into the more complex experiments. I think it would gain interest of a lot more students.”

Kim(p.67):” Probably for me, it would probably be less time explaining the notes rather than explain like experiments because then you get to see what’s going on instead of just reading notes and explaining it like that.”

More discussion and explaining, less lecturing and letting go of class structure are further identified by Steve and Chad in the focus group discussions:

Chad(p. 67): “I think teachers really need to get in depth, not just do this, write this down, work it out in your own time and learn what it means in your own time but don’t just be lecturing us the whole time and just make us take notes but talk but don’t go overboard but still explain it.

Steve: “In terms of teaching obviously more practical stuff is always a good start but as crazy as this might sound, sometimes on a particular day – probably not every lesson but actually letting go of the structure a bit and opening up for a bit of a class discussion. I seem to learn somehow through class discussions. I don’t know how but as long as it doesn’t get way off topic or anything. People really pay attention when there is a class discussion going on. Well, a class discussion can be fun.”