STUDENTS' RELATIVE AGE IN A COHORT AND ACADEMIC ACHIEVEMNT OF SCIENCE

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DECLARATION

I, Nicole Lewis, hereby declare that this thesis, except with the Graduate Research Committee's approval, contains no material which has been accepted for the award of any other degree or diploma in any university or other institution. I also affirm that to the best of my knowledge the thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signature of candidate: _____

Date: _____

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ABSTRACT

There is an increasing need, not only in science but in all disciplines, for research into what it is that contributes to a student having success in that subject, not least because success in itself can be defined and understood in many ways. This study investigates whether a student's relative age (SRA) in a cohort impacts on her academic achievement in the subject of science. The study was undertaken at an Australian private school, researching 113 female students in Years 7 and 8 and interviewing three teachers. The data suggested that a moderate, significant, negative correlation exists between academic achievement and SRA.

Also, five student characteristics associated with academic achievement (SCAAA) are proposed. They are regarding the student; possessing or not an aptitude for science, being motivated or indifferent, being confident or unsure, having a disposition or a reluctance to question, and possessing an accurate or an inaccurate perception of self.

CHAPTER 1

Introduction to the study

1.1. Chapter Overview

The purpose of this chapter is to give an introduction to the study. It begins with an outline of the background of the study. Then I express my personal motivation for carrying out this study. The aims of the research and the research questions are also presented. Finally, to conclude this chapter, the structure of this thesis is described.

1.2 Background of the Study

Back in the 1980s, a trend was observed amongst early childhood educators (Graue & DiPerna, 2000), in which parents would delay sending their children off to school by as much as a year. To explain this trend, Ong, Allison and Haladyna (2000) clarified that the dominant classroom organisation posed a dilemma, as it was being occupied by students of mostly the same age with significantly different academic achievement levels. The dilemma came about when Lincove and Painter (2006) reported that parents appeared to be concerned their younger children would be academically disadvantaged and may struggle with demands of the formal education setting when compared to the older students in the cohort. Edwards, Taylor and Fiorini (2011) went on to say it was becoming increasingly prevalent in first world countries for parents to delay the commencement of their children in school for a year after they first qualify. This is to give the child a perceived cognitive and emotional head start or advantage in school (Edwards et al. 2011). The dilemma was, to delay or not to delay school entry by a year?

What this implied is that there was potentially a difference of 16 months (or more) in age between the older and younger students in any particular cohort. As stated on the Victorian Department of Education and Training (2014) website, "school is compulsory for all Victorian children aged between six and 17" and "to start Prep, your child should be five years old by 30th April". This has meant that a child turning five between the 1st May (of the previous year) and 30th April (of the current year) can start school. The children born between 1st January and 30th April (of the current year) can delay school entry until the following year. With this in mind, a child starting school in a particular year could be at the youngest, four years eight months old or at the oldest six years old, on the 1st of January of that year. Having students in a cohort with an age range of 16 months (or more) set up the idea of a student having a relative age in a cohort. The student's age is positioned within the age range of their cohort (older, middle or younger), reflecting where their age is relative to the other students' ages in their cohort. How significant, if at all, might the impact of a student's relative age (SRA) be on his/her academic achievement? If SRA did impact academic achievement the older students may have obtained higher academic achievement or it might be the younger students with higher academic achievement.

The academic literature has not been conclusive in this matter. While some studies found that the older students in a cohort obtained higher academic achievement (Cobley, Mc Kenna, Baker & Wattie, 2009; Crawford, Dearden & Meghir, 2007; Lien, Tambs, Oppedal, Heyerdahl & Bjertness, 2005; B. Sampaio, Matta, Ribas & G. Sampaio, 2011; Sprietsma, 2010; Zubero, S. Gil, Irazusta, Hoyos & J. Gil, 2008), others suggested that the younger students in a cohort would obtain higher academic achievement (Black, Devereux & Salvanes, 2008; Dobkin & Ferreira, 2007; Lincove & Painter, 2006; Martin, 2009). This had left me perplexed as to how and whether SRA impacted academic achievement.

1.3 Nicole as a Teacher in a Family of Teachers

My choice of and motivation to carry out this study is partly influenced by the family I was born into and partly by my professional experiences as a teacher of science in a girls' middle school. Firstly, as a third generation teacher, education is often a topic of discussion at home, as well as at other family member's homes. We discuss what constitutes a 'good education'? Which institutions offer better academic options? Do different pedagogies deliver higher results? Why do some students excel and flourish academically in the formal educational setting while other students might struggle academically? It is always this last question generating the most heated conversations. One common explanation offered concerns the possibility of delaying or not delaying school entry by a year. Accordingly, the student would have an older SRA (if delayed entry by a year) or a younger SRA (if not delayed entry by a year). The student perhaps is age-appropriate (birthdate within the year level enrolment dates) or may be redshirted (delay school entry by a year). We are continually interested in and debating whether SRA impacts academic achievement.

I teach science to female students in Year 7 and Year 8. As with most teachers, I believe that my subject area of science is of the utmost importance to my students. Even so, research by Masters (2009) claimed that 13% of the 15 year old students in the Australian school system were classified as 'at risk' of not gaining the essential levels of scientific understanding to allow them to function in adult society effectively. Masters went on to suggest it will be higher levels of academic achievement in the subject areas of mathematics, science and technology that are vital to future national prosperity and this higher academic achievement will help solve emerging global problems. Supporting this, the Nous Group (2011) believed it is science and technology subjects that will carry Australia into the global

future. Consequently, I am extremely interested in how I can improve the science academic achievement of my students.

Connecting my interests of SRA impacting or not impacting academic achievement, and how I can improve academic achievement in the subject of science for female students in Years 7 and 8, led me to my research aim and resultant research questions. For clarification, research question 1 reflects my interest in SRA impacting or not impacting academic achievement, and research questions 2 and 3 are designed to help explain the answer I might find to question 1.

With the knowledge created from this research, this school and other similar schools can potentially improve the levels of academic achievement for female students in the subject of science in Year 7 and Year 8. The information can also be used to advise school policy makers and management on recommendations they can offer parents when deciding on the most appropriate age to enrol their child for school.

1.4 Research Aim and Questions

The aim of the study has been to develop an understanding of whether, and how, SRA impacts academic achievement in the subject of science for female students in Years 7 and 8.

Relating to this aim, the three research questions are:

1. What correlation exists, if at all, between academic achievement and SRA for Year 7 and 8 female science students?
2. What characteristics of Year 7 and 8 female science students do teachers think influence academic achievement?

3. What might be the connection between SRA and the teacher-identified student characteristics that influence academic achievement?

1.5 Structure of the Thesis

This thesis comprises of 6 chapters. Following this introductory chapter, Chapter 2 reviews the relevant literature, beginning with SRA impacts on academic achievement in primary school and into secondary school. Then SRA impacts on academic achievement with particular regard to evidence in three aspects; differing year levels, genders and subject areas. Additionally, the relevant literature concerning influences and characteristics influencing academic achievement are reviewed. In Chapter 3 the research methodology will be outlined and explained with a focus on a mixed method approach. Chapter 4 presents the findings of this study in relation to the research aim and research questions, followed by a discussion in Chapter 5 concerning the findings of this study in light of the literature review. Chapter 6 sets out the conclusions, implication and limitation of the study. Following these chapters are Appendices and a list of References cited throughout the study.

CHAPTER 2

Literature Review

2.1 Chapter Overview

This chapter reviews relevant literature to the aim of the study and the three research questions.

The aim of the study has been to develop an understanding of whether, and how, SRA impacts academic achievement in the subject of science for female students in Years 7 and 8.

This chapter will firstly outline the current understanding of the relationship between academic achievement and SRA. It starts with reviewing whether evidence demonstrated that SRA impacted academic achievement in primary school, then whether evidence demonstrated SRA impacted academic achievement into secondary school. The literature was further examined to see, if in secondary school, whether any such SRA impacts on academic achievement had differing sizes across gender, year levels and/or subject areas. The literature review revealed that current literature does not answer specifically, whether SRA has a significant impact on, or how it might be correlated with, academic achievement for female science students in Years 7 and 8.

The second part of this chapter reviewed literature generally focussing on what does influence academic achievement and then more specifically, on whether there is something about the student that may impact or influence their academic achievement.

2.2 Academic Achievement versus SRA in Primary School

The literature was reviewed initially considering whether SRA impacted academic achievement for the older students in the cohort in primary school and then whether SRA impacted academic achievement for the younger students of the cohort.

2.2.1 The older students in a cohort in primary school.

There existed a large consensus in the research literature that being an older student in the cohort at primary school was academically beneficial, as the older students had higher academic achievement when compared with the younger students. A study that investigated a sample of 144,047 observations on fourth graders in 2002, in Chile, by McEwan and Shapiro (2007) found that delaying school entry by one year increased these fourth graders' test scores by 0.29 standard deviations in mathematics and 0.38 standard deviations in language, both statistically significant (p = .05). In line with this finding, research by Graue and DiPerna (2000) reported the differences between the academic achievements of the older students in the cohort and the academic achievements of the younger students in the cohort as slightly higher for the oldest students in the first three years of schooling, based on a study of 8,000 students in Wisconsin. In addition to the Graue and DiPerna evidence that older students in the cohort had higher academic achievement in primary school, Hutchinson and Sharp (1999) found when they tested for reading levels in 1988, the oldest quartile students obtained better results than the youngest quartile students within all three cohorts when retested two years later. Hutchinson and Sharp researched 5,578 six year olds, eight year olds and ten year olds in London. Taken together, although the contexts of Wisconsin, London and Chile were different, the fact these studies found very similar results suggested there existed some positive correlation with academic achievement and an older SRA in primary schools.

2.2.2 The younger students in a cohort in primary school.

Complementing the research suggesting the older students had higher academic achievement, there existed evidence that being younger in a cohort at primary school impacted negatively on academic achievement. A study of over 1,000 primary school students in Northern Ireland by Mc Phillips and Jordan-Black (2009) found adverse effects on academic achievement for the younger group of students in a cohort. The younger students, born within 2 months of the cut-off point for the school year in Ireland (September 1st), may be particularly academically disadvantaged in their early schooling (Mc Phillips & Jordan-Black, 2009). An earlier study of Bedard and Dhuey (2006) had similar findings as their study suggested, at fourth grade, the youngest students, categorised by month, scored substantially lower academically than the oldest students. Bedard and Dhuey analysed test scores of students with older and younger SRA in month categories, at the fourth (primary) and eighth (secondary) grade levels across Organisation for Economic Co-operation and Development (OECD) countries using data from the 1995 and 1999 Trends in International Mathematics and Science Study. The youngest students scored 1.2–3.5 points lower on nationally standardised tests ($M = 50$, $SD = 10$).

The research findings concurred that being older in a cohort at primary school indicated some positive impact on student academic achievement and being younger in a cohort indicated some negative impact on student academic achievement at primary school. This suggested a positive correlation between academic achievement and SRA (academic achievement increases as SRA increases and vice versa) in primary school existed.

2.3 Academic Achievement versus SRA in Secondary School

In searching the literature, I located 12 relevant research papers investigating the longer term impacts of SRA. Eight of these found a positive impact of being older in the cohort on academic achievement (academic achievement increases as SRA increases) that continued beyond primary into secondary schooling. Obviously, the other four had findings of an opposite nature, that being younger benefited student academic achievement (academic achievement decreases as SRA increases) once in secondary school. I investigated current theories about the relationship between academic achievement and SRA in secondary school by analysing these research papers.

Reports investigating the first three years of secondary school suggested the positive correlation between academic achievement and SRA (academic achievement increases as SRA increases and vice versa) was still present after primary school. A study by Bedard and Dhuey (2006), investigated whether any initial SRA differences (being older or younger in a cohort) had long-lasting impacts on student academic achievement, found the youngest students in the cohort scored statistically significantly lower than the oldest students at both the fourth and eighth grade. Bedard and Dhuey reported that their results clearly showed the persistence of SRA impacts into adolescence, and were therefore suggestive of a longer term impact. Other research supported this finding, Cobley et al. (2009) reported on results from the North of England in 2005 that included 657 secondary students, evenly distributed across the Australian equivalent of Years 6, 7 and 8. Cobley et al. found the older students in the cohort significantly overrepresented the top 20% of academic achievement results across mathematics, science and physical education, and the younger students significantly overrepresented the lowest 20% of academic achievement results in these subjects. The Bedard and Dhuey and the Cobley and Mc Kenna studies indicated being older remained an

academic advantage in secondary school, this suggested a positive correlation between academic achievement and SRA (academic achievement increases as SRA increases and vice versa). Other research that investigated whether SRA impacted academic achievement in secondary school did not always support the conclusion that being older in the cohort correlated with higher academic achievement. In fact, other studies indicated the opposite, that being younger in the cohort correlated with higher academic achievement. This reflected a negative correlation between academic achievement and SRA (academic achievement decreases as SRA increases and vice versa).

When investigating test scores at Years 8, 10 and 12, Lincove and Painter (2006) concluded the younger students in the cohort had significantly higher test scores in Year 10 ($p < .001$) and in year 12 ($p < .05$), whilst no significant difference in Year 8 occurred. Their work encompassed 15,273 Year 8 students as they progressed through secondary school and into adulthood, from 1988 to 2000 in America. Lincove and Painter carried out their research by partitioning the school year level into 3 age groups: young, older and red shirted. Red shirted meant the birth of the student occurred before the school year level enrolment date, this indicated a delay in school entry by a year. Therefore, these redshirted students represented the oldest group of the cohort. Although other studies argued a positive correlation between academic achievement and SRA (academic achievement increases as SRA increases and vice versa) still existed into secondary school. The results put forward by Lien et al. (2005) demonstrated the long run correlation of increased academic achievement with increased SRA as they looked at Year 10 students, aged between 15 and 16. The Lien et al. research showed the youngest third of the Year 10 students had significantly lower average academic achievement than both the middle third and the oldest third of the cohort, with an effect size $d = 0.11$ between the youngest and oldest groups of students. Similarly, a

different study by Sprietsma (2010) reported the relatively youngest students had approximately 20% of a standard deviation lower test result than the eldest in a cohort with mathematics and reading test results using a sample of 15 year old students. Sprietsma looked at a cross-section of data from the 2003 OECD survey conducted as part of the Program for International Student Assessment. Here Sprietsma also found 10 out of the 16 countries researched showed a positive correlation between academic achievement and SRA (academic achievement increases as SRA increases and vice versa) on long-term test results. The Sprietsma research reported the oldest students in the cohort on average achieved 10 - 23 (reading) and 11-30 (mathematics) points higher than the youngest, suggesting SRA did have a significant long-term positive impact on students' academic achievement (academic achievement increases as SRA increases and vice versa). Confusing this argument, research by Dobkin and Ferreira (2007) concluded the youngest students in a cohort had somewhat higher academic achievement than their older peers. Martin (2009) who contended that academically, the age appropriate students (students whose birthdates fall within their year level enrolment dates) obtained higher academic achievement, particularly the younger students in the cohort, than the distinctly older students experienced, supported the Dobkin and Ferreira study. The Martin study investigated 3,684 secondary school students from seven Australian secondary schools, looking at all year levels. The research I read remained quite contradictory in their findings. Moreover, other research that examined students at the end of their schooling and beyond also emerged as contradictory in their findings.

When the correlation between academic achievement and SRA at the end of secondary school and beyond was reviewed, the contradiction of whether a positive or negative correlation existed continued. For example, a study by Hutchinson and Sharp (1999) acknowledged that important differences in the academic achievement of students born at

different times of the year existed. Their report suggested a positive correlation (academic achievement increases as SRA increases and vice versa) was evident through to the completion of their secondary schooling. In comparison to Hutchinson and Sharp, Black et al. (2008) claimed beginning school at a younger age has a small advantageous impact (academic achievement decreases as SRA increases and vice versa) on IQ testing at the age of 18. Black et al. studied Norwegian cohorts born between 1962 and 1988, with data gathered from the Norwegian Registry Data and IQ results sourced from the Norwegian military.

In contrast to the Black et al. (2008) study, Crawford et al. (2007), as did Hutchinson and Sharp (1999), maintained that academic achievement for the youngest (August) born students was at all age levels lower than the academic achievement for the oldest (September) born students in England and this disparity still existed at the end of the student's schooling. The Crawford et al. research indicated a positive correlation (academic achievement increases as SRA increases and vice versa). Adding to this, Mc Phillips and Jordan-Black (2009) reported when in the first three years of secondary school, the youngest students (born in the last two months of the year level enrolment dates) had the highest proportion of lower grades than any other two month grouping of students. Accordingly, (the older the student in the cohort the higher academic achievement attained), this data represented a significant linear trend. The Mc Phillips and Jordan-Black findings, also apparent in the last three years of secondary schooling, again showed an academic advantage to the older students, or a positive correlation between academic achievement and SRA. It is reasoned age differences do appear to matter for students finishing secondary school (Sampaio et al., 2011). Sampaio et al. established that the older students achieved significantly higher academically than the younger students on test scores on their applications for the major university in the Northeast

of Brazil (Universidade Federal de Pernambuco) for 12,636 students in 2004 and 10,530 in 2005.

In summary, although the majority of papers that investigated the long-term impact of SRA on academic achievement found a positive correlation between being older in the cohort and academic achievement (academic achievement increases as SRA increases and vice versa) that continued beyond primary into secondary school, not all research studies did. Indeed, there were studies which reported the exact opposite findings that being younger in the cohort had a positive impact on academic achievement (academic achievement decreases as SRA increases and vice versa). The above studies came out of different countries with diverse socioeconomic situations and different policies around school entry and school entry age. Maybe the disparity in the research outcomes was due to the legal requirements of beginning school and also due to the reasoning behind the delayed school entry for the students. Perhaps different subjects were being assessed in the different studies (see Section 2.6), and within similar subjects such as mathematics (say), there were different emphases on different types of cognitive tasks?

2.4 Academic Achievement versus SRA Variation across Year Levels

As discussed earlier, evidence existed from numerous studies (although not definitive) that the older students in a cohort had higher academic achievement than the younger students. This indicated a positive correlation between academic achievement and SRA (academic achievement increases as SRA increases). The strength of this correlation could be seen to decrease as the students progressed through secondary school. The gain of being older in the cohort varied from substantial in the six-year-old cohort to being much smaller at age 12 (Hutchinson & Sharp, 1999). Supporting this was a study by Crawford et al. (2007) who found the benefits the older students attained in higher academic achievement progressively

decreased, between the students of age seven and of age sixteen. Bedard and Dhuey (2006) also identified a weakening of the SRA correlation as the higher academic achievement obtained by the oldest students declined between grades four and eight.

2.5 Academic Achievement versus SRA Variation across Gender

As my research is investigating a sample of female students, the literature was also reviewed as to whether the correlation between academic achievement and SRA varied across gender. Once more the current literature appeared contradictory as to whether the correlation between academic achievement and SRA is stronger or weaker for female students or male students.

Certain researchers that analysed data by gender outlined that there is no difference across genders while looking at academic achievement correlated with SRA. When Black et al. (2008) looked at the academic achievement of male students they found little evidence of a correlation with SRA and these results were fairly similar for the female students. Also, a study by Zubero et al. (2008) investigated the subject area of Fine Arts and a significant difference in the academic achievement versus SRA correlation for both genders was observed, whilst Psychology and Physical Education had no significant differences in correlation for either gender.

Some research had suggested that a larger positive correlation (academic achievement increases as SRA increases and vice versa) for the male students existed compared to the female students. McPhillips and Jordan-Black (2009), whose study investigated the connection between month of birth and academic achievement in literacy skills in Northern Ireland, argued the higher results the older students obtained in the second half of high school were larger for the male students than for the female students. In line with this finding,

another study found a small but statistically significant correlation linking older students with higher entrance scores. When split for gender, the female students' correlations were not significant but the male students' correlations were (Zubero et al., 2008). The Zubero et al. study investigated whether a correlation existed between birth date and the average grade students obtained for their university entrance exam and included 32,740 students who had entered the Basque Country University between 1999 and 2004. When the study compared medical and engineering students born in the first and second semesters of the year, Zubero et al. observed significant correlations for the male students (academic achievement increases as SRA increases and vice versa), but not the female students.

Contrary to the findings that the positive correlation (academic achievement increases as SRA increases and vice versa) is more significant for male students than female students, other studies assert there is a stronger positive correlation for the older female students than the older male students. The Lien et al. (2005) research, for example, found that whilst average grades differed between the oldest and youngest groupings of male students, the average grades differed significantly between the oldest, middle and youngest third of the cohort for the female students; indicating the positive correlation is more significant for female students than the male students. Their sample included 6,752 Norwegian Year 10 students, aged between 15 and 16 years old during 2000 and 2001. The study categorised the student ages into three equal groups, the oldest third, the middle third and the youngest third. Referring back to the Zubero et al. (2008) study, interestingly, when they split their data for the subject area of Audio-visual Communication, they found a significant positive correlation for the females, but not the male students.

To summarise, lower academic achievement by the relatively younger students differs by gender. There is a stronger positive correlation (academic achievement increases as SRA

increases and vice versa) for male students in Ireland when compared with their female counterparts, whereas the research demonstrates a stronger positive correlation for the female students in Norway and Spain when compared with the male students. Subsequently, this study seeks to find out how female students' academic achievement in Australia might be impacted by their SRAs.

2.6 Academic Achievement versus SRA Variation across Subject Areas

Current thinking confirmed the academic achievement versus SRA correlation is not consistent across all subject areas (Cobley & Mc Kenna, 2009; Sampaio et al., 2011). Sampaio et al. (2011) indicated a strong correlation for the subjects of biology, history, physics, geography, chemistry, and foreign languages. This study investigated the contributory impact of SRA on academic achievement (measuring students' college entrance test scores) and SRA on their likelihood of admission to higher education. Also, research in England has confirmed a similar trend in the sciences, as SRA specifically impacted academic achievement in the subjects of science ($p < 0.05$), mathematics ($p < 0.005$) and physical education ($p < 0.05$), as reported by Cobley and Mc Kenna (2009). That research included 657 secondary students, evenly distributed across Years 7, 8 and 9, schooled in the North of England in 2005. Interestingly for the subject of English, Cobley and Mc Kenna did not find a correlation between academic achievement and SRA, likewise in the Sampaio et al. research, students' achievement in their native language of Portuguese did not correlate with SRA.

As my study focused on the school subject of science, interestingly Cobley and Mc Kenna (2009) found the strongest positive correlations between academic achievement and SRA existed in the subject of science in Year 9, then Year 9 physical education and then Year

7 science. Science appears to be a subject where a correlation between academic achievement and SRA was apparent and demonstrated to be apparent in middle schooling (Cobley & Mc Kenna, 2009) as well as at the end of secondary schooling (Sampaio et al., 2011).

2.7 Summary of Current Literature Investigating Academic Achievement and SRA

In summary, a positive correlation has been found between academic achievement and SRA (academic achievement increases as SRA increases and vice versa) in primary school. This correlation, although diminished is seen into and at the conclusion of secondary school, by some studies. Various other papers report a negative correlation (academic achievement decreases as SRA increases and vice versa) in secondary school. The relationship between academic achievement and SRA sometimes varied across gender, some studies reported it was a stronger correlation for male students other studies reported a stronger correlation for female students, depending on the subject areas. It has been shown the correlation can vary across subject areas as well as across year levels. What still remains uncertain is whether SRA has a significant impact on, or how it might be correlated with, academic achievement for female science students in Years 7 and 8.

2.8 Characteristics that Influence Academic Achievement

The second part of this literature review is focussed on teachers' opinion on characteristics of Year 7 and 8 female science students that influence academic achievement. This question will firstly be addressed by reviewing literature generally looking at what does influence academic achievement, and then more specifically, at whether there is something about the student that may impact or influence their academic achievement.

2.8.1 Influences on academic achievement.

Studies demonstrated numerous crucial elements that influenced or impacted on a student's academic achievement existed (Nous Group, 2011). One of these elements was the teacher. The connection and communication between an individual teacher and an individual student had a huge impact on that student's academic achievements. It has been shown that teacher quality influenced a student's academic achievement more than any other variable (Nous Group, 2011). Areepattamannil, Freeman and Klinger (2011) agreed with that finding as their research showed a teacher who utilised hands on activities for teaching their class had a substantial positive impact on their student's science academic achievement. Areepattamannil et al. analysed the science academic achievement of 13,985 fifteen year old students from 431 schools across Canada. Whilst these educational studies stressed the influence of particular teachers on student engagement and achievement, there obviously existed many other factors that impacted engagement and academic achievement that had nothing to do with the teacher (Panizzon, 2009).

By their very nature, the students themselves had a large influence on their academic achievement. This idea is supported by Chang and Cheng (2011) who investigated the relationship between students' science academic achievement and their interest and self-confidence. Chang and Cheng's data was gathered from 1,044 Year 11 students from 30 classes at four secondary schools throughout Taiwan and showed a student's level of self-confidence and interest in science significantly accounted for the variances shown in the student's academic achievements. Also Panizzon (2009) maintained half of the indicators for student academic achievement related to the students themselves. Panizzon suggested the student's motivation, their interest, their attitude and their confidence all impacted on that student's academic achievement. This indicated that certain student characteristics influenced

their academic achievement. Supporting the Panizzon study, Areepattamannil et al. (2011) asserted when investigating the variances between students' academic achievement in science, that 92% of the variance involved was with individual student's characteristics, whereas only 8% of this variance lay between different schools. These theories out of Australia, Canada and Taiwan, with their focus on student characteristics influencing academic achievement may have prompted the question, what was it particularly about an individual student that either supported or impeded their academic achievement?

2.8.2 Student characteristics that influence academic achievement.

The individual-based factors of a student's academic achievement has been of concern to many teachers and researchers over the past decades. It was of interest, if for no other reason than to identify advanced students, to extend them, and to be able to implement timely interventions for students who may perform below a certain standard. Educators and scholars attempted to pinpoint the best predictors of a student's academic achievement or define which characteristics of a student influence their academic achievement.

Many current theories of characteristics (or personality traits) that have an influence on academic achievement were concerned with the Big Five or the five factor model. The Big Five include characteristics labelled, conscientiousness (organised, responsible and efficient), neuroticism (anxious, tense and unstable), extraversion (assertive, enthusiastic and outgoing), openness (imaginative, insightful and wide interests) and agreeableness (appreciative, generous and trusting) (McCrae & John, 1992). Komarraju (2011) argued that out of the Big Five, conscientiousness correlated positively and significantly with, and had the strongest influence of, any of the predictors of academic achievement. Komarraju also found that both agreeableness and openness correlated positively with academic achievement. Similarly, De Feyter, Caers, Vigna and Berings (2012) outlined, after researching 375 students attending a

university college in Belgium, that conscientiousness positively influenced academic achievement indirectly through academic motivation. However, other studies suggest that emotional intelligence and academic self-efficacy play equally important roles in academic achievement (Caprara, Vecchione, Alessandri, Gerbino & Barbaranelli, 2011; Qualter, Gardner, Pope, Hutchinson & Whiteley, 2012). This thinking does not discount the Big Five, but simply builds on them to include extra descriptive characteristics.

Interestingly, labels researchers have assigned to the individual characteristics that influence academic achievement were consistent between some studies, and amongst others appeared to slightly differ or even overlapped. For example, of the Big Five, Caprara et al. (2011) acknowledged that openness contributed to junior high-school academic achievement. The research examined 412 students in Italy, 196 boys and 216 girls, ranging in age from 13 to 19 years old, where openness measured self-reported intellect, cultural interests and fantasy/creativity. They also found that academic self-efficacy (not one of the Big Five), measured by perceived capability to successfully master different curricular areas and for self-regulating learning activities, significantly influenced academic achievement. This is supported by Richardson, Abraham & Bond (2012) who detected a large correlation between performance self-efficacy and academic achievement, as it was the strongest correlate of 50 measures they explored with tertiary grade point average. It could be argued that these labels were linked. Self-efficacy significantly influences academic achievement (Caprara et al., 2011; Richardson et al., 2012) whereas other studies have highlighted characteristics such as conscientiousness (De Feyter, 2012; Komarraju, 2011). Self-efficacy was defined as one's perceptions of academic performance capability (Richardson et al., 2012) and conscientiousness was defined as disciplined, organised, and achievement-oriented

(Komarraju, 2011). Thus, is it likely that for some people, being achievement orientated may also increase their perception of their academic capability?

Likewise, Qualter et al. (2012) acknowledged from the Big Five, neuroticism as a negative predictor of academic achievement. Their study looked further at controlling noncognitive factors (personality) and cognitive ability (IQ) to determine whether emotional intelligence predicted academic achievement. After researching 413 students (199 males; 214 females) during Year 7 at transfer into secondary school in England, the study reported that emotional intelligence predicted academic achievement. But the Qualter study did also acknowledge the inter linkage of the terms used for these characteristics, suggesting emotional intelligence could be significant for academic achievement principally because emotional self-efficacy is an imperative facet of this construct.

Summing up, studies claimed particular student's characteristics were theorised to be good indicators of academic achievement. It appeared the terms or labels given to individual characteristics that influenced academic achievement differed or overlapped between studies. Whilst the previously mentioned studies have looked to individual characteristics to predict academic achievements, other researchers examined students' beliefs as a theme to clarify specific academic achievement outcomes.

An example of this type of research was Dweck (2006), who explained that people existed on a continuum with regards to their ideas or beliefs on intellect and learning. At one end of this continuum people believed there was an innate ability that came with intelligence, with the amount of ability fixed. Dweck labelled these people as fixed mindset. The opposite end described people who believed that success is about what you have done, for example, worked hard, studied, sought assistance and persisted. Dweck labelled these people as growth mindset. From the research, Dweck maintained these mindsets influenced academic

achievement; the fixed mindset impeded academic achievement whereas the growth mindset supported academic achievement.

A parallel theoretical method of helplessness, as progressed by Seligman (1975), predated Dweck's work. These helplessness theories were interested in the way people rationalise negative events that happened to them. Helpless individuals assigned the cause of some particular negative occurrences to things they have no control over. However, mastery individuals tended to believe they had some control over these particular adverse events. This suggests that an individual's beliefs about the way the world works influenced academic achievement, as a student that was helpless was left with no alternate for improving their academic position, whereas the mastery student had multiple resources available to them (Seligman, 1995).

As discussed, amongst other aspects, both characteristics and beliefs have been shown to be important predictors of academic achievement. Along similar lines, Sternberg's (2007) study presented a combination of intelligences he determined would predict academic achievement. Sternberg contended that intelligence had a three pronged approach. Firstly, the analytical aspect that included skills such as analysis, evaluation, and critiquing given knowledge; the creative part comprised discovery, creation and invention of new knowledge and finally, the practical portion encompassed implementation and application of knowledge in ordinary circumstances. The greater number of these attributes a student possessed, the higher their academic achievement (Sternberg, 2007).

In conclusion, studies have shown that different student characteristics and beliefs could be linked to the student's academic achievement. From a practical point of view, one may still try to draw similarities and connections between the labels given to these characteristics and beliefs. For example, Seligman's (1975) helplessness is similar to Dweck's fixed

mindset. As the literature reviewed so far did not identify student characteristics or beliefs through teachers' views, we are not able to determine what these teachers' views might be. As a result, this current study will be designed to determine what characteristics of Year 7 and 8 female science students' teachers think influence academic achievement.

CHAPTER 3

Research Methodology

3.1 Chapter Overview

The purpose of this chapter is to discuss, in the methodology section, a justification for the use of a mixed method approach and how this approach complements the aim of the research and the research questions. Furthermore, a summary is included of the research location, the research population, and the validity and reliability of the data collected. In the method section, the process of gathering and analysing the quantitative data from the school database and the qualitative data from the teacher interviews will be explained.

In brief, there are three main research methodologies in educational research, quantitative, qualitative and mixed methods (Johnson, Onwuegbuzie & Turner, 2007). The type of methodology that is chosen for conducting research depends on the purpose of the researcher. The purpose of this study is to develop an understanding of whether, and how, SRA impacts academic achievement in the subject of science for female students in Years 7 and 8. Therefore, given the numerical and interpretive nature of this study, a mixed methods approach appeared to be the most appropriate. As I conducted the research in two phases, this chapter addresses the two phases separately, firstly in the methodology and then in the method. For phase one, I collected data using a quantitative approach, drawing on student's birth dates and their academic achievement in science, from the school database. The second phase followed a qualitative approach. Structured interviews took place with the teachers who taught these students science in 2012.

3.2 Methodology

3.2.1 A mixed methods approach.

Onwuegbuzie and Leech (2005) explained while particular research questions lend themselves more to either a quantitative approach or a qualitative approach, since both approaches had inherent strengths and weaknesses, researchers might choose to employ the strengths of both methods in order to better understand their research results. To explain the mixed methods approach further, Bergman (2008) advised using a mixed methods approach to your research that included a blend of at least one qualitative and at least one quantitative part of a single research task. Consequently, in order to better understand whether SRA impacts academic achievement in the subject of science for female students in Years 7 and 8, I took a mixed methods approach to this research.

The mixed methods approach firstly used quantitative data to establish an answer for the first research question:

Q1. What correlation exists, if at all, between academic achievement and SRA for Year 7 and 8 female science students?

The quantitative data also enabled further investigation into the strength and significance of any correlation that existed. The inclusion of the qualitative data allowed for additional investigation into how or why any correlation between academic achievement and SRA existed. This qualitative data was used to formulate answers for the second and third research questions exploring how or why any correlation existed:

Q2. What characteristics of Year 7 and 8 female science students do teachers think influence academic achievement?

Q3. What might be the connection between SRA and the teacher-identified student characteristics that influence academic achievement?

3.2.2 Phase one: quantitative – a comparative approach.

There is more than one type of quantitative research design. Kervin, Vialle, Herrington and Okley (2006) labelled and described the three main types of quantitative research as: descriptive (describing the variables measured), experimental (addressing cause and effect relationships between the variables measured) and comparative (examining existing relationships between the variables measured). Comparative design includes the consideration of the strength and significance of a relationship that already exists between two variables (Lavrakas, 2008). As my research required the strength and significance of any relationship between academic achievement and SRA, I took a comparative approach in the design of this research. However, while this comparative approach explored relationships amongst variables, it did not include the experimental manipulation of variables and consequently, the results cannot establish a cause and effect association (Mertens & Laughlin, 1995). The design of my study enabled investigation of any existing relationship between the two the variables of interest, academic achievement in science and SRA, therefore the quantitative approach for this part of the research was comparative.

The quantitative data may establish whether SRA impacts academic achievement in the subject of science for female students in Years 7 and 8. Furthermore, as explained, the quantitative data can also show the strength and significance of the existing correlation. However, that is all the quantitative data addresses, it does not tell us why any such relationship exists or even if one variable is causing the other variable. So in order to investigate any existing relationship between academic achievement in science and SRA further, my research required a second approach.

3.2.3 Phase two: qualitative – the interview technique.

The inclusion of qualitative data in research helps to explain relationships that the quantitative data discovers (Onwuegbuzie & Leech, 2005). So, in order to explain any existence of a correlation between academic achievement in science and SRA, I obtained qualitative data from each of the student's science teachers. This was done by investigating the teacher's opinions concerning each student's learning and academic achievement in science. I was particularly interested in what the teachers thought about an individual student's characteristics that either supported that student's academic achievement or impeded that student's academic achievement in science.

It was considered as to which method would be the most appropriate to attain the teachers' opinions of the student characteristics that they believed influenced academic achievement. I used an adaption of Kelly's (1991) repertory grid as an interviewing technique. Patton (2002) referred to three types of qualitative data collection methods, interviews/focus groups, observations and documents. The comment around all three types of qualitative data collection methods was the quality of this data largely hinges around the researcher and their methods, sensitivity and integrity. More specifically, Patton suggested successful interviewing includes a lot more that merely asking questions. In addition to this, Kervin et al. (2006) proposed that using a specific interviewing technique can add hugely to the richness of the researcher's understanding of their question under investigation and the qualitative data collected. Nevertheless, one of the difficulties in trying to extract people's beliefs lies in the fact that personal theories can be subconscious: therefore teachers may be unable to express their true beliefs (Donaghue 2003). Consequently, I adapted Kelly's repertory grid as an interviewing technique.

Kelly (1991) believed that humans relate to the world using what he called constructs and contrasts. Constructs are bipolar groupings, the way two things are alike and different from a third, that people utilise to make sense of their world (Kelly, 1991). Examples of such constructs are "attractive" or "kind." A construct always infers a contrast. So to the construct of attractive, or intelligent, an opposite polarity is implied, and a person may assess others using the constructs "ugly" or "cruel." Raskin (2002) described Kelly putting forward the theory that people organised their experiences by establishing a set of opposite facets of meaning, or personal constructs and contrasts. Raskin went on to say the individual utilised these constructs and contrasts to anticipate and predict how people and the world around them might behave. In addition, Nailon (2013) explained, personal construct psychology has been used successfully for a number of years as an instrument in education and other fields for exploring personal decision making and views. Through utilising an adaption of Kelly's repertory grid (see Appendix D), I ascertained five student characteristics associated with academic achievement (SCAAA), from the teachers' interviews. This allowed for investigation into any connections concerning SRA and the characteristics the teachers perceived influenced academic achievement.

3.2.4 The research population.

It was imperative to clearly describe the population that any research endeavoured to study (Murphy & Schulz, 2006); my research investigated whether SRA impacts academic achievement in the subject of science for female students in Years 7 and 8. To more clearly define this population, my study included the academic achievements in science and SRAs for Year 7 and Year 8 female students at an independent school that provides parallel education. The parallel model has the students from Preparatory to Year 4 in co-educational classrooms. Then from Year 5 to Year 12 the school educates the students in single sex

classes. There were 49 Year 8 female students enrolled at the Brighton campus for the full school year of 2012. The school database had data for all 49 students. I analysed 48 of the student's academic achievements, as statistics indicated one student, an outlier on birthdate. Sixty five Year 7 female students were enrolled for the full school year of 2012 and the research data included all 65 students' data. In total, the study included 113 female students' academic achievements in science and SRAs.

For the qualitative data, I interviewed the three science teachers involved with teaching Year 7 female students and Year 8 female students for 2012. This study included a total of seven interviews, comprising of four Year 7 classes and three Year 8 classes. This process involved three teachers at the school (teachers J, M and N), including the researcher. The reliability of using the researcher's interview data is discussed in section 3.2.6.

3.2.5 Validity.

Validity referred to the degree to which the research procedure actually measured the concept that it intended to measure. The two variables in phase one of my study, SRA and academic achievement were both valid measures. Firstly, SRA denoted a valid measure as students' parents provided the birthdates to the school. The Microsoft Excel software calculated the SRA (number of days from the midpoint for enrolment for starting school) from these birthdates, ranging between negative 190 (the youngest student) to 395 (the oldest student). Although a very small chance existed that a parent changed this information for some unknown reason/s, the risk of this occurring remained small. Secondly, academic achievement in science denoted a valid measure as it was calculated as an average percentage of each student's coursework mark and examination mark for 2012 in the subject of science. Each student's teacher calculated their coursework mark as an average of the student's topic tests results, project results and practical reports results for 2012. The projects and practical

reports may have been completed at home with outside help. Teachers marked all coursework tasks to pre-agreed rubrics and often moderated them. The teachers marked the examinations to an agreed scheme and moderated them across the school. The average percentage of each student's coursework mark and examination mark gave high validity data for academic achievement in science as they were what each student academically achieved in 2012 for around 12 coursework assessment tasks and 2 examinations.

Golafshani (2003) claimed that there is a requirement of some type of validity check or measure for qualitative research as well as quantitative research. In my study, the qualitative component investigated, in the teacher's opinion, what characteristics of Year 7 and 8 female science students influence academic achievement, therefore it was the teacher's perception that my study investigated. Through utilising an adaption of Kelly's (1991) repertory grid as an interviewing technique, and acknowledging that personal construct psychology has been used as a valid instrument in education and other fields for exploring personal views for a number of years (Nailon 2013), this delivered a high degree of validity in the qualitative data.

When developing an experimental design, Kervin et al. (2006) suggested the researcher needed to be aware of, and even investigate, the balance between internal validity and external validity (generalised to other settings) their results may deliver. Mertler and Charles (2005) discussed five threats to the internal validity of educational research, namely: selection bias, participant drop-outs, a learning effect, history (knowledge the participant brings) and participant maturation. My research lends itself to a high internal validity with no selection bias in recruiting (my study included all Year 7 and 8 female students' data) and no participant drop out. The other three threats to internal validity: learning effects, history and participant maturation, in a sense is what my study partly researched. However, this high internal validity my study acquired, indicated a low external validity. As explained by Kervin

et al. the lower the external validity the less likely the research results could be generalised, so for example, my findings may not be easily transferred to other contexts or schools.

3.2.6 Reliability.

Reliability refers to the consistency and/or repeatability of the measurements to produce similar results (Kervin et al., 2006) in quantitative research. The population size of my study improved the reliability of the quantitative data. Firstly, the high number of students involved in the research (113) generated more reliable quantitative data. Secondly, researching two year levels (Year 7 and Year 8) compared with only one year level, prevented researching an anomaly in a particular year level. Furthermore, by analysing two types of data (coursework and examination results) for each year level, the data was the student's academic achievements in science and therefore more reliable.

As I was the teacher for two of the science classes in 2012, 1 supplied the data for two out of the seven teacher interviews. The reliability of this data needed to be addressed and subsequently two precautions were put in place. Firstly, my interviews occurred before the other five teachers, consequently no preconceived ideas from the other teachers were disseminated in the first two interviews. Secondly, I had no previous knowledge of the individual SRAs of the students discussed in the interview, as with the other teachers interviewed. Therefore no bias was brought into the qualitative data concerning SRA. With these two precautions in place my interview data was as reliable as the other two teachers' interview data involved in this research.

Given (2008), whilst stating the importance of validity and reliability, refers to the researcher with qualitative content striving for trustworthiness and credibility within their data. To improve the trustworthiness and credibility of the qualitative data, at the conclusion

of each interview the participant teachers viewed the notes I made from their responses. This approach is known as member-checking, the participants reviewed their responses, supplied more information if they felt it was required, and clarified any uncertainties the interviewer had (Kervin et al., 2006).

3.3 Methods

3.3.1 Research design.

This research was conducted in two phases. The first phase (the quantitative phase) involved the downloading and analysing of the quantitative data. This data included the students' date of birth and their science examination and coursework academic achievement for the year 2012. The quantitative data pre-existed, in a de-identified format that could ethically be accessed. The second phase (the qualitative phase) involved the process of interviewing the science teachers to obtain the qualitative data. This procedure included the briefing of the interview participants on the purpose of the interview and they consented.

3.3.2 Data collection phase one: quantitative.

To facilitate the answer to the first research question of my study:

Q1. What correlation exists, if at all, between academic achievement and SRA for Year 7 and 8 female science students?

Firstly I obtained student birthdates from the school database, these were manipulated in excel to calculate each SRA. Then I obtained student science results, these were manipulated in excel to calculate each student's academic achievement.

The investigation of the first research question required the collection of quantitative data. One of the variables obtained represented SRA. The school's Information Technology

Coordinator ran programs that collated the students' birthdates from the school's computer database. The birthdates downloaded into an excel spreadsheet, were matched with each student's corresponding five digit student identification (ID) number. A formula in excel manipulated each birthdate in order to calculate each student's corresponding SRA. As stated on the Victorian Department of Education and Training (2014) website, "To start Prep, your child should be five years old by 30 April." Using this information, the midpoint for enrolment for starting prep (or school) was the 1st of November. The excel spreadsheet calculated the number of days past this midpoint date, or the number of days before this midpoint date, each student's birthdate occurred. This gave a positive number of days born before the midpoint for enrolment for starting school or a negative number of days born after this midpoint. For example, a student born on 28/10 (three days before the midpoint date) had an SRA of 3 (positive three) and a student born on 3/11 (three days after the midpoint date) had an SRA of -3 (negative three).

The other variable required represented students' academic achievements in science. The school separates science academic achievements into two distinct areas, the first being examinations and the second being coursework. The information in the database existed as a percentage result for both examination and coursework. The school's Information Technology Coordinator organised four reports collating pre-existing data from the school's in house database, for 2012, these reports were:

- Year 8 students' semester 1 and 2 coursework percentage results for science.
- Year 8 students' semester 1 and 2 examination percentage results for science.
- Year 7 students' semester 1 and 2 coursework percentage results for science.
- Year 7 students' semester 1 and 2 examination percentage results for science.

This data existed in a de-identified format. I saved the data into excel spreadsheets and merged these with the SRA spreadsheets. Using the student's individual ID number as the link between the two variables, excel matched the student's academic achievements in science with their SRA. This merged spreadsheet had the data for the investigation into whether a correlation existed between academic achievement and SRA for Year 7 and 8 female science students.

3.3.3 Data collection phase two: qualitative.

The second phase of the data collection involved the interviewing process. This data was gathered to facilitate answers to the second and third research questions of my study:

Q2. What characteristics of Year 7 and 8 female science students do teachers think influence academic achievement?

Q3. What might be the connection between SRA and the teacher-identified student characteristics that influence academic achievement?

Firstly I will provide an overview of the steps in this process and then explain each step in more detail. The steps involved in the qualitative data collection were as follows:

1. Decide which teachers to interview.
2. Brief the selected teachers on their involvement in my study and seek their consent to participate.
3. Supply the teachers with their class lists and have them assign random numbers to each student in the class.
4. Conduct the interviews at an agreed time and place.
5. Have the teachers remove the student names from their class lists leaving their assigned numbers.

6. Transcribe the recordings of the seven interviews into Word documents.

The first step in this qualitative phase of my study had been to identify the teachers who would be interviewed. They were the teachers in the school who taught Year 7 and Year 8 science. There would be three such teachers, one of whom was myself. Teacher J taught three Year 7 Science classes and one Year 8 science class in 2012. Teacher M taught one Year 7 science class and teacher N taught two Year 8 science classes.

The two teachers identified as potential participants were then introduced to the study. They were informed that their part in this research would involve being interviewed once for each class they taught in 2012, where the researcher would ask the teachers questions relating to their students' science learning and academic achievement. They were informed that each interview needed between 15 to 20 minutes to complete, and that data would be gathered through audio recording as well as hand written notes in the Science Teacher Interview Form (see Appendix D). The interviews took place privately after school hours in an otherwise empty staffroom. Informed consent was obtained.

At the beginning of the interview, I handed the participating teachers their particular class list, including student name and student ID number. On this document the teacher randomly assigned a number to each student in their class (1–18), facilitating the student's anonymity to the interviewer.

(An excerpt from Interview 1 with teacher J can be viewed in Appendix E to illustrate this process)

I asked about students 1, 2 and 3, then students 4, 5 and 6. This process of questions continued for each triad of students including up to students 16, 17 and 18. The triads of students then were resorted starting with 1, 4 and 7 as per Appendix D. The first question was

asked again for these new triads of students. This continued until students had appeared in at least two triads.

Before the interview concluded I asked the participating teachers whether they wanted to add anything else as a comment to a particular student. I also encouraged the teachers to review my notes taken on the interview form, this allowed them to change or add further information.

Step 5: Have the teachers remove the student names from their class lists leaving their assigned numbers.

In order for the data to remain de-identified to the researcher, the teacher removed the column for the student names on their particular class list and what remained was the teacher randomly assigned numbers (1–18) for each student and their corresponding student ID number. The teacher randomly assigned numbers required rewriting as student 101 to 118. Student 101 represented teacher randomly assigned number 1 student from Interview 1 through to student 118 who represented teacher randomly assigned number 18 student from Interview 1. Each student's ID number matched with their corresponding date of birth through the loading of this information into an excel spreadsheet (see Appendix F).

Step 6: Transcribe the recordings of the seven interviews into Word documents.

An administration assistant transcribed the recorded interviews into seven separate Word documents. These documents, along with my interview notes, allowed for the analysing process to begin. The qualitative data collected from phase two had enabled for the generation of a theory that associated five student characteristics with the academic achievement of science, which will be discussed in greater detail in pages 48 and 78.

3.4 Data Analysis

3.4.1 Data analysis phase one: quantitative.

In order to establish whether a correlation existed between academic achievement and SRA for Year 7 and 8 female science students, the quantitative data was graphed separately for Year 7 and Year 8. The following statistical measures were then calculated, the strength and the significance of the correlation. Firstly, the quantitative data were presented as scatterplots with the help of Excel software, one graph for Year 7 students and another for Year 8 students. The vertical axis of each graph represented the student's academic achievements in science, calculated from the student's averaged examinations and coursework results for 2012 as a percentage. The horizontal axis of each graph represented SRA, the student's relative age in days from the midpoint of enrolment, a positive number of days born before the midpoint date for starting school or a negative number of days born after the midpoint date. From the scatterplot, for initial analysis excel calculated lines of best fit for two variables for both the Year 7 and Year 8 scatterplots.

In order to quantify the strength of any correlations, the Pearson correlation coefficient *r* was calculated. These r values were labelled either statistically significant or not statistically significant. A two-tailed test was more appropriate for this type of data. This research investigated whether any correlation existed between females' academic achievements and their SRAs, this was either a positive correlation or a negative correlation, accordingly, the decision included two-tailed testing. The two-tailed significance tests determined the significances of the *r* values using 63 and 46 degrees of freedom for the Year 7 and Year 8 data respectively. The Spearman correlation coefficient r_s was also computed to assess the

relationship between female students' academic achievements and their SRAs in science for Year 7 and Year 8, as the academic achievement data was slightly negatively skewed (see Appendix J).

After a correlation has been detected and the strength and significance of this correlation quantified, I wanted to investigate any difference in academic achievement between students with an older, middle or younger SRA. As the quantitative data was not yet grouped, to quantify any difference between two groups' academic achievements, the students' data needed grouping into three categories. These categories indicated whether a student had an older, middle or younger SRA. As there were more than two groups, an analysis of variance (ANOVA) was first used to test for a significant difference between groups. Then post hoc comparisons were performed, using a series of t-tests to investigate the difference between the middle SRA group's academic achievements and the older SRAs group's academic achievements for the Year 7 and Year 8 students. In addition, the difference between the younger SRA group's academic achievements and the middle SRAs group's academic achievements were also investigated. Two sample, one tailed, t tests were performed to demonstrate any statistical significance between these age groups' academic achievements.

I defined the older SRA students as being born before their year level enrolment date, before 30/4/99 for Year 7 and before 30/4/98 for Year 8. There were 21 Year 7 students categorised with older SRAs (or 32 % of the cohort) and nine Year 8 students categorised with older SRAs (or 19 % of the cohort). Middle SRA students were born in the first six months of their year level enrolment date, 1/5/99–31/10/99 for Year 7 and 1/5/98–31/10/98 for Year 8. There were 30 Year 7 students categorised with middle SRAs (or 46 % of the cohort) and 23 Year 8 students categorised with middle SRAs (or 48 % of the cohort). The students categorised with younger SRAs were born in the last six months of their year level

enrolment date, 1/11/99–30/4/2000 for Year 7 and 1/11/98–30/4/99 for Year 8. There were 14 Year 7 students categorised with younger SRAs (or 22 % of the cohort) and 16 Year 8 students categorised with younger SRAs (or 33 % of the cohort).

3.4.2 Data analysis phase two: qualitative.

The qualitative data collected from phase two had enabled for the generation of a theory that associated five student characteristics with the academic achievement of science, which will be discussed in greater detail in pages 48 and 78.

Prior to analysing the qualitative data, an administration assistant transcribed the seven teacher interviews into seven separate Word documents (refer to Appendix E for an excerpt of a transcript). The chaos and complications which Kervin et al. (2006) believed researchers often perceive were associated with analysing data within a qualitative design. Hence, I analysed the seven teacher interviews using a grounded theory approach (Glaser & Strauss, 1967). Charmaz (2012) explained grounded theory as consisting of a systematic, yet adaptable set of procedures for collecting and analysing qualitative data in order to build theories from the data themselves. Furthermore, Corbin and Strauss (1990) described utilising a grounded theory approach for analysing qualitative data as a process that facilitated arriving at theory appropriate to its supposed uses.

The grounded theory approach which was adopted to analyse the qualitative data analysis involved three stages of coding. The first stage was open coding; a procedure that developed categories of information from the interviews (Corbin & Strauss, 1990). The second stage involved axial coding; a process that interconnected the above categories (Corbin & Strauss, 1990). Finally, the third stage was selective coding. Selective coding built a story that

connected the categories producing a discursive set of theoretical propositions (Walker & Myrick, 2006). From the selective coding I established the five SCAAA.

3.4.2.1 Stage 1 open coding.

The first step of open coding required highlighting parts of the text which described student's characteristics that influenced their learning and academic achievements in science. I managed this on a sentence by sentence basis (refer to the transcript in Appendix G for examples). Then the highlighted text required grouping into salient categories in an attempt to begin to label the phenomena they represented. A constant comparative approach (Birks & Mills, 2011) was used for developing these salient categories. I utilised this approach until saturation occurred, the point where new data did not provide further insight into the category (refer to Appendix H for an example of the constant comparative approach). The developed categories had properties, dimensions and multiple perspectives (Birks & Mills, 2011). For example, motivation has a continuum, from highly motivated to no motivation. Also, motivation has a frequency, duration, intensity and a context.

3.4.2.2 Stage 2 axial coding.

Using axial coding allowed for the discovery of causal conditions, more specifically, what influenced the central phenomenon, events, incidences and happenings. The coded data required examination by looking for four attributes; firstly, what happened, then in what conditions did it happen, what resulted from the actions and finally, the consequences of what happened (Charmaz, 2006) (refer to Appendix I for an example of axial coding).

3.4.2.3 Stage 3 selective coding.

Selective coding is a procedure for building a story that connects the categories producing a discursive set of theoretical propositions (Walker & Myrick, 2006). Given the aim and

questions of this research, the central phenomenon for the qualitative data comprised ‘What characteristics influence science academic achievement?’ Through the selective coding stage, the teacher’s opinions of what characteristics of Year 7 and Year 8 female science students influence their academic achievement became apparent. From this, the five SCAAA were established.

3.4.2.4 Teacher interview comments coded as supporting or impeding academic achievement

In this part of the study I manipulated the qualitative data into quantitative data. Maxwell (2010) admitted the use of numbers in qualitative research was controversial, however, he went on to say that, particular statistics for the purpose of simple counts of things were a valid and an imperative kind of data for qualitative researchers. Likewise, Sandelowski (2001) claimed, just as in quantitative studies, researchers utilised numbers in qualitative studies to demonstrate the significance of a research project. Also, statistics were beneficial for highlighting the work and complexity of the qualitative data as well as creating some meaning from qualitative data (Sandelowski, 2001).

So as to establish whether any connections concerning SRA and the characteristics the teachers identified that influence academic achievement existed, I revisited the original transcripts of the seven interviews. The sections of the teachers’ transcripts that were highlighted, as they described the student’s characteristics that influenced academic achievement required coding as either supported or impeded. A comment labelled supported designated the teacher comment suggested a characteristic that would improve the student’s academic achievement in science. Impeded designated the teacher comment suggested a characteristic that would cause the student’s academic achievement in science to deteriorate.

I loaded the coded transcripts into an Excel spreadsheet against each student ID number and SRA. The coded teacher comments were combined for Year 7 and the Year 8 to allow for a larger sample size. The spreadsheet was sorted on SRA, then grouped the students as older SRAs born before 30/4 of the enrolment year, as middle SRAs, birthdates between 1/5 - 31/10 (the first six months of the school year) and as younger SRAs, birthdates between 1/11 - 30/4 (the second six months of the school year). The numbers of supported and the number of impeded comments were tabulated for each SRA group and then analysed for any patterns. A chi-square test of independence was performed to examine the relationship or connection between the types of comments and the SRA groups.

As I had the data available to me, and to further investigate any SRA versus comment type connection, I decided to perform a chi-square test of independence to examine the relationship or connection between the types of comments and academic achievement. The coded teacher comments were left combined for Year 7 and the Year 8 to allow for the larger sample size. The spreadsheet was sorted on academic achievement then grouped as top 3rd, middle 3rd and low 3rd. There were 38 students in the top 3rd academic achievement group, 38 students were in the middle 3rd academic achievement group, and 37 students were in the low 3rd academic achievement group. The numbers of supported and the number of impeded comments were tabulated for each academic achievement group and then analysed for any patterns. The chi-square test of independence was performed to examine the relationship or connection between the types of comments (supported or impeded) and the academic achievement groups.

3.5 Summary

This chapter provided an overview of how my research was undertaken and the reasoning behind the decisions made in its implementation. The methodology section began with a

description of the research design with justification for the use of a mixed method approach and how this approach supported the aim of the research and the research questions. To understand what was being researched, a brief description of the school and the population was given. The validity and reliability were then addressed. In the method section, I defined the process of gathering and analysing the quantitative data from the school database. Finally the procedure for gathering and analysing the qualitative data from the teacher interviews was explained.

CHAPTER 4

Results

4.1 Chapter Overview

This chapter reports the findings from the quantitative and qualitative data collected as proposed in Chapter 3 that addressed the research aim and questions. The aim of this research is to develop an understanding of whether, and how, SRA impacts academic achievement in the subject of science for female students in Years 7 and 8.

From this aim the three research questions are:

1. What correlation exists, if at all, between academic achievement and SRA for Year 7 and 8 female science students?
2. What characteristics of Year 7 and 8 female science students do teachers think influence academic achievement?
3. What might be the connection between SRA and the teacher-identified student characteristics that influence academic achievement?

To address the first question, this chapter presents findings on the strength and significance of the correlation between female students' academic achievements and their SRAs. Then to answer the second question, the five SCAAA that I developed from the interviewed teachers' opinions as to what characteristics of Year 7 and 8 female science students influence academic achievement will be described. This will lead to the introduction of the five SCAAA. Finally, the constructs labelled supported and the contrasts labelled impeded were used to demonstrate that the science teachers' opinions of the student characteristics that influence academic achievement were connected to SRAs.

4.2 The Correlation between Female Students' Academic Achievements in Science and their SRAs

Between the two variables of interest, academic achievement and SRA, the Excel software determined a line of best fit indicating a negative correlation (academic achievement decreases as SRA increases and vice versa). This is shown in Figures 1 and 2. The vertical axis of the graph represented the student's academic achievement in science, calculated as an average of the student's examinations and coursework results as a percentage for the school year 2012. The horizontal axis represented SRA, the student's relative age in days from the midpoint of the school year enrolment, a positive number of days born before the midpoint for enrolment for starting school or a negative number of days born after this midpoint. The line of best fit generated by Excel is labelled on the graphs as Linear.

Figure 1. Year 7 female student's science academic achievement versus SRA.

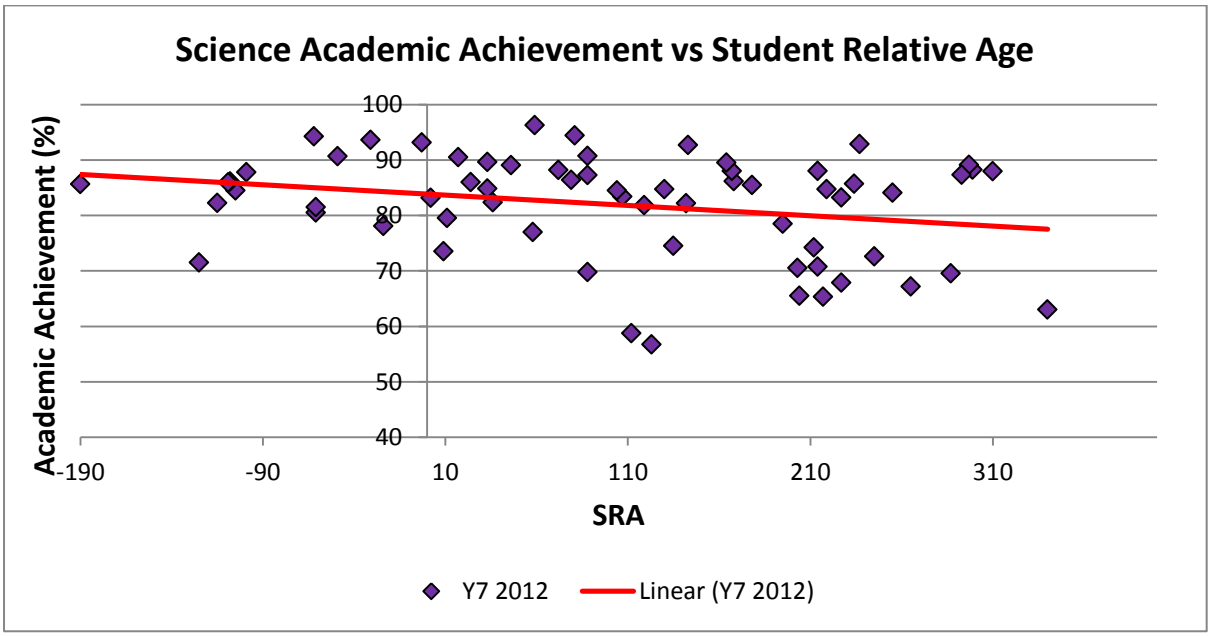
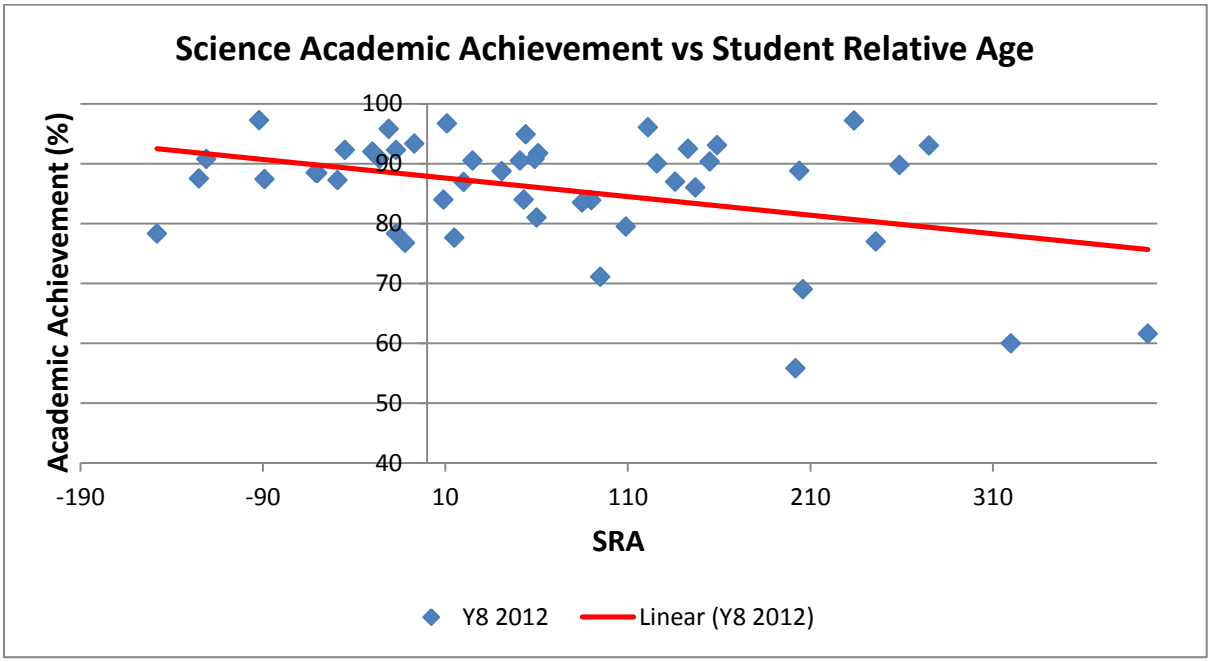


Figure 2. Year 8 female student's science academic achievement versus SRA.



4.2.1 The Pearson product-moment correlation coefficient, *r*.

The Pearson correlation coefficient *r* was computed to assess the relationship between female students' academic achievements and their SRAs in science for Year 7 and Year 8. The calculated *r* value indicated a negative correlation between the two variables in both Year 7 and in Year 8. For Year 7 students, academic achievement (M = 81.98, SD = 9.19) moderately and significantly negatively correlated with SRA (M = 102.58, SD = 129.24), r (63) = - .26, p = .036. For Year 8 students, academic achievement (M = 85.82, SD = 9.58) moderately and significantly negatively correlated with SRA (M = 67.63, SD = 122.36), r (63) = - .39, p = .006. Overall, at both year levels, a moderate and significant negative correlation existed between academic achievement and SRA. This indicated academic achievement decreases as SRA increases, and vice versa.

4.2.2 The Spearman rank correlation coefficient, r_s.

The Spearman correlation coefficient r_s was also computed to assess the relationship between female students' academic achievements and their SRAs in science for Year 7 and Year 8. This calculation was performed as the academic achievement results were slightly positively skewed. The calculated r_s value also indicated a negative correlation between the two variables in both Year 7 and in Year 8. For Year 7 students, academic achievement weakly and non-significantly negatively correlated with SRA r_s (65) = - .20, $p < .1$. For Year 8 students, academic achievement very weakly and non-significantly negatively correlated with SRA r_s (48) = - .19, $p < .1$. When the year levels were analysed as one set of data the calculated r_s value indicated, academic achievement moderately and significantly negatively correlated with SRA r_s (113) = - .25, $p < .01$.

4.2.3 The Older, Middle or Younger Students in a Cohort.

With the Pearson correlation coefficient r and the Spearman correlation coefficient r_s calculated between female students' academic achievements and their SRA established as moderate in strength and statistically significant, I wanted to investigate any difference in academic achievement between students with an older, middle or younger SRA. For this to occur the students required categorising into three groups for older SRAs, middle SRAs and younger SRAs. I defined older SRAs as being born before their year level enrolment date, middle SRAs as being born in the first six months of the of the year level enrolment dates and younger SRAs as being born in the last six months of the year level enrolment dates. As there were more than two groups, an ANOVA was first used to test for a significant difference between the groups. There was a significant effect for the Year 7 students of being in the older, middle or younger age group on academic achievement F(2,62) = 3.53, p = . 035. Also here was a significant effect for the Year 8 students of being in the older, middle or younger

age group on academic achievement F(2,45) = 5.88, p = . 005. As the direction of the correlation between academic achievement and SRA had already been established as negative, two sample, one tailed, t tests were performed to demonstrate any statistical significance between these age groups academic achievements.

There was a significant difference in the academic achievements in Year 7 between middle SRAs (*M*=83.2, *SD*=9.3) and older SRAs (*M*=77.9, *SD*=9.7), *t*(42) =1.96, *p* = .028 *d* = 0.56, 95% Cl [0.75, inf]. The difference in the academic achievements in Year 8 between middle SRAs (*M*=87.4, *SD*=6.3) and older SRA (*M*=76.9, *SD*=15.9) was also statistically significant at the specified .05 level, *t*(9) =1.96, *p* = .043 *d* = 0.95, 95% Cl [0.52, inf]. These results established a statistically significant disadvantage to student academic achievement in science when in the older SRA group of a cohort of Years 7 and 8.

There was no significant difference found in the academic achievements in Year 7 or in Year 8 when comparing the younger SRA group with the middle SRA group. For Year 7 younger SRAs (*M*=85.2, *SD*=6.2) and middle SRAs (*M*=83.2, *SD*=9.3), *t*(37) =0.85, *p* = .202 *d* = 0.26, 95% Cl [-2.00, inf]. For Year 8 younger SRAs (*M*=88.6, *SD*=6.1) and middle SRAs (*M*=87.4, *SD*=6.3), *t*(33) =0.56, *p* = .028 *d* = 0.19, 95% Cl [-2.23, inf]. These results indicated there is no statistically significant disadvantage to student academic achievement in science when belonging to the younger SRA group of a cohort of Years 7 and 8.

These results suggested that although a correlation between academic achievement and SRA existed across both year levels, the substantial effect occurred between those older students, born before the year level enrolment date and the rest of their cohort. I further examined this finding that the significant effect occurred between the older SRA students and the rest of the students in the discussion chapter, briefly, however, their lower academic

achievement may be due to the reasoning behind the student having their school entry delayed by a year.

4.3 Characteristics of Female Students That Teachers Think Influence Academic Achievement in Science

Five themes in relation to the characteristics that influence academic achievement of Year 7 and 8 female science students emerged from the data the interviewed teachers provided. These five themes, or five constructs and contrasts, I have labelled the five SCAAA. These were regarding the student:

- possessing or not possessing an aptitude for science;
- being motivated or indifferent;
- being confident or unsure;
- having a disposition or a reluctance to question; and
- possessing an accurate or an inaccurate perception of self.

The explanation as to how I arrived at each of these five opposite constructs and contrasts from the data the interviewed teachers provided will be addressed separately below, beginning with the student possessing or not possessing an aptitude for science.

4.3.1 Possessing or not possessing an aptitude for science.

In the interviews, the teachers mentioned several student characteristics which I coded as the construct, ‘possessing an aptitude for science’ or the contrast, ‘not possessing an aptitude for science’. Aptitude indicated a natural ability to do or understand something (The Australian Oxford dictionary, 2006) and therefore possessing an aptitude for science, is a

natural ability to do or understand science. Conversely, not possessing an aptitude for science is the lack of natural ability to do or understand something, so in this case science.

Examples of the student's characteristics the interviewed teachers spoke of that I coded as possessing an aptitude for science included such comments from teacher J as "both extremely intelligent", "all three of them were extremely bright" and "two of them were very intelligent … and mastered concepts easily". The types of statements made by teacher M coded in this construct included "both bright" and "great academic ability" and teacher N stated that "Both were naturally brighter than 3" and "with natural talent".

For these teachers, an important aspect of being successful in science is that there were some students who appeared to have innate science ability, or possessed an aptitude for science. Although this characteristic alone did not fully facilitate their success, it appeared to allow the students to demonstrate certain skills. For example, the teachers mentioned the ability to understand the more difficult theories and to master concepts easily. To demonstrate this, teacher J seemed to believe that possessing an aptitude for science can help students with higher order tasks in science, furthering their learning/understanding:

> She just struggled with science; she didn't understand things as easily as the other two did. You know the other two would grasp concepts quickly and they were quite insightful and the other two could analyse tasks whereas she found analysis tasks difficult. (Teacher J)

Furthermore, teacher J referred to a student who was "just extremely natural and an insightful thinker, very good analytically, great natural talent", again indicating this idea that possessing an aptitude for science appeared to enable students to undertake the more analytical tasks in science. Both teacher J and teacher M acknowledged the importance of

possessing an aptitude for science related to the student's academic achievement in this subject. They also appeared to indicate that with this aptitude, came higher order thinking skills that enabled the students to answer unseen questions and/or achieve higher academically. For instance, teacher M remarked when speaking of different students "All three of these girls are strong, so high academic potential, high results", "Both bright but able to apply what they have learnt to questions not seen before so higher order thinking questions" and "hard working, bright, has the ability to do high order thinking". In addition to this, teacher J described some students' as "both extremely bright girls and … would be very higher order thinkers".

While the teachers commented on the positive side of possessing an aptitude for science, they also mentioned opposing characteristics, an inability for science or not possessing an aptitude for science. For instance, teacher N commented about one student explaining, "Although they weren't naturally as bright at science." Moreover, teacher M, when asked about a particular student's science learning answered "is exceptionally weak, definitely has a memory problem" and described another student as "not being able to then do the high order questioning".

Furthermore, in this excerpt the teachers described students that just struggled with science:

> …is a very weak academic student I think has both visual and auditory problems, not to the extent she would be diagnosed with but I think she struggles to listen, see, hear all at the same time, she is a slow worker. (Teacher M)
>
> …has real learning difficulties and no matter how hard she tried, she would come to extra help, but it didn't, she did quite well but misinterpreted questions sometimes you

could ask her things orally she would get it and could explain it to you but to respond to a question on paper she couldn't do it as well. (Teacher J)

All three teachers perceived characteristics that I coded as not possessing an aptitude for science, that they stated impeded a student's academic achievement. In their opinions, science appeared difficult for some of their students to learn. This was demonstrated by teacher N's quote "Two of them really struggled, were not as naturally bright as the other".

Another example of this was:

> …both working hard to um they were both motivated to achieve success, with mixed success depending on the topic so they didn't have that sort of general always achieve greatness, but occasionally you would get that really good result out of them. (Teacher J)

The teacher's use of phrases like; "naturally bright" (teacher N), "naturally as talented" (teacher J) and "great academic ability" (teacher M) when describing the student characteristics that support academic achievement in science seemed to suggest that the three interviewed teachers perceived that the characteristic of possessing an aptitude for science supports academic achievement in the subject of science. Conversely, phrases like "wasn't naturally as talented" (teacher J), "Lower order thinking" (teacher M) and "not as naturally bright" (teacher N) left me with the impression the three teachers interviewed felt the characteristic of not possessing an aptitude for science impedes the individual student's academic achievement.

Accordingly, possessing or not possessing an aptitude for science became one of the five SCAAA. Another theme that surfaced from the data the interviewed teachers provided was regarding the student being motivated or indifferent.

4.3.2 Being motivated or indifferent.

In the interviews, the teachers referred to several student characteristics which were related to science learning and academic achievement which I coded as the construct ‘being motivated’, or the contrast ‘being indifferent’. Examples of characteristics the teachers mentioned in their interviews regarding students that I coded as ‘being motivated’, included such remarks from teacher N as “worked really hard”, teacher J discussed a student as “keener to do well” and teacher M indicated a student that did “apply themselves and studied hard”.

Examples of characteristics mentioned by the teachers that I coded as ‘being indifferent’, included when teacher N explained that a student “did not really make an effort” and teacher J said one of her students had “little interest in the work”. Another example of being indifferent was when teacher M said that two of her students “are lazy and have a negative attitude towards science”.

4.3.2.1 Being motivated.

Motivation means having internal and external factors that stimulate desire and energy in people to be continually interested and committed (D. McInerney & McInerney, 2006), in this case, to their science learning and academic achievement in science. The teachers indicated that a level of motivation enabled students to do well academically, “One of them was much keener to do well, worked hard to do well” (teacher J). Teacher J also described a student as “Very highly motivated, very keen to understand, always asked questions if at any time they didn’t understand. They would attend extra work, emailed constantly, always wanted to be on top of things and to make sure they understood everything”. In teacher M’s class two students “are hard-working, there is a proudness about their work”. In addition,

teacher N noticed about her students that “one did do a fair bit better as they were motivated to do better, they were interested in their marks and maybe the subject matter” and for teacher J her student “wanted to do well and so would really um work towards that in class and at home so they would complete all the tasks that you set them”.

For the interviewed teachers an important aspect of a student being successful in their science academic achievement was the student having characteristics of wanting to do well, or being motivated to do well.

In the interviews, the teachers did not explain why these students were motivated, or where their motivation came from. They may have been more interested in the subject matter or keener to achieve higher marks or their parents may have placed higher expectations on them.

4.3.2.2 Being indifferent.

Facilitated by the design of the interview questions, to the 'being motivated' construct the emerging contrast I coded as 'being indifferent'. Indifferent, means to have no particular interest, sympathy or care or to be unconcerned (The Australian Oxford dictionary, 2006) in this case, about science or their academic achievement in science.

In the interviews, the teachers referred to an indifference they suggested was impeding the student's academic achievement in science on a number of levels. Indeed, teacher J commented on individual students' approaches to science and on how she saw these approaches influencing the student's academic achievement: "the other one had no, very little interest in the work and struggled ... she wasn't driven she didn't see it as a priority she had other subjects she did well in". Also, another student "did very little extra homework and didn't seem to care whereas the other two cared and were motivated to do well" (teacher J).

Teacher J described a student whose indifference resulted in low academic achievement:

> one of them didn't really care, didn't want to be there, always wanted to be the first out of the door, um any test we had she was the first finished and it was always far and away the worst in the class. (Teacher J)

For teacher J, an aspect that decreased the likelihood of higher academic achievement in science was a student's indifference to the subject. Teacher N's answers to interview questions indicated she agreed, as she described one of her students as "not interested in the subject matter, she was not interested in doing well" and a second student "who wasn't really engaged in the subject and did not really care about her achievement". Likewise, teacher M appeared to encounter indifference in her classroom. She said she had students that were

“also disinterested in science and lazy and hard to get to do anything” and another student that “definitely has some learning issues but also lazy and not willing to put in the time”.

In brief, the teachers’ comments appeared to offer an indication that the three interviewed teachers recognised that being motivated (for whatever reason) supports academic achievement in the subject of science. Conversely, in the teachers’ opinions, being indifferent to science (again for whatever reason) impedes the student’s academic achievement. Accordingly, being motivated or indifferent became one of the five SCAAA. A further theme appeared in the data the interviewed teachers provided, it concerned the student being confident or unsure.

4.3.3 Being confident or unsure.

The third group of student characteristics highlighted by the teachers around the students’ science learning and academic achievement, I coded as the construct, ‘being confident’ or the contrast, ‘being unsure’. Confident, means the feeling or belief that one can have faith in or rely on oneself or one's abilities (The Australian Oxford dictionary, 2006). Unsure indicated not feeling or showing confidence and certainty.

To demonstrate the type of characteristics I coded as being ‘being confident’, teacher J talked about students who “were very confident in their ability” as well as another student who was “able to work quietly and confidently”. Furthermore, teacher N described one of her students by saying “she was sure of herself”. For the contrast being unsure, examples of characteristics I coded included when teacher M said one of her students “lacks self-confidence” and teacher N said of a student “even hesitant about their learning of science”. In teacher J’s class she recalled a student that “didn’t have a lot of confidence”.

Teacher J commented on a number of her students and that their confidence influenced their understanding of—and academic achievement in—science. For instance, two students she described "were very confident in their ability…They just would go and do further research um they felt comfortable with topics and they would go, do extra so they gained greater understanding". Also other students that "were very confident in their ability and would work away industriously... would just get along and do things and usually got it right." (Teacher J).

Finally, teacher J explained how it worked for one of her students:

> She was just able to work quietly and confidently in class independently and so didn't need me to monitor her as much, even though I did, she was just able to get on with the task, so she probably achieved more in class because of that.

Therefore, I suggest for teacher J an important aspect of being successful in science is that there were students who appeared to exhibit confidence in their science ability. This enabled the students to achieve more and create a greater understanding. Whilst being confident appeared to support academic achievement in science, in the interviews, being unsure appeared to impede a student's academic achievement.

Teachers J and M both commented on students without confidence, students that were unsure of themselves and its negative impact on their science learning. For example, when clarifying one of teacher J's responses I asked her "How do you think the lack of confidence impacted on their science learning?

Teacher J answered:

> They were not willing to show, or answer questions or ask for help in case they were wrong. Or well this is my interpretation in case they felt they looked sillier or silly, so that was a big issue with those two.

In relation to another student, where being unsure was perceived to influence their academic achievement, teacher J spoke about "quiet but never asks questions, disorganised umm seemed to lack confidence in her ability and mixed success in science". Teacher M described a student in her class as "lacks self-confidence, lacks knowledge of her own ability, an inability to do application type questions, resilience is low with her". Additionally in teacher J's class, a student was described as "didn't have a lot of confidence they needed constant reassurance". Other comments around students being unsure included "Lacked confidence…were very anxious… to the point of making themselves sick…they lost clarity on what the task was" (teacher J). Finally teacher M said about a student "If there was something she couldn't learn she wouldn't cope"

Just as being confident or possessing self-assuredness was indicated as supporting the learning of science and academic achievement, a lack of confidence or being unsure appeared to impede science learning and academic achievement. Although it may be argued that low science learning causes a lack of confidence in the student, as teacher J mentioned "and generally did really well but I remember one topic she came a cropper, I don't know why and that knocked the wind out of her sails". Furthermore teacher J said of another student "had become disengaged through lack of successes".

From these teacher observations it is suggested being confident was another indication of a characteristic that supported academic achievement in the subject of science and being

unsure impeded a student's academic achievement. For that reason, being confident or unsure became one of the five SCAAA. An additional theme emerged from the data the interviewed teachers provided, it concerned the student having a disposition or a reluctance to question.

4.3.4 Having a disposition or a reluctance to question.

The fourth theme of student characteristics the teachers mentioned regarding students' science learning and academic achievement arose from the interviews. I coded these characteristics as the construct 'having a disposition to question', or the contrast 'having a reluctance to question'.

Disposition means a predominant or prevailing tendency (The Australian Oxford dictionary, 2006). So the construct 'having a disposition to question', insinuated a student had a prevailing tendency to ask questions. Reluctance inferred unwillingness or disinclination to do something (The Australian Oxford dictionary, 2006), therefore the construct 'having a reluctance to question' implied the student did not ask questions.

Samples of the descriptions I coded as a student having a disposition to question, existed when the teachers referred to students as "she would ask more questions" (teacher N), "who asked for help" (teacher J) and from teacher M "high order questioning". Examples of the descriptions that I coded as a student having a reluctance to question, were when the interviewed teachers described students as, "would not ask questions I had to ask her" (teacher N), "they would never put their hand up" (teacher J) and also from teacher J "they would just suffer in silence".

Teacher J and N explained generally how having a disposition to question helped them to teach and supported their students' academic achievement, "I think if I knew where they were at, it's much better, so I would prefer students to be asking and making comments and giving

me some feedback as to whether they understood what I was doing" (teacher J). Teacher N clarified about her student "so she would ask more questions to check her understanding and this then delivered better results". Also an explanation of "All three were very bright girls…They asked a lot of questions always queried their understanding" (Teacher N).

Teacher J believed that a student having a disposition to question, may be an important aspect of higher academic achievement in science as it allowed her to check the student's understanding and add or correct if necessary. Her quote demonstrated this "you knew if they didn't understand something they would tell you and you could provide the feedback" (Teacher J).

She also added about other students:

> I had time to monitor their understanding and correct any misunderstandings, whereas the other one worked quietly and quite often struggled on tests because she hadn't really mastered something when she worked quietly and I didn't always get the impression she didn't get something until the assessment. (Teacher J)

Teachers J and N indicated for a number of students having a reluctance to question influenced negatively on the student's academic achievement. This is shown by teacher N's comment, "I think she struggled a little bit with the material and then did not question any of her learning".

Teacher J supported this view, as shown in a comment about a student:

…very quiet and not as confident, not as inclined to ask for assistance not inclined to ask for assistance at all, and not even, I don't think she has ever asked a question in class…she would often not complete the whole lot because she had misinterpreted or not done the whole task because she hadn't read the question properly so it did affect her learning.

Adding about two other students:

> …the other two you wouldn't have known they were in the room and struggled they would have benefited from asking more questions…I mean I did, I did address their understanding but they weren't forth coming to let me know. I had to find it out myself. (Teacher J)

Teacher J also compared students that just worked hard (without asking questions) to the students who asked a lot of questions and teacher J inferred this coincided with better academic achievement, "but tried hard…had worked really, really hard …often didn't ask for that extra bit of help I find the ones who really hound you are the ones you get to know and do really well". The interviewer clarified this comment by asking, "And do you think if they asked you questions they would have got better results?" Teacher J replied, "Yes, yes definitely".

Teacher J and N indicated that having a disposition to question, or the asking of questions was a major contributing characteristic to a student's academic achievement in science. An example of this was when teacher J explained, "Two of them were again, the kind of girls who asked for help they would be able to be involved in class discussions and then challenge their understanding". Furthermore, teacher N remarked about a student "The other was probably equally as smart, but asked questions and did all the work so achieved better results". Concerning an additional student teacher N reiterated this association between questioning and academic achievement, "Well as she was motivated and asked questions her knowledge improved". Likewise, when teacher J explained the difference between three of her students, she implied that questioning helps students construct meaning:

> …were both quite umm able to verbalise anything they didn't understand whereas 12 I don't think asked a question all year um and they would check, confirm any misconceptions and try and make sense of what was going on. They would try to construct meaning.

The interviewed teachers implied that with the characteristic of having a disposition to question, students could improve their science learning and consequently their academic achievement in science. This questioning not only allowed the teacher to correct any misunderstandings and fill in gaps, but gave students the opportunity to test their science understanding.

Teacher J talked of the timing of some of her student's questioning and how that influenced a student's science learning.

> …she could work and then come and see me. She would ask questions and you knew it was from genuine, "I've tried to do this, I don't get it, can you help me out here?", whereas a lot of the others just as soon as they don't get it, straight away, " What's this? What's this?" without having tried to work through it themselves".

and

> …she could just um spend the time to try and work things out herself and by doing that developed a bit more understanding than the other two. As soon as they didn't understand the first little bit they didn't have the resilience to persist to try and work it out themselves and I think they lost a bit of the understanding you get along the way and the sense of achievement you get and the ownership you get of the solution.

Teacher J's quotes demonstrated her perception that even though asking questions or being vocal around a student's own learning is an important aspect of being successful in

science, there is more benefit to the student if they attempt to work through it for themself first, not just putting their hand up straight away.

In summary, teachers J and N considered the ability to ask questions about learning or having a disposition to question, as a characteristic that supported academic achievement in science. Conversely, they indicated that a lack of this skill or having a reluctance to question, impeded academic achievement in science. The teachers gave the impression this questioning allowed the teacher and student the ability to check and construct the students' understanding. Teacher J also viewed the timing of the questioning as important, that it better equips the student if they have spent some time thinking about what they do not understand before they ask. Although teacher M did mention questioning, the theme did not reoccur in her interview.

Having a disposition or a reluctance to question became one of the five SCAAA. A final theme surfaced from the data the interviewed teachers provided, concerned with a student possessing an accurate or an inaccurate perception of self.

4.3.5 Possessing an accurate or inaccurate perception of self.

As well as possessing or not possessing an aptitude for science, being motivated or indifferent, being confident or unsure, having a disposition or a reluctance to question, a fifth and final theme of perceived student characteristics that influenced academic achievement surfaced from the interviews with the teachers. I coded these characteristics as the construct ;possessing an accurate perception of self', or the contrast 'possessing inaccurate perception of self'. Perception is defined as becoming aware of, self-perception is defined as becoming aware of yourself (The Australian Oxford dictionary, 2006). Possessing an accurate perception of self, indicated a student had a correct view of their abilities. Possessing an inaccurate perception of self, denoted a student has an incorrect view of their abilities

Illustrations of observations of student's characteristics I coded as a student possessing an accurate perception of self, were when the teachers referred to students as, "... was quite aware of her weaknesses and short comings" (teacher J) and "…knew what to ask to consolidate her knowledge" (teacher N).

Samples of characteristics I coded as a student possessing an inaccurate perception of self, were when the interviewed teachers referred to students as, "…have a misconception that they were not aware" (teacher N). Also when teacher J said of a student "…didn't realise how much she needed help" and when teacher M explained of a student "…lacks knowledge of her own ability".

The interviews indicated teachers J and N thought possessing an accurate perception of self, possibly was one of the more significant student's characteristics of academic achievement in science as it allowed the student to act on their own learning. For instance, teacher J illustrated that one of her students, "…realised her performance didn't match her effort and half way through the year that she changed her approach to revision and you could really see that in her work". Teacher J talked about other students, "…they didn't ignore the fact that they needed extra help they both wanted to do well and would come and do work for you". Similarly, teacher N suggested about a student, "… knew how she learned and this consequently aided her to do really well."

Teacher J and N indicated for a number of students possessing an inaccurate perception of self, influenced negatively on the student's science learning. The teachers' quotes demonstrated that they felt the student thought they were fine, when in reality they had a misunderstanding, so any errors or misconceptions went unacknowledged and therefore unable to be corrected. Teacher N explained, "I don't think she even knew that she did not know...which left her no options to improve", this idea was substantiated when teacher J

talked about a student “I’m ok, I don’t need help, but it didn’t translate in that she was delusional”. Further examples included, “Misunderstand a task or just have a misconception that they were not aware of so it wasn’t corrected” (teacher N) and “Well she just figured that she understood, so any misconceptions were not picked up” (teacher N) and finally “…quite capable but didn’t realise, they underestimated their own ability” (teacher J).

To summarise, it seemed teachers J and N considered the characteristic of possessing an accurate perception of self or the ability to accurately look at oneself and one’s learning as a basic feature that supported science learning and academic achievement. It also appeared that the teachers implied possessing an inaccurate perception of self, negatively affected or impeded students’ science learning and academic achievement. The teachers gave the impression that possessing an accurate perception of self would allow the student to change tack if necessary and to ask for help. Whereas, if the student possessed an inaccurate perception of self, the student did not even know they required help and this appeared to impede academic achievement. For that reason, possessing an accurate or an inaccurate perception of self became one of the five SCAAA. Although teacher M did mention possessing an inaccurate perception of self, the theme did not reoccur in her interview.

In summary, the five SCAAA were: possessing or not possessing an aptitude for science, being motivated or indifferent, being confident or unsure, having a disposition or a reluctance to question and possessing an accurate or an inaccurate perception of self. As to establish whether any connections existed concerning SRA and these five SCAAA the teachers identified, I manipulated the qualitative data into quantitative data, for further analysis.

4.4 Connections Made Concerning SRA and the Characteristics the Teachers Identified that Influence Academic Achievement

After I coded the teacher's comments that described the student's characteristics that influenced academic achievement as either supported or impeded (academic achievement), these were loaded into an Excel spreadsheet against each student ID number and SRA. These coded teachers' comments were combined for Year 7 and Year 8 to facilitate a larger sample size for analysis. The number of students in each SRA group, the number of comments coded as supported or impeded per SRA group, the percentage of comments coded as supported or impeded per SRA group along the average number of comments per student per SRA group is presented in Table 1.

Table 1

The number of supported and impeded academic achievement comments for each SRA group

Type of Comment	Older SRAs (n = 30)	Middle SRAs (n = 53)	Younger SRAs (n = 30)
Supported	29 (M = 0.97)	78 (M = 1.47)	56 (M = 1.87)
% Supported	45%	64%	72%
Impeded	36 (M = 1.20)	44 (M = 0.83)	22 (M = 0.73)
% Impeded	55%	36%	28%
Total Comments	65 (M = 2.17)	122 (M = 2.30)	78 (M = 2.60)

Note. Older SRAs = students born before the year level initial enrolment date (before 30/4 previous year). Middle SRAs = students born in the first 6 months of the year level enrolment dates (1/5 - 31/10). Younger SRAs = students born in the last 6 months of the year level enrolment dates (1/11 - 30/4).

To examine the relationship between the SRA groups and the types of comments, a chi-square test of independence was performed. The relation between these variables was significant, X^2 (2, N = 265) = 11.62, p =.003. In other words, the numbers of supported comments (and impeded comments) were significantly different between the SRA groups.

The younger SRA group received significantly more supported comments than the other two groups, as the older SRA group received significantly more impeded comments than the other two groups.

To examine the relationship between the academic achievement groups and the types of comments, a chi-square test of independence was performed. The relation between these variables was significant, X^2 (2, N = 265) = 64.64, p =.000. In other words, the numbers of supported comments (and impeded comments) were significantly different between the academic achievement groups. The top 3rd academic achievement group received significantly more supported comments than the other two groups, as the low 3rd academic achievement group received significantly more impeded comments than the other two groups.

4.5 Summary

To summarise the results presented in this chapter, the research has found a correlation between academic achievement and SRA for Year 7 and 8 female science students. The correlation was negative (academic achievement decreases as SRA increases and vice versa), moderate in strength and statistically significant. There was a significant difference in the academic achievements between the middle SRAs and the older SRAs in Year 7 and in Year 8. These results show there is a statistically significant disadvantage to student academic achievement in science when belonging to the older SRA group of a cohort of Years 7 and 8. There was no significant difference found in the academic achievements in Year 7 or in Year 8 when comparing the younger SRA group with the middle SRA group.

Five themes in relation to the characteristics that influence academic achievement of Year 7 and 8 female science students emerged from the data collected in the teacher interviews.

These five themes, or five constructs and contrasts, I have labelled the five SCAAA. These were regarding the student:

- possessing or not possessing an aptitude for science;
- being motivated or indifferent;
- being confident or unsure;
- having a disposition or a reluctance to question; and
- possessing an accurate or an inaccurate perception of self.

Finally, the individual comments from the teacher interviews were labelled as either supported (academic achievement) or impeded (academic achievement). This data was then used to determine a statistically significant connection between SRA and the characteristics the teachers identified that influence academic achievement. The younger SRA group received significantly more supported comments than the other two groups, as the older SRA group received significantly more impeded comments than the other two groups. These comments were also used to demonstrate a statistically significant connection between academic achievement and the characteristics the teachers identified that influence academic achievement. The top 3rd academic achievement group received significantly more supported comments than the other two groups, as the low 3rd academic achievement group received significantly more impeded comments than the other two groups.

CHAPTER 5

Discussion

5.1 Chapter Overview

The two aims of this chapter are to firstly revisit the three research questions posed at the beginning of this study, and to present discussions of the findings of this study in light of the literature review presented in Chapter 2

The aim of this study was to develop an understanding of whether, and how, SRA impacts academic achievement in the subject of science for female students in Years 7 and 8. This aim was investigated through responding to three research questions. I address each question with the proposed answer and discussion individually, beginning with the first research question.

5.2 Research Question 1: Correlation between SRA and Academic Achievement

What correlation exists, if at all, between academic achievement and SRA for Year 7 and 8 female science students?

The data from my study indicates a negative correlation between female students' academic achievements and their SRAs in Year 7 and 8 science. Therefore, academic achievement decreases as SRA increases and vice versa. This is a moderate negative and statistically significant correlation for Year 7 (p=.036) and Year 8 (p=.006) students. There exists a significant difference in the academic achievements between the middle SRA group and the older SRA group in Year 7 (p = .028) and in Year 8 (p = .043). There is no significant difference when comparing the younger SRA group with the middle SRA group in their academic achievements at either year level. These results show a statistically significant

disadvantage exists to student academic achievement for female students in science in the older SRA group in a cohort in Years 7 and 8. On the other hand, these results also show there is no statistically significant disadvantage to female students' academic achievement in science when in the younger SRA group in a cohort of Years 7 and 8.

The four major themes for discussion evolving from my results that answer research question 1 are:

- A confounding variable.
- Different studies investigating the correlation between academic achievement and SRA present opposing results, some research indicates a positive correlation other studies find a negative correlation, as this research does.
- The correlation of my data is stronger for Year 8 than Year 7.
- My data reveals there is no disadvantage to being a younger female student in a cohort.

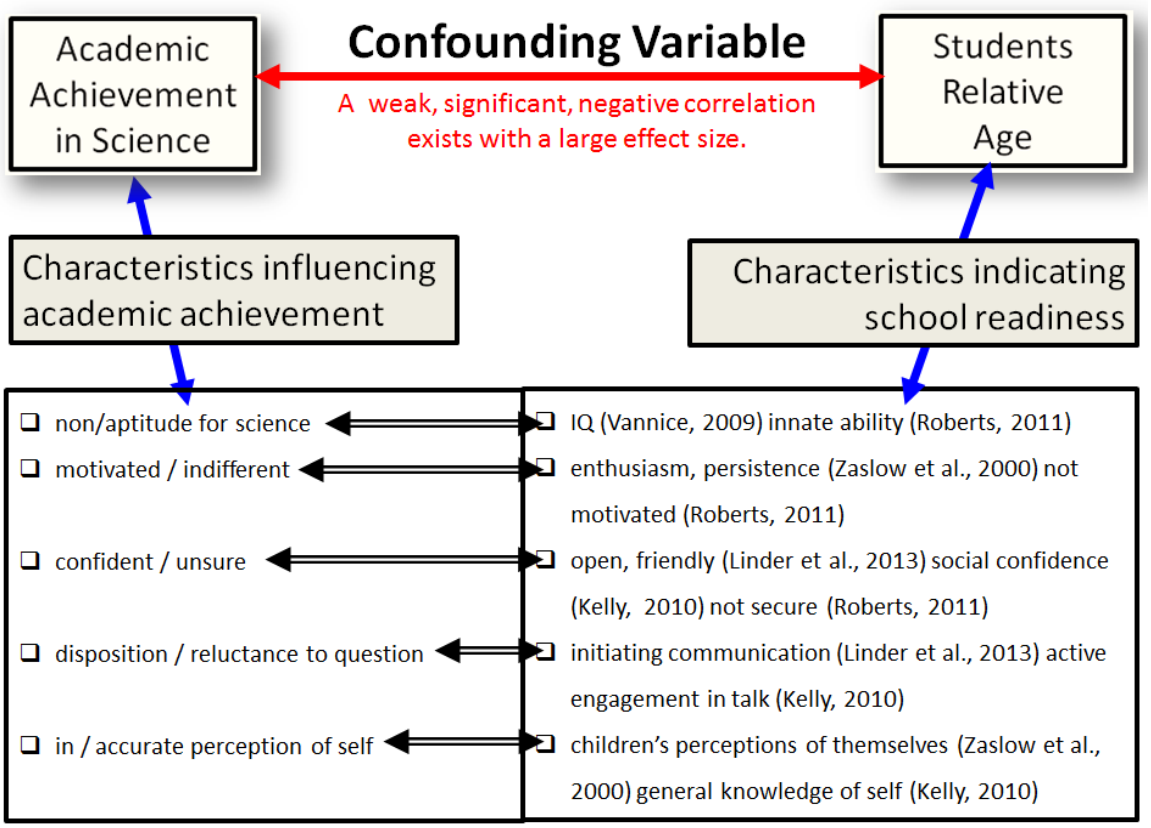
These four major themes are considered, when discussing the findings for research question 1.

5.2.1 A confounding variable between SRA and academic achievement.

While a comparative approach explores the relationships amongst variables, it does not include the experimental manipulation of variables and consequently the results cannot establish a cause and effect association (Mertens & Laughlin, 1995). Consequently, the correlation between academic achievement and SRA may be as a result of a confounding variable. A confounding variable is a variable that correlates with both the other two variables (Frank, 2000).

The data gathered to answer the second research question, "What characteristics of Year 7 and 8 female science students do teachers think influence academic achievement?" may provide a clue to what this confounding variable might be. The characteristics that influence academic achievement may be the same characteristics that decide whether the student has a younger, middle or older SRA (i.e. their school readiness). This confounding variable relationship is shown in Figure 3.

Figure 3. The confounding variable relationship with academic achievement and SRA.



Investigating what researchers say indicates school readiness, a plethora of characteristics can be found, but common themes do emerge. I have categorised a few common characteristics that line up with my five SCAAA. Similar to possessing an aptitude for science, Vannice (2009) suggests that a child's IQ is statistically significant when predicting school readiness. Along the same lines, Roberts (2011) proposes a child's innate and acquired

academic ability affects their school readiness. Comparable to being motivated or indifferent, Zaslow, Calkins, Halle, Zaff and Margie (2000) lists key components of school readiness to include enthusiasm, curiosity, and persistence on tasks. In relation to being indifferent, Roberts explains a child that is not motivated to learn will not be school ready. Like being confident or unsure, Linder, Ramey and Zambak (2013) mentions acting open and friendly, Kelly (2010) indicates a social confidence and Roberts clarifies that a child who is not secure will not be school ready. Having a disposition to question can be compared with Linder et al. claiming initiating communication is a skill that reflects school readiness as does active engagement in talk (Kelly, 2010). When looking at possessing an accurate perception of self, school readiness indicators were children's perceptions of themselves (Zaslow et al., 2000) and Kelly (2010) detailing that possessing general knowledge of self was considered important to school readiness.

A decision may be made to delay school entry by a year for the child demonstrating low school readiness. That child would become the old SRA group student with low levels of the five SCAAA and hence lower academic achievement. Whereas, the student demonstrating high levels of school readiness would be the middle or younger SRA group student with high levels of the five SCAAA hence higher academic achievement.

5.2.2 The opposing findings in current literature.

When considering the current literature on this topic of academic achievement correlating with SRA, conflicting findings are apparent (see Section 2.7). The results of my study indicate a negative correlation between academic achievement and SRA (academic achievement decreases as SRA increases and vice versa). My finding supports a number of studies that assert it is the younger students in the cohort who obtain higher academic achievement when compared with the older students in the cohort (Black et al., 2008; Dobkin

& Ferreira, 2007; Lincove & Painter, 2006; Martin, 2009). Other studies report the opposite phenomenon, a positive correlation between academic achievement and SRA (academic achievement increases as SRA increases and vice versa). My findings do not support the studies that assert it is the older students in the cohort who obtain higher academic achievement when compared with the younger students in the cohort (Cobley & Mc Kenna, 2009; Crawford et al., 2007; Lien et al., 2005; Sampaio et al., 2011; Sprietsma, 2010; Zubero et al., 2008).

Part of an explanation to the differing nature of these studies' results may be found in exploring how it is the students end up at school being either older or younger in a cohort. As stated on the Victorian Department of Education and Training (2014) website, "By law all children aged between six and 17 in Victoria must be enrolled at a registered school or registered for home schooling unless they have a reasonable excuse". The site also lists some exemptions to the above, including "where a student has reached 6 years but has not started school and will be enrolled in a second year of kindergarten". Kratzmann and Schneider (2009) suggest this delaying school entry by a year or completing a second year of kindergarten is primarily because professionals (kindergarten teachers) rate a child as not ready for school. These students who have reached 6 years old and attend a second year of kindergarten become the older group of students in a cohort (born before the year level enrolment dates) when they begin school in the following year. So, if there is doubt around whether a child is school ready or whether they would benefit from another year's maturation or whether they are just going to find school challenging, they could attend a second year of kindergarten. My study found it is this group of students (born before the year level enrolment dates) that tend to have the lowest academic achievement. Therefore, the students

whose school entry has been delayed by a year represent the older students in a cohort with lower academic achievement.

Not all families can afford to have their children in kindergarten for two years. A study by Bixby (2012) suggests an inadvertent consequence of delaying school entry by a year is the cost of an extra year of kindergarten or childcare. Low income families may not have this luxury of staying at home or paying for care (Bixby, 2012) and this may help clarify the statistic it is often the affluent families who delay school entry by a year for their children. Deming and Dynarski (2008) also raise this idea when they claim delaying school entry is most often practised by parents in the upper income brackets. Therefore, in areas of relative high wealth, the parents have the option to delay school entry by a year for their child that is deemed as not school ready. Many of the students in my study are from a high socio-economic background; this may allow the parents to choose to delay school entry by a year if deemed necessary, assuming that the financial situations of these families were already enabling when these students were young. Looking at my research data, the older SRA group is defined as being born before their year level enrolment date, before 30/4/99 for Year 7 and before 30/4/98 for Year 8. There were 21 Year 7 students categorised with older SRAs (or 32 % of the cohort) and nine Year 8 students categorised with older SRAs (or 19 % of the cohort). This suggests that 32% of Year 7s attended a second year of kindergarten or met another exemption and 19% of the female Year 8 students did as well. So what happens to the children that are rated as not school ready but are unable to delay school entry by a year?

If the professionals suggest a student is not school ready and the parents can afford to, they can delay school entry by a year. This means that the student will be one of the older students in the cohort. My data suggests it is this group of students (born before the year level enrolment dates) that have the lowest academic achievement. If the professionals suggest a

student is not school ready and the parents cannot afford to delay school entry by a year, the student may represent the younger students in the cohort but with lower academic achievement, as they were deemed not school ready. The difference in results from studies investigating the correlation between academic achievement and SRA (a positive correlation compared with a negative correlation) may be partly explained by this idea of not being able to afford, compared with being able to afford, to delay school entry by a year.

To discuss this further, some of the studies that indicate a positive correlation are from countries or areas where delaying school entry may not be a choice due to lack of parental wealth. Therefore, the children that are not school ready, or might find school challenging, are sent to school and may represent the younger students in the cohort with lower academic achievement. The studies I read are from a variety of countries. Examples of the country (or state) of origin for the research that claim the older students obtain higher academic achievement and their gross domestic product (GDP) per capita in US dollars are presented in Table 2.

Table 2

The country (or state) of origin for research that claim the older students obtain higher academic achievement and their GDP

Research	Country (or state)	GDP per capita in US dollars
Sampaio et al. (2011)	Brazil	$ 11,208
McEwan and Shapiro (2007)	Chile	$ 15,732
Zubero et al. (2008)	Spain	$ 29,863
Graue and DiPerna (2000)	Wisconsin	$ 39,308
Hutchinson and Sharp (1999)	England	$ 41,787
Mc Phillips and Jordan-Black (2009)	Northern Ireland	$ 41,787
Cobley and Mc Kenna (2009)	England	$ 41,787

Crawford et al. (2007)	England	$ 41,787
Lien et al. (2005)	Norway	$ 100,819

Examples of the country (or state) of origin for the research that claim that the younger students obtain higher academic achievement and their gross domestic product per capita in US dollars are presented in Table 3.

Table 3

The country (or state) of origin for research that claim the younger students obtain higher academic achievement and their GDP

Research	Country (or state)	GDP per capita in US dollars
Dobkin and Ferreira (2007)	California	$ 46,092
Lincove and Painter (2006)	America	$ 53,042
Martin (2009)	Australia	$ 67,458
Black et al. (2008)	Norway	$ 100,819

The anomaly of the Lien et al. (2005) study finding a positive correlation with a higher GDP could be explained by the fact that the Lien et al. study drew their data only from Oslo. Oslo is not listed on the World Bank website, but other sources list Oslo with a GDP of around $55,000 per capita in US dollars (brookings.edu, 2014; insidermonkey.com, 2014). This compared with the national average GDP of $100,819 may be considered lower. With this in mind, and by no means am I proposing any proof or significant relationship, it does appear the countries (or states) with the lower GDP per capita are the studies suggesting the older students obtain higher academic achievement. Conversely, the higher GDP per capita are the studies suggesting the younger students obtain higher academic achievement. Which encourages my suggestion that if there is uncertainty as to whether a student is school ready or whether they would benefit from another year's maturation or whether they are just going to find school challenging, in the more affluent countries/states they can delay school entry by a year and these students may represent the older students in the cohort with lower

academic achievement. However, if school entry cannot be delayed by a year due to a lack of parental affluence, these students may represent the younger students in the cohort with lower academic achievement. This explanation could be one part of a complexity of reasons as to why the current literature on this topic of academic achievement correlating with SRA are conflicting in their findings.

5.2.3 A Stronger Correlation for Year 8 than Year 7.

A number of studies that report a positive correlation between academic achievement and SRA (academic achievement increases as SRA increases and vice versa) suggest the strength of this correlation decreases as the students progress through secondary school. For example, Hutchinson and Sharp (1999) claim the academic advantage of being older in the cohort or the strength of the correlation, varies from substantial in the six-year-old cohort to being much smaller at age 12. Supporting this, Crawford et al., (2007) state the strength of their correlation progressively decreases, between the students of age seven and of age 16. Bedard and Dhuey (2006) also identify a weakening of the strength of the correlation, as the higher academic results obtained by the older students decline between Grades 4 and 8. All this being said, my study reports the opposite both in correlation (I report negative they report positive) and correlation strength (I report an increase from Year 7 to Year 8 they report a decrease over year levels). The the difference in academic achievement between the middle SRA group and the older SRA group are in Year 7 ($d = 0.56$) and in Year 8 ($d = 0.95$).

These differences between my study's findings and these other studies' findings in regards to the strength of the correlation, are explained by offering three valid reasons for their occurrences. Firstly, a number of studies suggesting a decreasing strength of the correlation for the academic achievement differences between age groups researched a particular cohort. Their investigations studied the correlation between academic achievement

and SRA following one cohort of students over a number of years, whereas my study looked at two different cohorts over one academic year. So, my opposing findings (I report an increase in the strength of the correlation from Year 7 to Year 8) could be caused by factors of the specific cohorts I investigated, rather than factors caused by the same cohort moving through school.

Another possible reason for my findings, when comparing the increasing strength of the correlation, could be that the teachers have lower expectations of my older SRA group. This group had lower academic achievement and they had a higher percentage of their characteristic comments as impeded academic achievement. Perhaps as the teachers perceived the older students to have less aptitude, less motivation and less questioning for science, the teachers demanded less of the student and this may have impacted negatively on the older SRAs groups' academic achievement, increasing the strength of the correlation.

Finally, the studies reporting a decreasing strength of the correlation over year levels also report a positive correlation. The studies reporting negative correlation did not include the strength of the correlation changes over the year levels. As I report a negative correlation between academic achievement and SRA (academic achievement decreases as SRA increases and vice versa) maybe this has a different consequence on year levels than the reported positive correlation.

5.2.4 No disadvantage to being younger in a cohort.

It is becoming more prevalent in first world countries for parents to delay school entry for their children for a year after they first qualify (Graue & DiPerna, 2000). Edwards et al. (2011) report this is to give the child a perceived cognitive and emotional head start or advantage. Furthermore, Lincove and Painter (2006) suggest some parents appear to be

concerned that their younger children will be disadvantaged and may struggle with demands of the formal education setting when compared to the older students in the cohort. The results from my study indicate there is no disadvantage to sending younger (in a cohort) children to school in the appropriate year level enrolment dates. In fact, my study indicates a moderate and significant advantage to being younger in the cohort on academic achievement. Of course, this is assuming a professional does rate the child as ready for school.

Summing up, the current literature on the topic of academic achievement correlating with SRA provides conflicting conclusions. With a number of assumptions, part of a very complex explanation may be rooted in the affluence of the study population. Where families can afford to, students who are perceived to have found school challenging can delay school entry by a year and may represent the older students in the cohort with lower academic achievement. Whereas, if the family cannot meet the expense of delaying school entry by a year, those students may represent the younger students in the cohort with lower academic achievement. An explanation for the differences in the strength of the correlations for Year 7 and Year 8 could be caused by factors of the specific cohorts. Finally, there is no academic disadvantage to sending a younger (in a cohort) child to school in the appropriate year level enrolment dates, as long as the child is ready for school. Indeed, my study finds there is an academic advantage to being younger in the cohort.

5.3 Research Question 2: Characteristics of Students that Influence Academic Achievement

What characteristics of Year 7 and 8 female science students do teachers think influence academic achievement?

Five themes in relation to the characteristics that influence academic achievement of Year 7 and 8 female science students emerged from the data the interviewed teachers provided. These five themes, or five constructs and contrasts I have labelled the five SCAAA. These were regarding the student:

- possessing or not possessing an aptitude for science;
- being motivated or indifferent;
- being confident or unsure;
- having a disposition or a reluctance to question; and
- possessing an accurate or an inaccurate perception of self.

The three major themes for discussion evolving from my results that answer research question 2 are:

- The five SCAAA show strong links with current literature
- The five SCAAA add to the knowledge on influences on academic achievement.
- The teachers did not indicate SRA as one of the five SCAAA.

These three major themes are considered, when discussing the findings for research question 2.

The five SCAAA not only verify current literature on characteristics that influence a student's academic achievement, but also further this discussion. Reviewing the qualitative research shows different personality characteristics and beliefs influence a student's academic achievements (Caprara et al., 2011; Dweck, 2006; McCrae & John, 1992; Qualter et al., 2012). Even though the terms or labels given to these characteristics and beliefs may appear to differ or overlap between studies, my research is in line with these findings. My study not

only supports the findings from previous research, but also brings new insight to the discussion. This new insight derives from the constructs and contrasts being opposites, that is, the student being motivated compared with a student that is indifferent. At one end of a spectrum, a characteristic the teachers perceive to support the student's academic achievement and at the other end an opposite characteristic that impedes academic achievement. Again, being confident or being unsure of yourself, being confident supports and increases the student's academic achievement, according to the teachers' perceptions, whereas the opposite, being unsure of yourself, according to the teachers' perception, impedes and decreases the student's academic achievement. So, as a consequence of the design of my research, an adaption of Kelly's (1991) repertory grid, we now have the five SCAAA that teachers perceive to support or impede academic achievement in the subject of science for Year 7 and Year 8 female students. These can be used as a tool by the school to help develop a greater understanding of how to improve academic achievement in the subject of science for Years 7 and 8 female students.

Current literature concludes that characteristics and beliefs influence a student's academic achievements. Initially, I addressed the research around the characteristics that influence a student's academic achievements and then the research around beliefs that influence a student's academic achievements. The five SCAAA demonstrate links with much of the current research on characteristics that influence a student's academic achievement. For example, I can see similarities with four of McCrae and John's (1992) Big Five characteristics (the five-factor model) that influence a student's academic achievement and the five SCAAA I identified from the interviewed teacher's in my study. For instance, joining McCrae and John's extraversion factor (assertive, enthusiastic and outgoing) and their neuroticism factor (anxious, tense and unstable) together are comparable to my being

confident construct or unsure contrast. In addition, McCrae and John's openness factor (imaginative, insightful and wide interests) are similar to my having a disposition to question construct. De Feyter et al. (2012) suggest from their research the conscientiousness factor (organised, responsible and efficient) positively influences academic achievement indirectly through academic motivation. This is another link or parallel to my findings, as being motivated is one of the five constructs that influence academic achievement I identified from the teacher's interviews.

As well as characteristics that influence academic achievement, a number of studies reference student's beliefs that influence academic achievement. Again, links can be drawn between these studies' findings and the five SCAAA which I suggest teachers perceive to influence academic achievement. For instance, Caprara et al. (2011) concludes self-efficacy (a person's belief in their ability to complete a task in the future) significantly influences academic achievement. This belief in your ability definitely connects with my being confident construct. Furthermore, Richardson et al. (2012) contend a large correlation is detected for self-efficacy and higher academic achievement, again linking with my being confident construct.

Overlaying the theory around a student's belief in their ability to complete a task in the future (self-efficacy) influencing academic achievement, Dweck (2006) has a slightly different view on beliefs that influence academic achievement. The Dweck model suggests students are on a spectrum with regards to their beliefs on intellect and learning. At one end, Dweck contends, the students believe there is an innate ability that comes with intelligence or a fixed amount, these students are categorised as fixed mindset. At the opposite end of the spectrum, students believe success is about what you do, for example, hard work, studying, seeking assistance and persistence, these students are categorised as growth mindset. These

mindsets can influence academic achievement; the fixed mindset impedes academic achievement, whereas the growth mindset supports academic achievement (Dweck, 2006). From my research, I suggest teachers perceive that a student possessing or not possessing an aptitude for science either supports or impedes academic achievement respectively. This perception echoes the Dweck fixed mindset. The teachers see the students as having a fixed ability that cannot change and Dweck suggests this is disadvantageous to academic achievement, that I concur with. The teachers also perceive that characteristics such as motivation can influence a student's academic performance. The teachers interviewed for my study perceive that students come with a fixed innate ability or an aptitude for science, but that this can be enhanced by being motivated, being confident, having a disposition to question or possessing an accurate perception of self. This suggests that, being the teachers perceive a fixed mindset (i.e. you come with a given amount of intelligence) to an extent, but one which can be enhanced with a growth mindset (your motivation, confidence etc.). With all this information on influencing characteristics for academic achievement, these studies do not mention age in the cohort or SRA. Furthermore, the interviewed teachers in my research did not mention age in the cohort or SRA as influencing academic achievement.

My study found a moderate and statistically significant correlation between academic achievement and SRA. Given this fact, it is interesting that none of the teachers interviewed stated that a reason for a student's high or low academic achievement is their SRA. With the new knowledge from my study (that academic achievement decreases as SRA increases) this can facilitate a discussion with teachers to equip them with more knowledge to focus on individual students' improvement of science academic achievement.

Summing up, the three major themes for discussion evolving from my results that answer research question 2 are the five SCAAA not only show strong links with current literature,

but also add to the knowledge concerning influences on academic achievement. This extra knowledge comes from the opposite nature of the constructs and contrasts. The five SCAAA do not include SRA.

Finally, I need to address the possibility that the teacher's opinion of a student may also be influencing the student's academic achievement as well as the student's characteristics. Murdock, Anderman, and Hodge (2000) suggest students' perceptions of their teachers' expectations of how well they will do in 7th grade is a more accurate predictor of their future college plans than students' view of their academic capabilities. In my study, the teacher's comments about the younger SRA group are 72% concerning characteristics that support academic achievement and the younger SRA group have the higher academic achievement. The older SRA group, where less than half of the teacher's comments (45%) are concerning characteristics that support academic achievement, have the lower academic achievement. So, are the teacher's opinions influencing the student's academic achievement? Which comes first, the student's achievement or the teacher's opinions?

5.4 Research Question 3: Connections Concerning SRA and Characteristics

What might be the connection between SRA and the teacher-identified student characteristics that influence academic achievement?

The data from my study indicates a statistically significant difference exists in the numbers of supporting comments (or impeding comments) for each SRA group.

The three major themes for discussion emerging from my results that answer research question 3 are:

- A statistically significant connection exists between SRA and the characteristics the teachers identified that influence academic achievement.
- A statistically significant connection exists between academic achievement and the characteristics the teachers identified that influence academic achievement.
- The teacher's expectations of a student influencing that student's academic achievement.

These three major themes are considered, when discussing the findings for research question 3.

After I coded the teacher's comments that described the student's characteristics influencing academic achievement as either supported or impeded (academic achievement) and sorted by SRA group, even at first glance, a connection did seem apparent. The comments the teachers made with regards to the younger SRA group are 72% for characteristics that supported academic achievement. The comments the teachers made with regards to the middle SRA group are 64% for characteristics that supported academic achievement. The comments the teachers made with regards to the older SRA group are less than half (45%) for characteristics that supported academic achievement. A linear trend appears to be present with the younger SRA group receiving a higher percentage of supported comments, followed by the middle SRA group, and then lastly, the older SRA group. When a chi-square test of independence was performed to examine the connection between the types of comments and SRA groups with more rigour, the relationship between these variables was found to be statistically significant. The numbers of supported comments (and impeded comments) were significantly different between the SRA groups. Indicating the younger SRA

group receives significantly more supported comments than the other two groups, as the older SRA group receives significantly more impeded comments than the other two groups. In other words, my results show that the teacher's comments (coded as supported or impeded academic achievement) and SRA group are not independent of one another (p =.003). Armed with this new information (SRA is connected with teacher comment type) I began to think of reasonable explanations for this connection.

As being younger in the cohort correlates with a higher academic achievement, then it is logical that the teacher's comments would be more around characteristics that support academic achievement for this younger SRA group. Likewise, the data shows the teacher's supported comments as a percentage of total teacher comments per group, were the least for the older SRA group. As being older in the cohort correlates with a lower academic achievement, then it is logical that the teacher's comments would be more around characteristics that impede academic achievement for this older SRA group. To investigate this more rigorously, I look to my results that show the teacher's comments and academic achievement group are not independent of one another either (p =.000). With this in mind, the dependence of SRA and teacher comment types possibly resulted from the even stronger dependence of academic achievement and teacher comment type. Contemplating the academic achievement dependence with teacher comment type lead me to consider what sound justifications for that connection may exist.

Research indicates that if a student believes their teacher expects them to be successful in a subject then the student will do well and becomes successful. For example, Murdock et al. (2000) proposes a student's perceptions of their teachers' expectations of how well they will do in 7th grade is a more precise predictor of the student's college plans than the student's view of their academic capabilities. The possibility of the teacher's opinion (or expectation)

of the student actually influencing the student's academic achievement and not the student's characteristics needs to be addressed. My results show that the teacher's comments (coded as supported or impeded academic achievement) and SRA group are not independent of one another (p =.003). My results also show that the teacher's comments and academic achievement group are not independent of one another either (p =.000). As this is statistically the case, then the question needs to be asked: which comes first, the student's achievement or the teacher's opinion? From the teacher's opinions, does the student academically achieve or from the student's academic achievements, does the teacher form their opinions? The data from my study does not provide the definitive answer to this question, nevertheless, the data does provide an exceptionally strong dependence link between the two variables of academic achievement and teacher comment type (p =.000).

It is worth noting here the teacher's supported academic achievement comments were very dependent on the students who do well, suggesting that teachers are aware of students who are doing well and why they are doing well. Compared to if the teacher's supported academic achievement comments were based on the students who were not doing well. This may indicate that the teachers do not know who is learning what and why in their classroom.

In summary, a statistically significant connection exists between SRA and the characteristics the teachers identified that influence academic achievement. As academic achievement is negatively correlated with SRA, the SRA versus teacher comment type could be due to the existence of a statistically significant connection between academic achievement and the characteristics the teachers identified that influence academic achievement. My study did not set out to answer the question of whether teacher's expectations of a student influence that student's academic achievement, therefore an answer is not included.

5.5 Summary

One of the main findings of this study is that a negative correlation exists between academic achievement and SRA for Year 7 and 8 female science students. The correlation is moderate in strength and statistically significant. This indicates the older students in a cohort, where school entry has been delayed by a year have a lower academic achievement compared with the age appropriate students (students whose birthdates fall within their year level enrolment dates) in the same year levels. This leads onto the second major finding of this study, that the younger students in a cohort are not academically disadvantaged.

The third major finding of this study is the development of the five SCAAA (five constructs and contrasts) identified from the opinions of interviewed teachers regarding characteristics of Year 7 and 8 female science students that influence academic achievement. The five SCAAA are: possessing or not possessing an aptitude for science, being motivated or indifferent, being confident or unsure, having a disposition or a reluctance to question, and finally, possessing an accurate or inaccurate perception of self. It was not investigated as to whether the teachers saw these characteristics as fixed or malleable. If the five SCAAA the teachers perceive to influence academic performance could be learnt, teachers and students can utilise this information to increase students' academic achievement in the subject of science.

CHAPTER 6

Conclusions, Implications and Limitations

6.1 Chapter Overview

This chapter firstly presents the three major educational conclusions my study reached. Secondly, the contributions to new knowledge are clarified, followed by the implications of the study and for policy making. The implications for professional practice are discussed and finally, the study limitations are addressed.

6.2 Conclusions Regarding the Research Questions

Three major educational conclusions originate from the analysis of the data for the three research questions. They are:

- A negative correlation exists between academic achievement and SRA.
- Younger students in a cohort are not academically disadvantaged.
- There are five SCAAA, namely, possessing or not possessing an aptitude for science, being motivated or indifferent, being confident or unsure, having a disposition or a reluctance to question and possessing an accurate or an inaccurate perception of self.

The two important conclusions resulting from investigating research question 1 are, firstly, that a correlation does exist between academic achievement and SRA, and secondly, that the younger students in a cohort are not academically disadvantaged. In fact, the data generated to answer question 1, indicates a moderate negative statistically significant correlation, exists between academic achievement and SRAs for Year 7 and 8 female science students. Demonstrating that academic achievement decreases as SRA increases, or more simply put, the younger students achieve academically higher than the older students in the

cohort. The fact that a correlation exists is an important conclusion in itself, as all teachers need to be aware of any early indicators for their students' academic achievement. Indeed, as a stand-alone indicator, SRA information needs to be supplied to all teachers before the school year commences, to allow for early intervention strategies for the older students in the cohort; especially those students born before the year level enrolment dates. These older students have significantly lower academic achievement when compared with the age-appropriate (birthdate within the year level enrolment dates) students' academic achievement.

The second important conclusion is, that no academic disadvantage occurs when sending a child that is younger in a cohort to school in the appropriate year level enrolment dates, as long as the child is ready for school. Indeed, my study finds there is an academic advantage to being younger in the cohort. Lincove and Painter (2006) suggest parents are concerned their younger children will be academically disadvantaged and struggle with formal education when compared to the older students in the cohort, yet, my study concludes this to be an inaccurate concern. When Edwards et al. (2011) report parents delay school entry by a year to give their child a perceived academic and emotional advantage, my study concludes this is an inaccurate perception. This new information, that not only is there no academic disadvantage to being younger in the cohort, and in fact, it is an academic advantage to be younger, should be used to advise school policy makers and management on recommendations they offer parents when the parents are deciding on the most appropriate age to enrol their child for school.

The one important conclusion resulting from investigating question 2 are the five themes in relation to the characteristics that influence academic achievement of Year 7 and 8 female science students that emerged from the data the interviewed teachers provided. These five

themes, or five constructs and contrasts, I have labelled the five SCAAA. These were regarding the student:

- possessing or not possessing an aptitude for science;
- being motivated or indifferent;
- being confident or unsure;
- having a disposition or a reluctance to question; and
- possessing an accurate or an inaccurate perception of self.

The five SCAAA not only show strong links with current literature, but also add to the knowledge concerning influences on academic achievement. This extra knowledge comes from the opposite nature of the constructs and contrasts.

Certain students' characteristics and beliefs influence their academic achievement (Caprara et al., 2011; Dweck, 2006; McCrae & John, 1992; Qualter et al., 2012). My results are in line with these findings, and expand on the current knowledge. The expansion comes from the idea around the opposing constructs and contrasts and the student being motivated compared with a student that is indifferent. At one end, a characteristic the teachers perceive support the students' academic achievement, and at the other end, an opposite characteristic the teachers perceive impedes the students' academic achievement. Again, being confident or unsure of yourself, being confident support the students' academic achievement, according to the teacher's perceptions, whereas the opposite, being unsure of yourself, according to the teacher's perception, impedes the students' academic achievement. So, as a result of the design of my research, an adaption of Kelly's (1991) repertory grid, we now have the five SCAAA that teachers perceive support or impede academic achievement in the subject of science for Year 7 and 8 female students. My school and teachers will utilise the SCAAA as a

tool by to help develop a greater understanding of the process to improve academic achievement in the subject of science for Years 7 and 8 female students. The SCAAA may not only be useful for teachers of female science students in Years 7 and 8, but also those teaching other subject areas and year levels.

The conclusion resulting from investigating question 3, is that a significant connection exists concerning SRA and the characteristics the teachers identified that influence academic achievement. As academic achievement is negatively correlated with SRA, the SRA versus teacher comment type could be due to the existence of a statistically significant connection between academic achievement and the characteristics the teachers identified that influence academic achievement. So, this then leads us to wonder which comes first, the student's achievement or the teacher's opinion? From the teacher's opinions, does the student academically achieve or from the student's academic achievements, does the teacher form their opinions? It is not clear whether the fact that the teacher perceives a student to have an aptitude for science, impacts the students achievement. The teacher may expect more from that student, and consequently may be more rigorous with that student's learning, this student may achieve better results. Or, is it simply that if you have an aptitude for science you will perform better academically than a student who does not possess an aptitude for science? My study did not set out to answer the question concerning whether teachers' expectations of a student influence that student's academic achievement, therefore the answer is not resolved.

6.3 Contributions to New Knowledge

There are two key findings that further the discussion on SRA and academic achievement. Firstly, an interesting outcome from my research, that was not apparent previously, is the finding that if a female student is younger in a cohort, that being younger, on its own, is not detrimental to that child's academic achievement. In fact, they may be one of the better

performing female students in science in their year level. Secondly, the five SCAAA the teachers perceived to support or hinder student's academic achievement, can be used by schools to develop a greater understanding of how to improve academic achievement in the subject of science for Years 7 and 8 female students.

6.4 Implications of the Study

I will address the implications of my study under three headings. Firstly, I will cover the implications for future research; followed by the implications for policy makers; and finally, include the implications for professional practice.

6.4.1 Implications for future research.

There are a number of possibilities for future research relating to the three questions of this thesis. Initially, although my quantitative data is aligned with the negative (SRA increases as academic achievement decreases and vice versa), increasing correlation (the correlation increases at higher year levels) models, I have only looked at a narrow band of students. The study was undertaken in an Australian private school, investigating 113 Year 7 and 8 students. The students in my study were female, as I taught in a girls' middle school and thus there was convenient access to participants, and not because this is gender based research. Research within different schools, subjects, year levels and encompassing both genders would be required in order to reveal any underlying reasons for the correlation my study found.

Another key finding of this research is the qualitative data highlighting the five SCAAA that teachers perceived to either support or hinder academic achievement. Further research would be beneficial concerning whether the teachers believed these characteristics to be fixed or malleable.

6.4.2 Implications for policy making.

A negative correlation exists between academic achievement and SRA that indicates the younger students in a cohort are not academically disadvantaged. This information should be used to advise school policy makers and management on recommendations that they can offer parents when deciding on the most appropriate age to enrol their child for school. School policy makers ought to be aware of this negative correlation between academic achievement and SRA when deciding on information to provide to teachers about their students. It is imperative teachers are given as much information about their students to improve academic achievement, and this includes the students SRA.

6.4.3 Implications for professional practice.

There are five SCAAA identified from what the interviewed teachers perceived contributed to the students' academic achievements in the subject of science. They are the students: possessing or not possessing an aptitude for science, being motivated or indifferent, being confident or unsure, having a disposition or reluctance to question, possessing an accurate or inaccurate perception of self. Although it was not investigated as to whether the teachers saw these characteristics as fixed or malleable, if the five characteristics that these teachers perceive to indicate academic performance can be learnt, the students could learn how to question or be confident. This possibly will increase their academic achievement in the subject of science. So, with the knowledge created from this research, this school and other similar private schools can potentially improve the levels of academic achievement for female students in the subject of science in Years 7 and 8.

6.5 Limitations of the Study

As acknowledged in Chapter 3, there are limitations to this research. Using a correlative approach is a limitation in itself. While it explores relationships amongst variables, it does not include the experimental manipulation of variables and consequently the results cannot be used as proof for a cause and effect association (Mertens & Laughlin, 1995). Therefore, although I can say a negative correlation exists, that is statistically significant between academic achievement and SRA for Year 7 and 8 female science students, I cannot claim that one variable is causing the other.

Another limitation of this study is concerning the labels I assigned to the five SCAAA. It would have decreased the limitations if I had three people analysing the data from the beginning of the process. As this research has only one author, this was not feasible. Although both supervisors associated with this research agreed with the analysis process and final labels I attributed to the comments made by the teachers concerning the five SCAAA.

A final limitation for this study is that I collected data from and conducted interviews at only one school. In order to expand on this research, students and their teachers from other schools could have been included.

6.6 Concluding Remarks

The goal of this research is to develop an understanding of whether, and how, SRA impacts academic achievement in the subject of science for female students in Years 7 and 8. The fact that a correlation exists between academic achievement and SRA is an important piece of information in itself. Looking to the future, all teachers require the knowledge of any early indicators for their student's academic achievement, particularly for those students born before the year level enrolment dates as they have a significantly lower academic

achievement. As research suggests, science will be one of the subjects that leads a global Australia into the future (Masters, 2009; Nous Group, 2011). Having a tool like the five SCAAA will enable not only me, but other teachers as well, to improve the science academic achievement of students. Finally, as the third generation teacher, when education is a topic of discussion at those family gatherings, I will have an answer as to whether delaying school entry by a year impacts on a student's academic achievement. I can now provide an empirically-based argument that a negative correlation exists between academic achievement and SRA, and add conclusively, that the younger students in a cohort are not academically disadvantaged.

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Appendix A – Ethics Permission Letter.

MONASH University

Monash University Human Research Ethics Committee (MUHREC)
Research Office

Human Ethics Certificate of Approval

Date:	**19 February 2013**
Project Number:	**CF13/186 – 2013000068**
Project Title:	**Student's relative age in their cohort and Science learning**
Chief Investigator:	**Prof Michael Askew**
Approved:	**From: 19 February 2013 To: 19 February 2018**

Terms of approval

1. The Chief investigator is responsible for ensuring that permission letters are obtained, if relevant, and a copy forwarded to MUHREC before any data collection can occur at the specified organisation. **Failure to provide permission letters to MUHREC before data collection commences is in breach of the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research**.
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must contain your project number.
6. **Amendments to the approved project (including changes in personnel):** Requires the submission of a Request for Amendment form to MUHREC and must not begin without written approval from MUHREC. Substantial variations may require a new application.
7. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
8. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. **Final report:** A Final Report should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected date of completion.
10. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by MUHREC at any time.
11. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.

Professor Ben Canny
Chair, MUHREC

cc: Ms Nicole Lewis

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ABN 12 377 614 012 CRICOS Provider #00008C

Appendix B – Explanatory Statement.

MONASH University

1st January, 2013

Explanatory Statement – Information for teachers being interviewed

Title: 'Student's relative age in their cohort and Science learning.'

This information sheet is for you to keep.

Dear 'eacher,

My name is Nicole Lewis and I am conducting a research project with Professor Mike Askew the Foundation Chair Professor of Primary Education at Monash University in the Department of Education towards a Masters of Education at Monash University. This means that I will be writing a thesis which is the equivalent of a short book. Our principal has given permission for this research project to be conducted in our school and I am writing to invite you to participate in this study. Please read this Explanatory Statement in full before making a decision.

As I am researching in the field of girls learning science in a middle school and you taught Year 7 or 8 girls Science in 2012, I am interested in your opinion around this learning.

The aim of this study is to develop an understanding of how your age in your cohort impacts on your science learning. At the beginning of each teaching year there is certain information about each student that I require to assist my students to reach their potential their age is not currently included. I am conducting this research to find out whether being older in a cohort, maybe the child has been held back (redshirting), or younger in the cohort (sent to school early) has any effect on your academic outcomes in science. I would like to work with teachers', like you, to obtain your professional opinion on how you see student's science learning.

The results of this study will be presented to the heads of your school with suggestion about the future use of age in cohort data. The benefits of this research will be that I will be able to inform your and the heads of school about any best practices utilising age in cohort data for individual learning/teaching strategies at Haileybury College.

This research involves a quick informal interview, where I will ask you questions relating to the student's science learning of groups of students that you have taught. It will take between 15 to 20 minutes and I will be audio recording and taking hand written notes during the interview.

Inconvenience/discomfort

As you will only be providing de identified information on grouped students there is no risk that may come from others identifying your participation in the research. If you should feel worried, anxious or upset after answering the questions you can discuss your feelings with the school counsellor, Ms Vicki Kyrou [redacted]

Can I withdraw from the research?

Being in this study is voluntary and you are under no obligation to consent to participation. However, if you do consent to participate, you may withdraw from further participation at any time up to four weeks after your interview.

Storage of data and Confidentiality

Storage of the data collected will adhere to the University regulations and kept on University premises in a locked cupboard/filing cabinet for 5 years. All information will remain confidential. A report of the study may be submitted for publication, individual participants and schools will not be identifiable as pseudonyms will be used. .

If you would like to be informed of the aggregate research finding, please contact Nicole Lewis at [redacted]. Findings will be available from late 2013.

If you would like to contact the researchers about any aspect of this study, please contact the Chief Investigator:	If you have a complaint concerning the manner in which this research <insert your project number here> is being conducted, please contact:
Chief Investigator Mike Askew (Masters Supervisor) [redacted] Co - Investigator Nicole Lewis [redacted]	Executive Officer Monash University Human Research Ethics Committee (MUHREC) Building 3e Room 111 Research Office Monash University VIC 3800 [redacted]

Thank you very much for reading this information and please feel free to contact me if you have any further concerns or queries

Kind Regards

[redacted]

Nicole Lewis

Appendix C – Permission Letters.

Consent form for teachers participating in an interview

Title: **Student's relative age in their cohort and science learning.**

NOTE: **This consent form will remain with the Monash University researcher for their records.**

I understand I have been asked to take part in the Monash University research project specified above. I have had the project explained to me, and I have read the Explanatory Statement, which I keep for my records.

I understand that:	YES	NO
- **I will be asked to be interviewed by the researcher**	☑	☐
- **unless I otherwise inform the researcher before the interview I agree to allow the interview to be audio-taped**	☑	☐
- **I will be asked questions about student's achievement in science**	☑	☐

and

I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage of the project up to four weeks after being interviewed without being penalised or disadvantaged in any way.

and

I understand that any data that the researcher extracts from the interview / questionnaire for use in reports or published findings will not, under any circumstances, contain names or identifying characteristics without my signed consent below.

and

I understand that no information I have provided that could lead to the identification of any other individual will be disclosed in any reports on the project, or to any other party

and

I understand that data from the interview / questionnaire will be kept in secure storage and accessible to the research team. I also understand that the data will be destroyed after a 5 year period unless I consent to it being used in future research.

Participant's name: _____

Signature: _____ **Date:** _____

Appendix D - Science Teacher Interview Form

Interview: Student's relative age in their cohort and science academic achievement and learning.

Teacher's Name: _____

Opening Statement
"Now I would like you to tell me something about these three students in regard to their science learning and academic achievement." – Place down the 3 relevant sort number cards in front of the participating teacher.
Question 1
"In what important way are two of the students alike in regard to their science learning, but different from the third?" - record the teacher's response under construct heading
Question 2
"What number student is not included in the two?" – circle corresponding number
Question 3
"How is this student different from the other 2?" - record the teacher's response under contrast heading

Sort Number	CONSTRUCT	CONTRAST
1. 1, 2 and 3	_____	_____
2. 4, 5 and 6	_____	_____
3. 7, 8 and 9	_____	_____
4. 10, 11 and 12	_____	_____
5. 13, 14 and 15	_____	_____
6. 16, 17 and 18	_____	_____
7. 1, 4 and 7	_____	_____
8. 2, 5 and 8	_____	_____
9. 3, 6 and 9	_____	_____
10. 10, 13 and 16	_____	_____
11. 11, 14 and 17	_____	_____
12. 12, 15 and 18	_____	_____
13. 1, 8 and 14	_____	_____
14. 2, 9 and 15	_____	_____
15. 3, 10 and 16	_____	_____
16. 4, 11 and 17	_____	_____
17. 5, 12 and 7	_____	_____
18. 6, 13 and 18	_____	_____

Appendix E – An excerpt from Interview 1 with teacher J to illustrate examples of a construct and a contrast

Interviewer: If we look at students 1, 2 and 3 and thinking about their science learning can you tell me in what way two were similar and one was different to them?

Teacher J: One was very independent [noted as the contrast] and the others needed constant reassurance [noted as the construct] as to whether they were doing the right thing. Even though they were doing the right thing they just needed to double check all the time whereas one just went off and did what she thought was the right thing.

Interviewer: And out of those three which was the number that was independent?

Teacher J: Number 1

Interviewer: So 2 and 3 needed reassurance?

Teacher J: Yes.

Interviewer: And so how do you think that independence helped her with her science learning?

Teacher J: She was willing to take a risk and so able to make suggestion to changes of experiments without really having to double check first. She was just able to work quietly and confidently in class independently and so didn't need me to me to monitor her as much, even though I did, she was just able to get on with the task, so she probably achieved more in class because of that.

Appendix F - Teacher assigned number with the student's interview number, student's ID numbers and corresponding date of birth.

	A	B	C	D
1		Interview 3		
2	Teacher Assigned Number	Interview Number	**Student ID**	**DOB**
3	1	301	79092	9/08/1999
4	9	309	48037	26/11/1998
5	10	310	1019336	24/05/1999
6	2	302	74989	16/07/1999
7	12	312	77499	20/10/1999
8	8	308	59369	4/04/1999
9	3	303	45165	15/04/1999
10	11	311	54500	1/01/2000
11	7	307	38664	23/06/1999
12	4	304	51864	5/01/1999
13	13	313	64371	7/10/1999
14	15	315	64884	3/09/1999
15	5	305	1019540	9/08/1999
16	16	316	86895	26/03/1999
17	14	314	81079	14/04/1999
18	6	306	63277	21/05/1999

Appendix G – Highlighted parts of the text that described student's characteristics that influenced their learning and academic achievements in science.

Transcription 1: JGW250313

Nicole: If we look at student 1 2 and 3 and thinking about their science learning can you tell me in what way two were similar and one was different to them?

Interviewee: One was very independent and the others needed constant reassurance as to whether they were doing the right thing. Even though they were doing the right thing they just needed to double check all the time whereas one just went off and did what she thought was the right thing.

Nicole: And out of those three which was the number that was independent?

Interviewee: Number 1

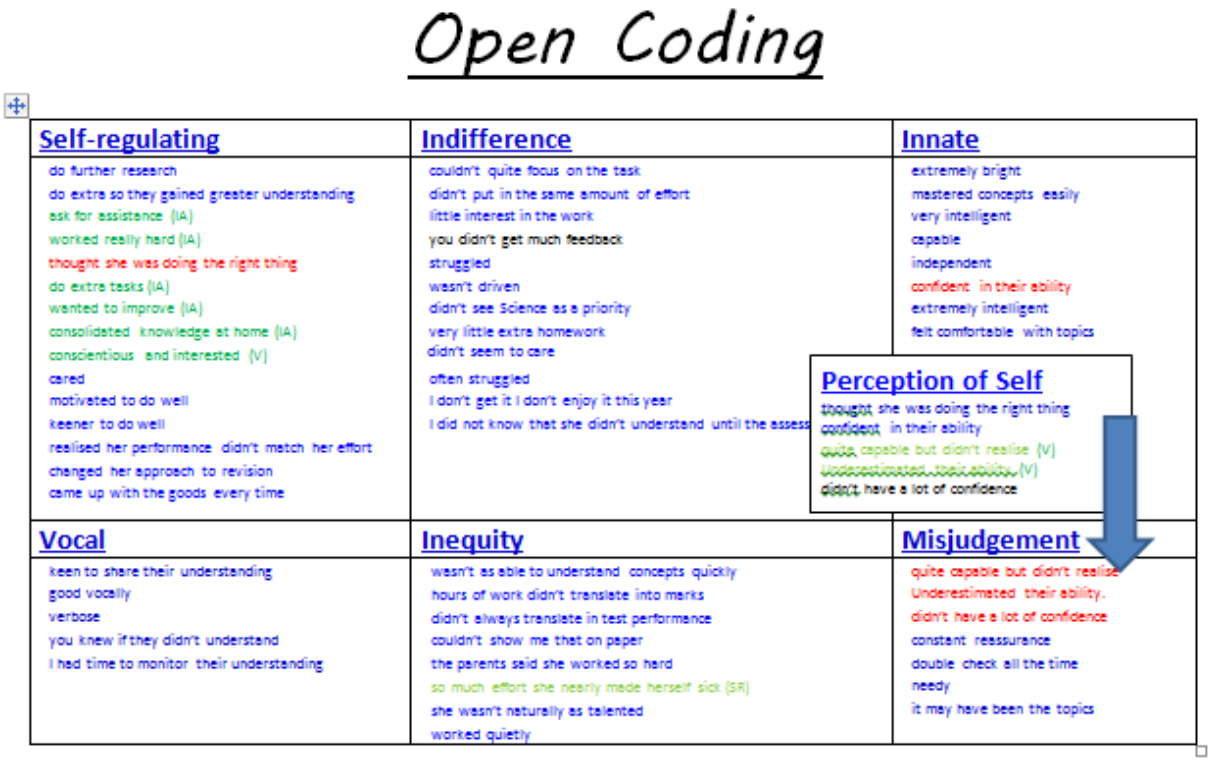
Nicole: So 2 and 3 needed reassurance?

Interviewee: Yes.

Nicole: And so how do you think that independence helped her with her science learning?

Interviewee: She was willing to take a risk and so able to make suggestion to changes of experiments without really having to double check first. She was just able to work quietly and confidently in class independently and so didn't need me to me to monitor her as much, even though I did, she was just able to get on with the task, so she probably achieved more in class because of that.

Appendix H – The constant comparative approach (Birks & Mills 2011) used for developing the categories.



Appendix I – Axial Coding

Phenomenon	Conditions	Action	Consequences
Innate ability	extremely bright	one of them worked really hard	she nearly made herself sick
	extremely bright	more confident in her ability	you could ask to do extra tasks to consolidate her understanding
	very intelligent	worked hard worked independently	mastered concepts easily
	independent	willing to take a risk was just able to work quietly and confidently in class	she probably achieved more in class because of that.
	independent	she would do is go home and consolidate a lot of her work	Capable
	extremely intelligent	you could ask to do extra tasks	consolidate her understanding more confident in her ability
	felt comfortable with topics	do extra	they gained greater understanding
	extremely natural	insightful thinker	very good analytically
	definitely has a memory	will benefit from visual learning techniques	exceptionally weak

Appendix J – Histogram with normal plot for SRA and academic achievement.