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School climate, student engagement and academic achievement across school sectors in Australia

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Abstract

Driven by the focus on standardised assessment and performance-driven accountability, a considerable body of literature has documented differences in students' academic achievement across school sectors, both internationally and in Australia. However, few studies have to date explored the potential mechanisms underlying such differences, particularly through the lens of school climate and student engagement. And despite extensive literature on school climate and student engagement, including their relationships with achievement, the differences in these patterns across school sectors remain under-studied. In this paper, we leverage nationally representative data from a large-scale longitudinal survey in Australia with linked administrative data on student achievement to reveal different patterns of school climate and student engagement across government, Catholic and independent sectors. Employing multivariable regression analyses, we identify unique school climate and student engagement facets that are associated with improved achievement in each of these sectors, offering important pointers for educational policies.

Keywords School sectors · School climate · Student engagement · Australia

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Introduction

Differences across school sectors have been the focus of much policy debate and academic research over the recent decades. Driven by the focus on standardised measures of academic achievement, such as those captured through the OECD's Programme for International Student Assessment (PISA) surveys, a significant body of research has focussed on comparing student performance across sectors, both internationally (e.g. Dronkers & Avram, 2015; Dronkers & Robert, 2008) and in Australia (e.g. Lamb et al., 2004; Mahuteau & Mavromaras, 2014; Marks, 2015; Miller & Voon, 2012). Whilst undoubtedly important, this body of research has not explicitly considered the mechanisms that could be driving the observed differences in student performance across the sectors.

One of the potential mechanisms that could help to explain the cross-sectoral differences in student achievement are differences in school climate and student engagement amongst students in different sectors. Previous literature suggests that school climate, capturing aspects such as safety and teachers' self-efficacy, and student engagement, encompassing behavioural, affective and cognitive dimensions, are strongly associated with academic achievement at the individual level (e.g. Fredricks et al., 2004; Wang & Degol, 2016). However, whilst there is anecdotal evidence suggesting differences in school climate and student engagement between government/public and non-government schools, systematic research on cross-sectoral differences in patterns is scarce (for an exception see Perry et al., 2016).

This paper aims to address this research gap. Drawing on a robust, nationally representative sample from the Longitudinal Study of Australian Children (LSAC), we document the differences in school climate and student engagement across school sectors in Australia and investigate the association between school climate and student engagement with students' academic achievement in different sectors. As such, the paper provides new and robust evidence on the patterns of some of the potential mechanisms that could be driving differences in academic achievement of students across Australian school sectors.

Literature review

The relevance of school sectors

A substantial body of empirical evidence has explored the differences in student performance across school sectors, both internationally (e.g. Sakellariou, 2017), and in the Australian context (e.g. Mahuteau & Mavromaras, 2014). Many of these studies have leveraged the Programme for International Student Assessment (PISA) data to explore the differences in students' cognitive achievement and academic performance (e.g. Dronkers & Avram, 2015). This body of research has found that, on average across OECD countries, students in private government-dependent (i.e.

publicly subsidised private schools, usually religious schools)[1] have achieved the highest PISA scores, followed by those from government/public schools.

In the Australian context, private sector encompasses Catholic and independent[2] schools, which map onto Private Government-Dependent and Private Independent sectors identified in international literature. Cross-sectoral comparisons in Australia have also predominantly focussed on standardised measures of academic achievement (Lamb et al., 2004; Marks, 2015). These comparisons have attracted considerable attention in Australia as the country is distinct internationally with respect to the amount of public funding that non-government schools receive from government (Gleeson et al., 2018)[3], although empirical evidence provides an inconclusive picture of the cross-sectoral differences. For instance, Mahuteau and Mavromaras (2014) found that students from Catholic schools performed better in PISA than their peers from the public and independent sectors; whereas Rodgers et al. (2016) found no significant effects on non-government school enrolment on primary students' academic achievement on standardised tests, once differences across school sectors in student characteristics are taken into account.

Both in Australia and internationally, evidence going beyond the focus on school performance is scarce. Internationally, Dronkers and Robert (2008) found that better cognitive achievement in non-government-dependent schools is largely explained by better school climate in these schools across a number of OECD countries. In Australia, Perry et al. (2016) also utilised PISA data to explore the differences in students' perceived learning environments between public and private sectors and only found significant differences in classroom disciplinary climate and teaching strategies across the two sectors. This limited evidence highlights the importance of looking beyond achievement, and considering aspects such as school climate and student engagement when studying cross-sectoral differences.

Hypothesising cross-sectoral differences

There are a number of reasons to hypothesise that school climate or culture, and student engagement—as well as student outcomes—may differ across school

[1] According to OECD (2019, p.154) definition of school sectors, private (i.e. non-government) institutions are those controlled and managed by a non-governmental organisation (e.g. a church, a trade union, or a business enterprise, foreign or international agency), or their governing board consists mostly of members not selected by a public agency. Private institutions are considered government-dependent if they receive more than 50% of their core funding from government agencies or if their teaching personnel are paid by a government agency. Independent private institutions receive less than 50% of their core funding from government agencies and their teaching personnel are not paid by a government agency.

[2] Catholic school make up the largest group of non-government schools, whilst independent schools refer to those are associated with other religions, other denominations, particular educational philosophies, or operate as single entities (ACARA, 2019, p.121).

[3] For instance, in 2019, a full-time student in government school sector received on average $17,531 from Commonwealth and State/territory government, compared to $11,687 for a student in the Catholic sector, and $9748 by a student from independent schools (ACARA, 2019). On top of the government grants, Independent and Catholic sectors are also funded through private income averaging $12,539 and $4727 per student, respectively (ACARA, 2019).

sectors in Australia. First, the socio-demographic make-up of students in each sector are different (Perry et al., 2016), with higher proportions of students from more socio-economically advantaged families attending non-government schools. To illustrate these patterns, a recent report published by the Independent Schools Council of Australia (ISCA, 2018) utilising ABS 2016 Population & Housing Census data shows marked differences in family income between students from different school sectors. For instance, in 2016, 41 per cent of independent students came from families with high household income (defined as AUD 156,000 and above), in comparison to 31 per cent for Catholic and 18 per cent for public sector.

From a theoretical perspective of cultural capital (e.g. Bourdieu, 1977; Bourdieu & Passeron, 1990; Davies & Rizk, 2018), the different socio-economic composition of students across school sectors would result in different school practices and school cultures, as well as the ways that students engage with their schools. Whilst the original concept of cultural capital referred to cultural traits that are valued in education settings, subsequent research further operationalised it as certain cultural practices, such as exposure to great works of literature and visit museums (e.g. DiMaggio, 1982) and parental efforts in aligning their practices with school requirements (that is 'concerted cultivation' coined by Lareau, 2002). As such, a bi-directional relationship between parental school choice and school profile might emerge. Specifically, parents would choose school sectors where their religions, values and cultural preferences are rewarded (e.g. Dumais, 2005; Yang & Kayaardi, 2004). And then such values and preferences would be reinforced both at home through parental concerted cultivation and at school through parental involvement in school practice. Indeed, empirical evidence shows that parents prefer private schools because they perceive better communication and chances of parental involvement in these schools (Goldring & Phillips, 2008).

As such, certain school sectors are more likely to become a community of shared values and develop close social ties through interactions amongst students, family and school community (e.g. Dronkers & Robert, 2008; Dronkers & Avram, 2010; Nguyen et al., 2018), which was coined as organisational habitus by Bourdieu (1977). For instance, Dronkers and Robert (2008) posit that religious schools may try to achieve broader educational goals instead of only focussing on cognitive results, based on their strong value-oriented community embracing students, parents and teachers, as well as corresponding selection of school practices. Similarly, Tarabini et al., (2017, p.2) point to 'intrinsic, but not linear, relationship between a school's social composition and the school's organisational practices, structures, norms, and values' that could drive differences across school sectors. Furthermore, previous studies show that there are relationships between students' socio-economic status, their engagement with learning and their academic achievement (Tomaszewski et al., 2020). Thus, arguably, the different ways that students from different family backgrounds engage with learning might manifest at a school sector-level due to differences in the socio-economic composition.

The relevance of school climate and student engagement

As outlined earlier, previous research has predominantly focussed on comparing the differences in school achievement amongst school sectors. We argue that, whilst important, the dominant focus on student performance amongst the studies investigating cross-sectoral differences represents a narrow perspective that limits our understanding of the experience of schooling across the school sectors. Specifically, we argue the concepts of school climate and student engagement constitute important dimensions to focus on when comparing educational outcomes and experiences across different school sectors. Whilst previous literature suggests that school climate, capturing aspects such as safety and teachers' self-efficacy, and student engagement, encompassing behavioural, affective and cognitive dimensions, are strongly associated with academic achievement at the individual level (e.g. Fredricks et al., 2004; Wang & Degol, 2016), there is little evidence on how they vary across different sectors. We now turn to describing these concepts in more detail.

School climate

There is a long history of research on school climate, particularly in the American educational literature, which has extensively explored its impact on students' academic achievement and behavioural outcomes (e.g. Kutsyuruba et al., 2015; Wang & Degol, 2016). Despite the lack of consensus amongst researchers on the specific dimensions that constitute school climate, it is frequently conceptualised as a multidimensional construct encompassing multiple aspects of school environment (e.g. Thapa et al., 2013; Wang & Degol, 2016).

When theorising the relevance of school climate for explaining student achievement across different school sectors, we focus on those aspects that are measurable in the data at hand, thereby deriving theoretical propositions that we are able to test empirically. These include *safety* (physical and emotional) (Thapa et al., 2013), *school discipline* (Johnson et al., 2007), as well as *teachers' self-efficacy,* which taps into the academic dimension of school climate (Thapa et al., 2013; Wang & Degol, 2016).

Safety Safety at school is considered one of the powerful drivers of student learning and development (Devine & Cohen, 2007). This is because feeling safe at school is an essential condition for students to thrive in the educational environment and a significant determinant of student experiences (Thapa et al., 2013). One important indicator of students' safety at school relates to students' experiences of being bullied (Thapa et al., 2013). A body of empirical research points to a positive relationship between safety and various student outcomes (Wang & Degol, 2016). For instance, studies found that security factors are positively associated with students' achievement (Esposito, 1999), whereas experiences of being bullied are found to be associated with lower academic achievement (Strøm et al.,

2013). Other studies point to associations between low rates of bullying and student engagement and students' commitment to their study and the school (Mehta et al., 2013; Thapa et al., 2013).

Another important indicator of school safety is *school discipline* (Johnson et al., 2007), which can be captured by teachers' perception of the consistency and capability of school discipline practices. Studies highlight the important role of consistent and effective school discipline practice in promoting various students' outcomes (Wang & Degol, 2016). In particular, studies reveal the association between improved school safety and students' positive emotional wellbeing and attitudes towards school (Durlak et al., 2011).

Teacher's self-efficacy Teacher's self-efficacy is another important aspect of school climate, tapping into its academic dimension. The concept, defined as the beliefs that teachers hold about their capabilities to perform their professional duties (Morris et al., 2017), has been extensively utilised in many applications, including in the educational settings (Pajares, 2006). Teacher's self-efficacy has been shown to not only impact on teachers' own job satisfaction, wellbeing, and teaching effectiveness (Klassen & Tze, 2014; Zee et al., 2018), but is also associated with students' attitudes and self-efficacy, and promotes student motivation and academic achievement (e.g. Zee, et al., 2018).

Despite the rich literature on school climate, the differences across school sectors have not been well documented. We argue that studying such differences can shed the light on the disparities in academic performance across the school sectors, which has been the focus of the bulk of extant research.

Student engagement

The past three decades have witnessed an explosion of research on student engagement in psychology and education literature (Wang & Degol, 2014). This increased interest is due to the potentially malleable nature of student engagement, as well as its association with a range of important student outcomes. First, student engagement has been found to be responsive to contextual factors such as family and school environment (Wang & Eccles, 2013). Secondly, higher student engagement is positively associated with better educational outcomes. Empirical evidence suggests that strong student engagement, manifested through positive attitudes, experiences and behaviours at school, leads to better academic achievement, higher aspirations for further education, and improved overall wellbeing (e.g. Fredricks, et al., 2004; Pietarinen et al., 2014). As such, focussing on student engagement has the potential for addressing a range of persistent educational problems such as low achievement and high dropout rates (e.g. Wang & Degol, 2014). There is a broad consensus in the literature that student engagement is a complex and multidimensional construct and has been conceptualised as encompassing behavioural, cognitive and affective dimensions (e.g. Fredricks et al., 2016), which are briefly summarised below.

Behavioural engagement Behavioural engagement has been defined as either participation in school-related activities and positive behaviours (Finn, 1993), or involvement in learning, including effort and persistence (Skinner & Belmont, 1993). At an operational level, behavioural engagement is typically captured by teacher's rating of students' behaviour (Whitney et al., 2020).

Affective engagement Affective engagement has been defined as either students' positive and negative reactions in the classroom, including interest, boredom, and happiness (Connell & Wellborn, 1991), or identification or sense of belonging (Finn, 1993). In line with these conceptualisations, affective engagement is typically measured by students' reports on their general feelings about their school and teachers, including indicators capturing sense of belonging and school liking (Goodenow, 1993).

Cognitive engagement Cognitive engagement has been defined as, (i) psychological investment in learning, including preference for challenge (Connell & Wellborn, 1991), or (ii) being strategic or self-regulating. There is a broad consensus in the literature of student engagement that cognitive engagement can be captured through goal-directed learning strategy, which are similar to the constructs in the motivation literature (Appleton et al., 2006; Fredricks et al., 2004; Quin, 2017; for a review on the measurement of motivation and cognitive engagement see Greene, 2015). As such, previous research on student engagement has largely adopted measures from the motivation literature (Fredricks et al., 2004), such as goal theory (Ames & Archer, 1988; Elliot & McGregor, 2001) to gauge achievement motivation and associated strategies (Greene, 2015). We follow this approach in the present paper by focussing on goal orientations to tap into the cognitive aspect of engagement.

Based on the goal theory, Elliot and McGregor (2001) suggested that individuals with different goal orientations adopt different strategies to learning and developed a 2×2 framework, integrating goal achievement orientations and strategy types. Specifically, the framework distinguishes between students with mastery-approach goal orientations, who tend to focus on mastering skills or a task itself; students with mastery-avoidance goal orientation, who are more focussed on avoiding failure in learning, such as striving to avoid mistakes (Cury et al., 2006); students with performance-approach goal orientations, who tend to focus on being able to show success and outperform others; and students with performance-avoidance goal orientations, who tend to focus on avoiding performing worse than others and motivated by fear of performing poorly relative to their peers.

Whilst a recent meta-analysis (Senko & Dawson, 2017) reveals a more nuanced pictures of associations between goal orientation and performance,[4] there is empirical evidence that these four basic types of goal orientations are differentially linked

[4] For instance, there are two motivations behind performance-approach goal orientation: focussing on appearing capable versus focussing on outperforming peers. Whilst the former is negatively associated with academic achievement, the later—performance-approach goal orientation motivated by desire to outperform peers—is positively associated with academic achievement.

to students' academic achievement. For instance, students with mastery-approach goals have been shown to perform best, followed by those with mastery-avoidance and performance-approach goals, whereas those with performance-avoidance goals typically perform worst (Cury et al., 2006; Elliot & McGregor, 2001). However, what is currently unknown is whether there are cross-sectoral differences in the prevalence of various facets of student engagement, including goal orientations, that might translate into the differences in academic achievement across the school sectors.

Research aims

As outlined earlier, despite a considerable body of research exploring the disparities in academic performance across the school sectors, the cross-sectoral differences in various aspects of school climate and student engagement remain poorly documented and understood. This paper aims to address this research gap and contribute to the literature in two ways: first, by comparing the patterns of school climate and student engagement across the school sectors in Australia; and second, by documenting the associations between school climate and student engagement and students' academic achievement in different school sectors. As such the paper contributes to a fuller understanding of educational outcomes and experiences across different school sectors in Australia, with learnings relevant to other developed countries with similar sectoral parameters.

Data and methods

This study uses a nationally representative sample from the Longitudinal Study of Australian Children (LSAC), which is a major Australian national cohort study following the development of a representative sample of about 10,000 children and their families in Australia. The study commenced in 2004 with two cohorts, that is, families with 0–1 years old infants (B cohort) and families with 4–5 years old children (K cohort). The study child, their parents/carers and schoolteachers were surveyed every two years with eight waves of data available to date for each of the cohorts. The survey data has been linked to administrative data on the National Assessment Program—Literacy and Numeracy (NAPLAN), which provide standardised measures of academic achievement. Our outcome variables capture the result of the NAPLAN assessment undertaken in Year 7, which is completed when students are typically 12/13 years old.

The LSAC data offer a strong empirical basis for this study because it combines large-scale, comprehensive data on school climate and engagement with administrative records on students' academic achievement captured by standardised test scores. This makes it a very powerful data source, overcoming typical limitation of general surveys of having to rely on self-reported achievement measures. On the other hand, the LSAC survey adopted a range of internationally validated survey instruments to capture school climate, student engagement, and family circumstances, which is typically not available in stand-alone government administrative records.

In this study we use wave 5 data from the K cohort when the participants were in Year 7 (i.e. 12/13 years old), due to its more extensive coverage of engagement measures, compared with other waves. For instance, data on cognitive engagement were only collected in wave 5. Therefore, using data from wave 5 enables us to examine all three engagement dimensions, and to include more engagement measures than is possible with other waves.

Key variables

Outcome variables: academic achievement

The variables capturing students' academic achievement come from nationally administered and standardised NAPLAN test. NAPLAN is an annual assessment for all Australian students in Years 3, 5, 7 and 9, testing students' knowledge and skills across five domains: Reading, Writing, Spelling, Grammar and Punctuation, and Numeracy[5]. The NAPLAN scores range from 0 to 1000, and are designed to be comparable across school year levels and over time, but not comparable across the five domains (Daraganova et al., 2013).

We focus on Reading and Numeracy scores as the outcome variables for two reasons. Firstly, the scores on the remaining domains, i.e. Writing, Spelling and Grammar, are strongly correlated with Reading (over 0.72) and Numeracy (over 0.67). Secondly, reading and numeracy has been demonstrated in previous research to play the foundational role for students' long-term academic achievement (e.g. Armbruster et al., 2010; Duncan et al., 2007). Capitalising on the longitudinal nature of LSAC, we capture Reading and Numeracy scores in Year 7, whilst controlling for such scores in Year 5.

School climate and student engagement

Due to data availability, this study explores three aspects of school climate: school safety, disciplinary climate, and teachers' self-efficacy, captured through both student and teacher reports. *School safety* is captured by students reported experiences of being bullied at school. Seven items are adapted from the School Climate Bullying Scale. Items are answered on a 4-point Likert scale ranging from 1 = never to 4 = several times a week. The scale is scored by taking the mean of the seven items, with higher scores indicating a higher incidence rate of being bullied. *School discipline* is captured through teachers' perception of disciplinary policies in the school is measured by six items[6], which are answered on a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. The scale is scored by taking the mean of the six items. Higher score indicates better perceived school discipline practices.

[5] The assessment process is performed using a national common reporting format set by the Australian Curriculum, Assessment and Reporting Authority (ACARA).

[6] LSAC derived variable, items adopted from National Longitudinal Survey of Children and Youth (NLSCY) Cycle 2.

Teachers' self-efficacy is captured using a 4-item scale[7], tapping into teachers' self-efficacy for instructional strategies, for classroom management and for engaging students. Items are answered on a 5-point Likert scale ranging from 1 = strongly agree to 5 = strongly disagree. We reverse-coded the individual items and take the mean of the 4 items, with higher scores indicating higher self-efficacy (School climate scale details in Appendix Table 3).

LSAC data set provides measures for all three dimensions of student engagement (Student engagement scale details in Appendix Table 4). Specifically, affective engagement (sense of belonging) is captured in the LSAC by adapting items from the Psychological Sense of School Membership Scale. The scale is constructed by taking the mean of the 12 items with higher scores indicating higher sense of belonging to the school.

Behavioural engagement is captured by tapping into teachers' perception of students' behaviour in English class. Teachers were asked eight items about how often the student display a range of behaviours. The scale is generated by taking the mean of the eight items with higher scores indicating higher level of behavioural engagement.

Cognitive engagement is operationalised in terms of achievement goal orientation, which is captured in LSAC by adapting items from the revised Achievement Goal Questionnaire, which consists of four subscales: performance-approach, performance-avoidance, mastery-avoidance, and mastery-approach orientations. Each subscale comprises three items and is scored by taking the mean of the three items with higher scores indicating the students' higher tendency on this goal orientation.

Control variables

We control in the analyses for a range of student and family characteristics. Student characteristics include gender (male; female), born in Australia (yes; no), Indigenous status (yes; no), speaking English at home (yes; no), and having a medical condition (yes; no). Family characteristics include born to biological parents (yes; no), and family socio-economic status (SES), which is an indicator of 'socio-economic position' generated for the LSAC data (Baker et al., 2017). Students' prior academic achievement is also included as a proxy for the baseline levels of academic ability. Descriptive statistics for these control variables are presented in the appendix (Table 5).

Empirical approach

This study uses wave 5 data from the K cohort of LSAC, which captures data on 3956 children at the age of 12/13. We first address the issue of missing information by undertaking mean imputation on all independent variables. Mean imputation is the most widely used method of handling missing data involving calculating the mean for each variable and substituting missing data in that variable with the mean

[7] LSAC derived variable, items adopted from National Longitudinal Survey of Children and Youth (NLSCY) Cycle 2.

of the same variable. We then create an analytic sample, which comprises 3184 students (full sample)—1625 from public schools, 804 from Catholic schools, and 755 from independent schools, who have complete information on all key variables, including dependent variables (NAPLAN).

To address the first research aim, we use confidence interval (CI) plots to visualise the patterns of school climate, student engagement and academic achievement across the three school sectors. The CI plots present the average scores of the continuous variables by school sector, overlaid with 95% confidence intervals to indicate whether the differences between sectors are statistically significant.

To address the second research aim, we fit a series of multivariable linear regression models to examine the effects of school climate on students' academic achievement for each sector[8]. In doing so we identify elements of school climate that are particularly effective in facilitating students' academic achievement in each sector. We then extend the analyses by including student engagement in the models, separate by school sectors as follows:

$$NAPLAN_{Y7} = SC1\beta_1 + SC2\beta_2 + SC3\beta_3 + Z\beta_4 + NAPLAN_{Y5}\beta_5 + e_i \quad (1)$$

$$\begin{aligned} NAPLAN_{Y7} = {} & SC1\beta_1 + SC2\beta_2 + SC3\beta_3 + Z\beta_4 + SE1\beta_5 \\ & + SE2\beta_6 + SE3\beta_7 + NAPLAN_{Y5}\beta_8 + e_i \end{aligned} \quad (2)$$

where i denotes individual; $NAPLAN_{Y7}$ is the outcome variable capturing academic achievement in Year 7; *SC* is the school climate indicator (*SC1* for school discipline, *SC2* for being bullied and *SC3* for teachers' self-efficacy); *Z* is a vector of control variables; *SE* is indicators of student engagement (*SE1* for behavioural engagement, *SE2* for affirmative engagement and *SE3* for cognitive engagement); the βs represent coefficients to be estimated, and e is the usual random error in regression. We include NAPLAN Numeracy and Reading scores at Year 5 in both models to test whether school climate and student engagement continue to exert an influence on students' academic achievement, over and above their effects reflected in the Year 5 achievement scores. All school climate and student engagement variables have been standardised before including in all models, and therefore the coefficients should be interpreted in terms of standard deviation units. Furthermore, we use longitudinal weights included with the LSAC data to correct for sample design and participant attrition up to wave 5; all regression coefficients reported in the tables are based on weighted estimates.

To formally test cross-sectoral differences, we supplement the regression models with a series of Wald tests to assess the significance of differences in parameter estimates across the sectors. We further run a model on pooled data with sectoral interaction effects as a robustness check. We refer to these tests when discussing specific findings in the results section.

[8] LSAC sample is individual rather than school-based, which prevents us from identifying students attending the same schools and employing multilevel models in these analyses.

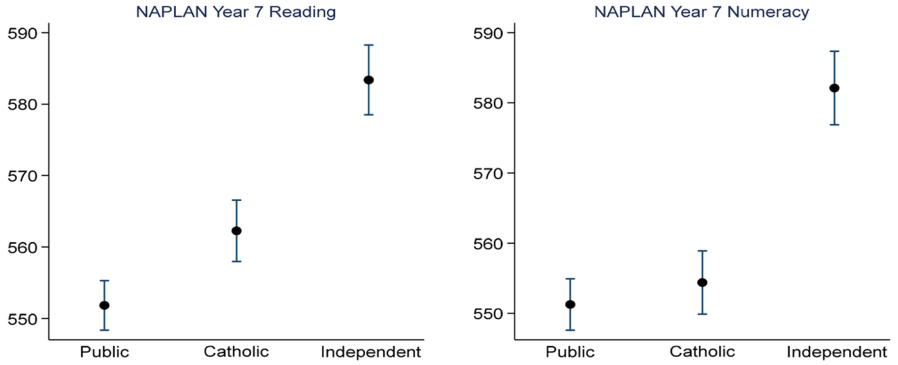

Fig. 1 NAPLAN Reading and Numeracy Scores in Years 5 and 7 by school sectors. Source: LSAC, K cohort, wave 5

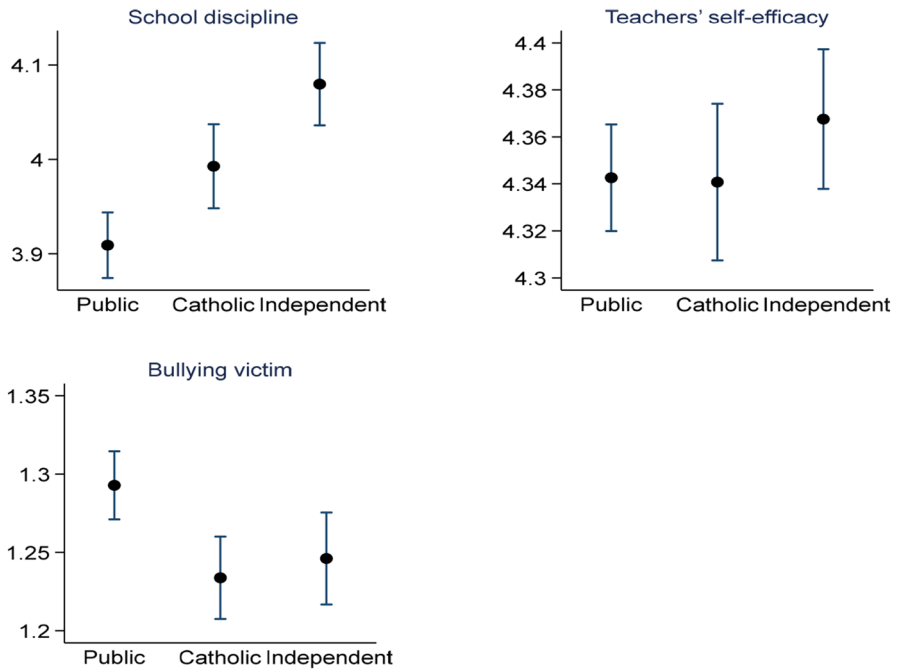

Fig. 2 School climate indicators by school sectors. Source: LSAC, K cohort, wave 5

Results

Patterns of academic achievement, school climate and student engagement across school sectors

To address the first research aim, we visualise the patterns of key variables using CI

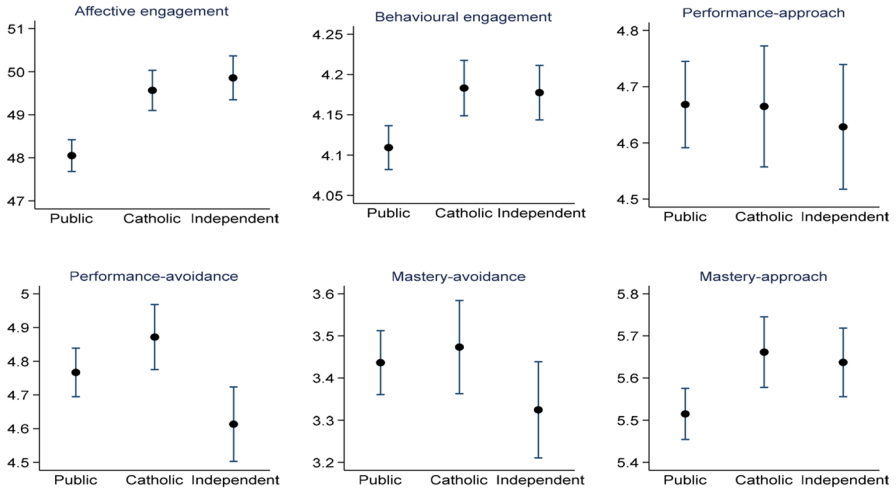

Fig. 3 Student engagements by school sectors. Source: LSAC, K cohort, wave 5

plots (Figs. 1, 2, 3), with the estimates shown in Table 6 in the Appendix. The average scores of NAPLAN Reading and Numeracy in Years 7 are highest amongst students in independent schools (583.4 and 582.1 respectively), and lowest (551.8 and 551.3) amongst students in public schools, with Catholic school students in between (Fig. 1). In addition, the CI shows that the differences between independent and the other sectors are statistically significant, whereas the differences between Catholic and public sectors are only statistically significant for Reading but not for Numeracy.

Figure 2 presents the patterns of school climate indicators across school sectors. In comparison to the other sectors, students from public sector score significantly lower in school discipline (mean = 3.91), and higher in the levels of being bullied (mean = 1.29). There are no significant differences amongst three sectors in terms of teachers' self-efficacy scores.

As Fig. 3 indicates, amongst student engagement measures, public school students score significantly lower in behavioural (mean = 4.11) and affective engagement (48.05), as well as mastery-approach orientation (mean = 5.51) than their peers in the other two sectors, whereas Catholic and independent school students score at a similar level. Independent school students score consistently the lowest in three negative Cognitive engagement measures (i.e. which have been shown negatively associated with academic performance in previous literature): performance-approach, performance-avoidance, and mastery-avoidance, although the differences are not statistically significant.

Cross-sectoral differences in the effects of school climate and student engagement on academic achievement

To answer the second research question, we explore the relationships between multiple indicators of school climate, student engagement and academic achievement

Table 1 The effects (weighted estimates) of school climate on NAPLAN Reading and Numeracy by school sectors

	Reading				Numeracy			
	Full sample	Public	Catholic	Independent	Full sample	Public	Cathpenolic	Indedent
	β	β	β	β	β	β	β	β
School discipline	1.02	0.59	0.99	1.81	− 0.39	− 0.16	− 0.69	− 2.48
Being bullied	− 1.62*	− 1.06	1.16	− 6.62***	− 1.50$^{\#}$	− 0.93	− 1.74	− 2.60
Teachers' self-efficacy	0.96	0.96	0.14	2.32	1.18	2.25$^{\#}$	0.10	− 0.51
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3184	1625	804	755	3184	1625	804	755
R^2	0.62	0.63	0.58	0.62	0.66	0.68	0.60	0.67
$R^{2\wedge}$	0.62	0.63	0.58	0.61	0.66	0.68	0.59	0.67

LSAC, K cohort, wave 5. All school climate variables have been standardised. Weighted estimates using LSAC longitudinal weights. Control variables include gender, born in Australia, Indigenous status, speaking English at home, having a medical condition, born to biological parents, family SES and Year 5 NAPLAN Reading and Numeracy

$^{\#}p<0.1$, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$; $R^{2\wedge}$ indicates the R-squared values from a model that only includes control variables

using multivariable linear regression models. Table 1 presents the effect of school climate on Year 7 NAPLAN Reading and Numeracy by school sectors (full results, including coefficients for control variables is presented in the appendix, Table 7), as well as the fit of the model as indicated by the R-squared values[9].

The results show that being a victim of bullying has a significant and negative effect ($\beta = -1.62$, $p<0.05$) on Reading scores in the full sample. Looking across the sectors, this association is driven by the independent school sector, where the coefficient on bullying is strongly significant ($\beta = -6.62$, $p<0.001$), but not significant for public or Catholic school students. Being bullied has also a negative effect on Numeracy scores although is only marginally significant in the full sample ($\beta = -1.5$, $p<0.1$). Teachers' self-efficacy appears positively associated with Numeracy scores for public school students although with only marginal statistical significance ($\beta = 2.25$, $0.05<p<0.1$), but not for students from the other two sectors.

Table 2 reports the role of student engagement in predicting NAPLAN scores by school sectors after controlling for school climate indicators (full results, including coefficients for control variables is presented in the appendix, Table 8). For NAPLAN Reading, behavioural engagement strongly and positively predicts

[9] Whilst the R-squared values are relatively high, additional analysis shows that this is largely driven by the control variables, as indicated by the last row in Table 1. it might be worth mentioning that the effects of school climate are likely to have impacted students Year 5 NAPLAN results, and as such including prior achievement as a control variable will have likely attenuated the strength of these school climate measures.

Table 2 The effects (weighted estimates) of engagement on NAPLAN Reading and Numeracy by school sectors

	Reading				Numeracy			
	Full sample	Public	Catholic	Independent	Full sample	Public	Catholic	Independent
	β	β	β	β	β	β	β	β
Engagement								
Affective engagement	0.23	1.09	− 2.47	0.92	− 1.08	− 0.74	− 1.90	− 1.56
Behavioural engagement	5.22***	5.38***	3.92*	6.32***	5.96***	6.10***	6.05**	6.84***
Cognitive engagement								
Performance-approach	1.65	0.67	5.23*	0.22	2.41*	2.75	2.45	1.87
Performance-avoidance	− 0.59	− 1.23	1.11	0.26	− 1.22	− 0.97	− 2.40	0.04
Mastery-avoidance	− 3.58***	− 2.54	− 6.04***	− 4.11*	− 5.29***	− 5.10***	− 4.86**	− 7.68***
Mastery-approach	0.44	0.29	− 0.03	0.85	0.96	0.06	3.09	− 0.01
School climate								
School discipline	0.92	0.66	0.29	1.06	− 0.49	− 0.05	− 1.07	− 3.22
Being bullied	− 0.05	0.69	1.68	− 4.43**	0.07	0.73	− 0.50	− 0.65
Teacher self-efficacy	0.10	0.06	− 0.73	1.37	0.23	1.30	− 1.26	− 1.04
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3184	1625	804	755	3184	1625	804	755
R^2	0.63	0.64	0.59	0.63	0.68	0.69	0.61	0.69
$R^{2\wedge}$	0.13	0.12	0.12	0.18	0.13	0.13	0.11	0.16

LSAC, K cohort, wave 5. All school climate and student engagement variables have been standardised. Weighted estimates using LSAC longitudinal weights. Control variables include gender, born in Australia, Indigenous status, speaking English at home, having a medical condition, born to biological parents, family SES and Year 5 NAPLAN Reading and Numeracy

$^{\#}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. $R^{2\wedge}$ indicates the R-squared values from a model without control variables

achievement across all school sectors [βs range between 3.92 for Catholic sector ($p < 0.05$) and 6.32 for independent sector ($p < 0.001$)], and the effect is strongest for independent school students, followed by public school students ($\beta = 5.38$, $p < 0.001$). For cognitive engagement, mastery-avoidance is significantly and negatively associated with Reading scores across all school sectors ($\beta = -3.58$, $p < 0.001$ for the whole sample). The negative association is strongest for Catholic school students ($\beta = -6.04$, $p < 0.001$, followed by independent ($\beta = -4.11$, $p < 0.05$) but not statistically significant for public school students ($\beta = -2.54$, $p > 0.05$). Despite apparent differences on these two variables, further Wald tests show that there are no statistically significant differences amongst the three sectors, indicating uniformly strong positive effects of behavioural engagement, and uniformly strong negative effects of mastery-avoidance on Reading achievement.

Of other variables, performance-approach is significantly and positively associated with Reading scores for Catholic students only ($\beta = 5.23$, $p < 0.05$); further Wald tests indicates that it is significantly different to the other two groups. Affective engagement (i.e. sense of belonging), performance-avoidance and mastery-approach are not statistically associated with Reading scores across the school sectors. Furthermore, whilst some of the effects of school climate measures have been attenuated by the engagement measures, being bullied is still negatively associated with Reading scores for independent school students, although with marginal statistical significance ($\beta = -4.43$, $0.05 < p < 0.1$)[10]. Further Wald tests also confirm that the differences in the effects of performance-approach on NAPLAN Reading is statistically significant between Catholic and the other two sectors ($p < 0.05$); and the differences in the effects of being bullied on NAPLAN Reading is statistically significant between independent and the other two sectors ($p < 0.01$).

For Numeracy scores, similar to Reading, the key finding is a strong, and consistent across the sectors, positive effect of behavioural engagement, and a strong negative effect of mastery-avoidance on numeracy achievement. Consistent with the models predicting Reading scores, behavioural engagement is the strongest predictor of students' Numeracy scores (β range from 6.05 for Catholic sector to 6.84 for Independent sector, $p < 0.001$). The negative effect of mastery-avoidance on Numeracy scores ranges between $\beta = -7.68$ ($p < 0.001$) for independent school students and $\beta = -4.86$ ($p < 0.01$) for Catholic school students. Further Wald tests indicate no significant differences in the magnitude of these effects across the sector, indicating the uniform character of the positive effects of behavioural engagement, and negative effect of mastery-avoidance on numeracy achievement.

Discussion and conclusion

In this study, we have leveraged nationally representative LSAC data to examine the patterns and relationships between a range of indicators of school climate, student engagement and students' academic achievement across school sectors in Australia. Adopting the theoretical lens of cultural capital, our findings contribute to

[10] Results from interaction models confirm the pattern presented here.

the literatures on student engagement and school climate, through documenting their association with students' academic achievement across Australian school sectors. Our research also provides novel empirical evidence to reveal the potential mechanisms underlying the differences in academic performance across Australian school sectors. Key study contributions include demonstrating that the perceived school climate and student engagement differ across the school sectors in Australia, and identifying the different facets of student engagement that are particularly strongly associated with students' academic achievement in different school sectors.

Our findings show that the patterns of school climate and student engagement do differ across school sectors in Australia. Specifically, independent schools report highest average scores in school discipline, and lowest scores in the experience of being bullied. In contrast, public school students report highest average score on being bullied and score the lowest on behavioural and affective engagement. Catholic schools rank highest in reported teachers' self-efficacy, performance-approach, performance-avoidance, and mastery-approach orientations.

Further modelling reveals that the association between school climate, student engagement and students' academic achievement is also different in each school sector. Specifically, the experience of being bullied stands out as an important predictor of Reading scores for independent school students. Controlling for school climate and demographic characteristics, behavioural engagement was the strongest predictor of students' academic achievement of both Reading and Numeracy scores across all three school sectors. The findings highlight that behavioural engagement is the strongest predictor of students' academic achievement amongst all engagement measures included in the models, a finding consistent with student engagement literature (e.g. Finn, 1993; Fredricks et al., 2004).

Another important finding relates to the effect of cognitive engagement: here, the most consistent and strongest indicator is mastery-avoidance goal orientation, which is significantly negatively associated with both Reading and Numeracy achievement across all school sectors. Mastery-avoidance appear particularly detrimental for students' Reading scores in Catholic sector and for students' Numeracy scores in independent sector (although when formally tested there are no statistically significant differences in the strength of this effect across the sectors). Contrary to some of the previous studies (Senko & Dawson, 2017), mastery-approach goal orientation was not a statistically significant predictor of NAPLAN performances in our analyses, whilst performance-approach goal orientation is only significantly associated with students' Reading scores in Catholic sector and students' Numeracy scores in the whole sample. In addition, performance-avoidance goal orientation, which previous research suggests to be most detrimental orientation, is not significantly associated with the NAPLAN scores.

Taken together, these findings offer important contributions to the literature, enriching our understanding of the effects of school climate and student engagement on academic achievement. Furthermore, the findings presented in this study point to implications for educational practice. Our results suggest that the perceived school climate and the way that students engage with their schools vary across school sectors and may have different impact on students' outcomes. Specifically, our results show that, although students in independent schools are less likely to report being bullied, the consequences of being bullied—when it

happens—appear to be more detrimental than in the other two sectors. Whilst the literature on the prevalence and consequences of bullying across school sectors is limited, some of the existing studies suggest that some forms of bullying, such as cyber-bullying, might be particularly acute amongst students in independent schools (Lodge & Frydenberg, 2007). Catholic school students report the highest level of performance-approach goal orientation, which is also significantly associated with better Reading performance amongst students in this sector. This might help to explain why some previous studies have found students from Catholic sector to perform better academically (cf. Dronkers & Robert, 2008). Furthermore, whilst behavioural engagement is shown to be significantly associated with both Reading and Numeracy across the three sectors, students from public schools report the lowest level of behavioural engagement. These findings may offer pointers for practitioners that can help them to identify the specific aspects that are particularly relevant to students in different sectors, and to provide more targeted support to students.

Whilst noting the significant contributions of the study, some of its limitations must be acknowledged, and these open up opportunities for further research. First, constrained by the available measures in the data set, this study can only capture selected aspects of school climate. Future studies could provide a more comprehensive picture by broadening the range of different facets of school climate they cover. The institutional aspects of school climate would be particularly relevant when exploring the differences across school sectors. Our findings may open avenues for future international research in the field of student performance across school sectors. For instance, the Programme for International Student Assessment (PISA) run by the Organisation for Economic Co-operation and Development (e.g. OECD, 2010) has a range of measures of school climate and student engagement. Future studies can employ this rich information to further explore the mediating role of school climate in the relationship between school sectors and student performance. Second, although drawing on a longitudinal data set, this study could only conduct cross-sectional analysis given that the engagement measures are not available consistently over time. Future research using longitudinal data, where available, would further our understanding of the causal relationships and mechanisms that are at play in determining the patterns of school climate, student engagement and academic achievement in different sectors. Last, whilst this study identifies the different patterns of school climate and student engagement across school sectors, we were not able to determine *why* the effect of school climate or student engagement on academic achievement may differ across school sectors. To address this issue, future studies could investigate the underlying mechanisms using mixed-methods or qualitative approaches. This could help to further explain some of the findings reported in this study, such as the particularly detrimental effects of bullying on academic achievement in the independent school sector.

Despite the limitations noted above, the study makes several novel contributions to the academic literature and provided important pointers for educational policy and practice. Furthermore, to the best of our knowledge, this study is the first to document the association between school climate, student engagement and students' academic achievement across the school sectors in Australia. Therefore, the study paves the way for other studies—in Australia and internationally—to follow and build and extend on the evidence provided here.

Appendix: School climate, student engagement and academic achievement across school sectors in Australia—Additional tables

See Tables 3, 4, 5, 6, 7, 8.

Table 3 Composite measures and scale items for school climate

Composite measures	Respondents	Scale items	Response format
School discipline	Teacher	Please indicate the extent to which you agree or disagree with the following statements regarding your school's disciplinary policies: Teachers in this school have reached a consensus about how to discipline children who break rules All children who break rules in this school face the same consequences Teachers in this school overlook physical aggression amongst children. (reverse) Teachers in this school overlook verbal aggression amongst children. (reverse) Teachers in this school overlook cyberbullying amongst students. (reverse) Teachers feel there is insufficient support within the school for managing disciplinary problems. (reverse)	1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly agree
Bullying—victim	Student	During the past month (30 days) at school… Kids hit or kicked me Kids grabbed or shoved me Kids threatened me Kids said mean things to me Kids stopped others being my friend Kids stopped me joining in Kids sent mean text or email	1. Never 2. Once or twice 3. About once a week 4. Several times a week
Teachers' self-efficacy	Teacher	Please indicate how strongly you agree or disagree with the following statements: I have a strong effect on the academic achievement of the students I teach I feel competent in dealing with students' behavioural problems I feel competent in dealing with students' learning problems I have high expectations for the academic success of my students	1. Strongly agree 2. Agree 3. Neither agree nor disagree 4. Disagree 5. Strongly Disagree

Table 4 Composite measures and scale items for Student engagement

Composite measures	Respondents	Scale items	Response format
Affective engagement (Sense of belonging)	Student	For each of the following sentences please pick the answer that best matches your experience. There are no right or wrong answers a. People here notice when I'm good at something b. It is hard for people like me to be accepted here. (reverse) c. Other students in this school take my opinions seriously d. Most teachers at this school are interested in me e. Sometimes I don't feel as if I belong here. (reverse) f. There's at least one teacher or other adult in this school I can talk to if I have a problem g. Teachers here are not interested in people like me. (reverse) h. I am included in lots of activities at this school i. I can really be myself at this school j. The teachers here respect me k. I wish I were in a different school. (reverse) l. Other students here like me the way I am	1. Not at all true 2. Not very true 3. Neither not at all true nor completely true 4. Somewhat true 5. Completely true
Behavioural engagement (Students' behaviour perceived by the teacher)	Teacher	How often does this student demonstrate the following behaviours in your English class? Usually works hard for good results/grades Seems to relate well to other students Exceptionally passive or withdrawn (reverse) Attentive Disruptive (reverse) Late (reverse) Absent (reverse) Completes homework assigned	1. Never 2. Rarely 3. Some of the time 4. Most of the time 5. All of the time
		Cognitive engagement	

Table 4 (continued)

Composite measures	Respondents	Scale items	Response format
Performance-approach	Student	The following statements concern your attitudes towards learning and performance in your classes this year: a. My goal this year is to get better grades than most of the other students b. It is important for me to do well compared to other students this year c. I want to do better than other students this year	1. (not at all true of me) 2 3 4 5 6 7. (very true of me)
Performance-avoidance	Student	d. I just want to avoid doing poorly compared to other students this year e. The fear of performing poorly is what motivates me f. My goal this year is to avoid performing poorly compared to other students	
Mastery-avoidance	Student	g. I am afraid that I may not understand the content of my courses as thoroughly as I'd like h. I worry that I may not learn all that I possibly could this year i. I am definitely concerned that I may not learn all that I can this year	
Mastery-approach	Student	j. Completely mastering the material in my courses is important to me this year k. I want to learn as much as possible this year l. The most important thing for me this year is to understand the content in my courses as thoroughly as possible	

Table 5 Demographic characteristics of students and families by school sector

Variable	Public (1625)		Catholic (804)		Independent (755)	
	Mean/%	SD	Mean/%	SD	Mean/%	SD
Female	0.48		0.52		0.5	
Born in Australia	0.97		0.97		0.94	
Speaking English at home	0.92		0.93		0.92	
Have medical condition	0.03		0.04		0.04	
Indigenous status	0.03		0.02		0.01	
Born to biological parent	0.70		0.82		0.85	
Family SES	− 0.22	0.95	0.13	0.85	0.47	1.01
Y5 NAPLAN Reading	500.75	83.42	514.24	72.6	532.73	74.99
Y5 NAPLAN Numeracy	499.78	73.57	502.93	63.28	523.86	70.68

Table 6 Summary statistics of school climate, students' engagement, and performance by school sectors

Variable	Public (1625)		Catholic (804)		Independent (755)	
	Mean	SD	Mean	SD	Mean	SD
Outcomes						
Y7 NAPLAN Reading	551.83	71.14	562.27	62.08	583.38	68.29
Y7 NAPLAN Numeracy	551.27	75.14	554.4	64.99	582.11	73.3
School climate						
School discipline	3.91	0.71	3.99	0.64	4.08	0.61
Teachers' self-efficacy	1.66	0.47	1.66	0.49	1.63	0.42
Being bullied	1.29	0.45	1.23	0.38	1.25	0.41
Student engagement						
Behavioural engagement	4.11	0.56	4.18	0.5	4.18	0.47
Affective engagement	48.05	7.59	49.57	6.75	49.86	7.15
Cognitive engagement						
Performance-approach	4.67	1.58	4.66	1.56	4.63	1.55
Performance-avoidance	4.77	1.48	4.87	1.4	4.61	1.54
Mastery-avoidance	3.44	1.56	3.47	1.6	3.32	1.6
Mastery-approach	5.51	1.25	5.66	1.21	5.64	1.14

Source: LSAC, K cohort, wave 5

Table 7 The effects of school climate on NAPLAN Reading and Numeracy by school sectors (whole table with details of control variables and sample weights)

	NAPLAN Reading				NAPLAN Numeracy			
	Full sample	Public	Catholic	Independent	Full sample	Public	Catholic	Independent
	β	*β*	*β*	*β*	*β*	*β*	*β*	*β*
School discipline	1.02	0.59	0.99	1.81	− 0.39	− 0.16	− 0.69	− 2.48
Being bullied	− 1.62*	− 1.06	1.16	− 6.62***	− 1.50	− 0.93	− 1.74	− 2.60
Teachers' self-efficacy	0.96	0.96	0.14	2.32	1.18	2.25	0.10	− 0.51
Control variables								
Female	1.34	2.66	4.11	− 5.68	− 2.91	− 1.12	− 2.99	− 8.18*
Born in Australia	− 7.21	3.97	− 22.62*	− 11.08	− 5.57	− 5.66	− 6.80	− 2.60
Speak English at home	5.48	7.89	4.70	0.12	− 7.68*	− 7.83	− 9.61	− 5.33
Have medical conditions	− 8.22	− 10.44	7.80	− 20.49**	− 13.19***	− 10.39*	− 16.87**	− 17.04
Indigenous	− 14.74**	− 16.54*	− 10.28	− 14.68	− 8.37	− 13.17	8.31	− 8.14
Born to biological parents	5.23*	6.36*	2.87	0.20	2.38	1.70	1.60	1.12
Family SES (Ref: middle SES)								
Low-SES	− 6.49**	− 7.83**	− 0.65	− 1.04	− 8.20***	− 10.12***	− 0.05	− 5.56
High-SES	13.77***	16.94***	7.08	12.90***	12.24***	13.17***	9.32*	9.82**
Year 5 NAPLAN Reading	0.64***	0.63***	0.64***	0.66***				
Year 5 NAPLAN Numeracy					0.79***	0.79***	0.76***	0.80***
N	3184	1625	804	755	3184	1625	804	755
r2	0.62	0.63	0.58	0.62	0.66	0.68	0.60	0.67

LSAC, K cohort, wave 5. All school climate variables have been standardised

$^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

Table 8 The effects of engagement on NAPLAN Reading and Numeracy by school sectors (whole table with details of control variables and sample weights)

	Reading				Numeracy			
	Full sample	Public	Catholic	Independent	Full sample	Public	Catholic	Independent
	β	β	β	β	β	β	β	β
Engagement								
Affective engagement	0.23	1.09	− 2.47	0.92	− 1.08	− 0.74	− 1.90	− 1.56
Behavioural engagement	5.22***	5.38***	3.92*	6.32***	5.96***	6.10***	6.05**	6.84***
Cognitive engagement								
Performance-approach	1.65	0.67	5.23*	0.22	2.41*	2.75	2.45	1.87
Performance-avoidance	− 0.59	− 1.23	1.11	0.26	− 1.22	− 0.97	− 2.40	0.04
Mastery-avoidance	− 3.58***	− 2.54	− 6.04***	− 4.11*	− 5.29***	− 5.10***	− 4.86**	− 7.68***
Mastery-approach	0.44	0.29	− 0.03	0.85	0.96	0.06	3.09	− 0.01
School climate								
School discipline	0.92	0.66	0.29	1.06	− 0.49	− 0.05	− 1.07	− 3.22
Being bullied	− 0.05	0.69	1.68	− 4.43**	0.07	0.73	− 0.50	− 0.65
Teacher self-efficacy	0.10	0.06	− 0.73	1.37	0.23	1.30	− 1.26	− 1.04
Control variables								
Female	− 0.30	0.43	4.66	− 7.78*	− 5.45**	-3.65	− 5.67	− 11.22**
Born in Australia	− 7.31	3.22	− 22.22*	− 10.73	− 5.31	-6.10	− 5.66	− 1.91
Speak English at home	6.04	8.14	5.79	1.31	− 7.46*	-7.14	− 10.22	− 4.13
Have medical conditions	− 6.38	− 6.81	10.28	− 22.62**	− 11.44**	-7.63	− 13.44*	− 18.76*
Indigenous	− 13.44*	− 16.13*	− 4.87	− 14.64	− 6.96	− 12.98	12.64	− 5.41
Born to biological parents	3.74	4.51	0.80	0.49	0.96	− 0.34	0.45	2.40
Family SES (Ref: middle SES)								
Low-SES	− 5.38**	− 6.32*	0.34	− 1.56	− 6.72**	− 7.99**	1.03	− 6.43
High-SES	13.14***	16.52***	7.06	11.62***	11.37***	12.52***	8.54*	7.60*
Year 5 NAPLAN Reading	0.62***	0.61***	0.61***	0.63***				

Table 8 (continued)

	Reading				Numeracy			
	Full sample	Public	Catholic	Independent	Full sample	Public	Catholic	Independent
	β	β	β	β	β	β	β	β
Year 5 NAPLAN Numeracy					0.76***	0.76***	0.73***	0.76***
N	3184	1625	804	755	3184	1625	804	755
r2	0.63	0.64	0.59	0.63	0.68	0.69	0.61	0.69

LSAC, K cohort, wave 5. All school climate and student engagement variables have been standardised. Control variables include gender, born in Australia, Indigenous status, speaking English at home, having a medical condition, born to biological parents, family SES and Year 5 NAPLAN Reading and Numeracy

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Author contributions All authors contributed to the study conception, analyses and writing up. Data analyses were performed by YH, NX and WT. The first draft of the manuscript was written by WT and NX, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability The Longitudinal Study of Australian Children (LSAC) data used in this study are available from the National Centre for Longitudinal Data (NCLD), subject to approval. Instructions for how to apply for Release 7 of LSAC can be found on the *NCLD Dataverse* website: https://growingupinaustralia.gov.au/data-and-documentation/accessing-lsac-data.

Declarations

Conflict of interest The authors have indicated they have no potential conflicts of interest to disclose.

Ethical approval This project has been reviewed by the Office of Research Ethics at the University of Queensland and is deemed to be exempt from ethics review under the National Statement on Ethical Conduct in Human Research and University of Queensland policy (No. 2018000117). This paper is exclusively based on secondary data analysis of publicly available data (LSAC). LSAC obtained ethics approval from the Australian Institute of Family Studies Ethics Committee, which is a Human Research Ethics Committee registered with the National Health and Medical Research Council (NHMRC).

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