Uneven impacts of COVID-19 on the attendance rates of secondary school students from different socioeconomic backgrounds in Australia: A quasi-experimental analysis of administrative data

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Abstract
This paper contributes to the growing body of research that demonstrates uneven impacts of the COVID-19 pandemic on educational outcomes of students from different socioeconomic status (SES) backgrounds. We evaluate the early impacts of COVID-19 on student attendance in secondary school and show how these impacts depend on students' SES. We employ a quasi-experimental design, using difference-in-differences (DiD) estimation extended to incorporate third-order differences over time between low-SES and other students, and pre- versus during-COVID-19, leveraging robust administrative data extracted from the registers of the Tasmanian Department of Education. Using data from multiple cohorts of secondary school students in government schools in Tasmania (N = 14,135), we find that while the attendance rates were similar pre- and during-COVID-19 for high-SES students, there was a significant drop in attendance rates during COVID-19 among socioeconomically disadvantaged students, demonstrating the more pronounced impacts of COVID-19 for these students. The findings demonstrate that even “relatively short” lockdowns, as those
1 | INTRODUCTION

As experienced globally, student learning in Australia has been impacted by the COVID-19 pandemic, including as a result of the periods of remote learning and school closures. The pandemic has also significantly affected families' socioeconomic circumstances and emerging evidence points to increasing inequalities due to COVID-19, including socioeconomic inequalities in educational outcomes (Brom et al., 2020, Brown et al., 2020; Cullinane & Montacute 2020; Clinton, 2020; Education Endowment Foundation, 2020; Sonnemann & Goss, 2020).

While there is growing international research exploring the impacts of COVID-19 on educational outcomes, most studies have focused on estimating the projected or real effects of the pandemic on learning loss, typically approximated by academic achievement (Brom et al., 2020; Education Endowment Foundation, 2020; Hammerstein et al., 2021). The evidence has been somewhat mixed. Some studies suggest a degree of learning loss associated with school closures and remote learning, while others show no such effects. However, research exploring the effects of COVID-19 on outcomes beyond academic achievement, such as attendance, retention or completion, remains scarce. Understanding the impacts of the pandemic on a broader set of outcomes is important for a comprehensive assessment and to pick up patterns that are not easy to detect when looking at academic achievement alone, particularly over a relatively short period of time.

One key outcome that could be plausibly affected by school closures and remote learning is school attendance following return to classroom-based learning. School attendance is typically viewed as a precondition for students' social and educational development and progression (Hancock et al., 2017). Furthermore, research suggests that school attendance may be particularly important for students experiencing educational or social disadvantage (Gershenson, Jacknowitz & Brannegan, 2017; Hancock et al., 2017; Zubrick, 2014). Assessing the impact of COVID-19 on school attendance is important to understand the longer-term impacts of the pandemic on subsequent outcomes like school engagement, achievement and attainment, which are indicated by or mediated through attendance.

COVID-19 also provides an important test of whether home learning exacerbates inequalities in school attendance because COVID-19-related school closures were system wide and thus experienced by almost all students. This allows us to treat the pandemic as a “natural experiment” and test the impact of school closures on attendance levels across different groups of students without the risk that the students who experienced school closures also varied in other ways from those who did not. This is particularly important when investigating the

in Tasmania in 2020 (30–40 days of home learning), can significantly affect the learning experiences of students from socioeconomically disadvantaged backgrounds. We discuss the implications of this for future pandemic planning in educational policy and practice and how this needs to be addressed in Australia's COVID-19 recovery.

KEYWORDS
COVID-19, inequality, school attendance, school closures, secondary education
differential effects that COVID-19 might have had on school attendance of students across the socioeconomic status (SES) strata.

In this paper, we contribute to the research base on the effects of COVID-19 on educational outcomes by analysing school attendance using administrative data obtained from the Tasmanian Department of Education, and investigating how the SES gaps in attendance changed after pandemic-related school closures in 2020. The paper draws on data collected for the “Learning through COVID-19” project (McDaid et al., 2021) which explored the impact of COVID-19 on educational disadvantage in Australia and identified a portfolio of policy and program solutions.

Tasmania is an important context for the research objectives. On the one hand, in Tasmania, socioeconomic inequities both within the state—and in comparison with other Australian jurisdictions—make it well suited to study the impacts of COVID-19 on school outcomes of students from socioeconomically disadvantaged backgrounds. On the other hand, the 2020 Tasmanian lockdown was relatively brief, with Tasmanian school students averaging between 30 and 40 days learning from home. As such, the effects estimated using Tasmanian data can be treated as lower bound estimates of the effects of more prolonged lockdowns, such as those experienced subsequently by students in New South Wales or Victoria, as well as in many counties internationally (UNESCO, 2021).

2 | EMERGING EVIDENCE ON EDUCATIONAL IMPACTS OF COVID-19 IN AUSTRALIA

Extant research into the educational impacts of COVID-19 falls into two phases. Early in the pandemic, researchers tried to identify potential educational impacts by extrapolating from earlier studies of “COVID-19-like events,” or by seeking expert and professional opinion from teachers and others. As the pandemic progressed, direct empirical studies of the impact of COVID-19 disruptions on school students' educational outcomes began to appear.

Both phases of research assume that the COVID-19 primarily disrupts pre-COVID “normal education” through widespread school closures led to a heavy reliance on (largely online) home learning. The early literature highlighted the potential impacts of this shift on student mental health and well-being, other COVID-19-induced health consequences, reduced social connections and the loss of services and schools as safe places, particularly if students were already socially or educationally vulnerable (Brown et al., 2020; Clinton, 2020; Western Australian Commissioner for Children and Young People, 2020). Other researchers argued that an increased reliance on digital technologies and resources could worsen educational inequalities, because students and young people lack equal access to high-quality digital devices like laptops and mobile phones and fast affordable Internet, and digital literacy among students and their parents and carers also varies (Drane et al., 2020; Lamb, 2020).

Several early studies focused on student achievement, attempting to quantify potential “learning loss” in areas like literacy and numeracy from school closures. These analyses drew on reports from teachers about the pace of learning during school closures compared to in-class learning (Sonneman & Goss, 2020), and prior research about the impact of events such as long school breaks, or direct comparisons between online learning and classroom-based teaching on student achievement (Brown et al., 2020; Clinton, 2020; Drane et al., 2020; Joseph & Fahey, 2020; Lamb, 2020; Sonneman & Goss, 2020). Australian studies using these methodologies produced a range of estimates of lost learning, with one study suggesting the loss from online delivery in Australia could vary from 4% to 33% depending on learning area (reading or numeracy), student year and the length of exposure to the online home learning environment (Lamb, 2020).
Early research was largely speculative about potential educational impacts of COVID-19 disruptions. As the pandemic has continued, empirical research into its actual effects has emerged. The primary focus of these empirical studies has been the impact of school closures on student achievement. Hammerstein et al., (2021) provide a systematic review of the high quality, including Australian, literature on the effects of COVID-19-related school closures on student school achievement. They identify 11 robust empirical studies from Germany, China, Netherlands, Belgium, the USA, Switzerland and Australia, where durations of school closure varied between 6 and 8 weeks. The studies include primary and secondary school students, and focus largely on reading and mathematics, albeit with some other subject areas. These results are mixed, with most studies finding negative effects of COVID-19 school closures on performance in mathematics, about half finding negative effects on performance in reading, but some others also finding positive effects of school closures and home learning on achievement in these subjects.

The one Australian study included in the review (Gore et al., 2021) examined Year 3 and 4 students in New South Wales (NSW) public schools, finding no effect of COVID-19 school closures on student achievement across the sampled year groups. However, when the analysis was disaggregated by year level and school-level social and economic advantage, Year 3 students in the least advantaged schools experienced 2 months less growth in mathematics as the result of school closures, but Year 3 students in mid-level schools achieved 2 months additional learning gain. An analysis of NSW Department of Education data (NSW Department of Education, 2020) similarly showed no learning loss in NSW state schools in years 3 and 5 reading and years 5 and 9 numeracy. There was also some evidence of higher achievement in Year 3 maths associated with school closures. The Australian research on COVID19-related school closures on student achievement thus shows varying results and does not consistently support early projections of either learning loss or widening gaps in student achievement.

The focus so far has been mainly on student achievement. However, the impact of COVID-19 on students potentially extends beyond academic achievement, and effects on other outcomes also matter for explaining longer-term impacts of the pandemic. Some existing studies have flagged the potential effects of school closures and online home learning on other educational outcomes, including student engagement. Student engagement with online learning depends on features of home environment (e.g. support from family, adequate study environment and digital resources), student motivation and self-direction, age and digital literacy, ongoing engagement with teachers and the suitability of home learning resources. These factors are unequally distributed. Students already experiencing social and economic disadvantage could therefore be more at risk of disengagement from online learning if they are also disadvantaged with respect to the precursors of effective online learning (Andrew et al., 2020, Flack et al., 2020).

3 | THE RELEVANCE OF SCHOOL ATTENDANCE

This study focuses on attendance, which is a relatively easy to capture education outcome closely related to other educational outcomes. Attendance is considered a key indicator of behavioural engagement. School attendance upon return to classroom-based learning could plausibly be impacted by COVID-induced school closures and remote learning. The importance of attending school is recognised in Australian policy literature, which emphasises that “everyday counts” (e.g. Hancock et al., 2013; Queensland Department of Education, 2021; Tasmanian Department of Education, 2019). This assessment is firmly backed up by academic research. For instance, one study based on a large dataset from Western Australia (Zubrick, 2014) demonstrates that academic achievement declines with any absence, leading to the conclusion that “there is no ‘safe’ threshold” of absences (ibid., p. 34). Lower attendance rates have been
associated with increased risk of social isolation, leaving school before completing an upper secondary qualification, poorer outcomes in literacy and numeracy, and overall reduced educational attainment (AITSL, 2019; Buckingham et al., 2013; Eslake, 2019; Zubrick, 2014).

Furthermore, students in low-SES schools and from low-SES backgrounds tend to have relatively more absences (Hancock et al., 2017; Zubrick, 2014). Research suggests that students from lower SES households also may be less well supported than higher-SES students to catch up on schoolwork following an absence, due to both school and home contexts (Hancock et al., 2017; Zubrick, 2014). These students, on average, already have lower academic achievement than their more advantaged peers, and this may be exacerbated by higher levels of absences. Zubrick, (2014, p. 37) concludes that: “[t]he combination of low SEI [socioeconomic index] with poor attendance rates, with higher proportions of unexplained absences, is particularly damaging to achievement attainment and onward success.” It is therefore important to investigate the potential impacts of COVID-19 on attendance across different SES levels, which is the focus of this paper.

4 | TASMANIAN CONTEXT AND THE COVID-19 RESPONSE

Tasmania is an island state located to the southeast of the Australian mainland. Much of the state is classified as rural or regional, an attribute that commonly marks disadvantage (Davidson et al., 2020; Productivity Commission, 2018). Average wages in Tasmania are the lowest in Australia, yet living costs in Tasmania are some of the nation's highest (Ivanoski, 2020). There are high levels of unemployment in Tasmania, and up to 40% of Tasmanian income units depend on government support (Ivanoski et al., 2020). High rates of disadvantage contribute to poorer health, educational and life outcomes across Tasmania (Eslake, 2019).

Furthermore, educational attainment in Tasmania is relatively low. The Year 12 (i.e. upper secondary) attainment rate was 58% in 2019, compared to 72% for Australia overall. For low-SES students, the figures were 52% in Tasmania versus 68% across Australia (Productivity Commission, 2021). This low attainment has been attributed to the structure of the secondary school system in Tasmania by some (Rowan & Ramsay, 2018). Until recently, the government system had separate schools for lower secondary education (years 7–10, known as high schools) and upper secondary education (years 11–12, known as colleges). Not only did this mean that students from regional areas had to travel to access college, but there was also a sense among young people that completing Year 10 marked the end of schooling. Recent policy initiatives, such as raising the minimum leaving age or giving students the option to stay in their high school for upper secondary education or go to a college, aimed to increase student retention. There has been some improvement, but Tasmania still lags behind the rest of the country. Between 2014 and 2020, the apparent retention rate for Year 7/8 to Year 12 remained stable across Australia, at 83.6%, but improved in Tasmania from 68.4% to 74.9% (ABS schools Australia 2020). Furthermore, despite the introduction of extended high schools, the majority of students continue to move from Year 10 in a “high school” to Year 11 in a college.

In response to the COVID-19 pandemic, the Tasmanian State Government initiated public health restrictions from 15 March 2020. A state of emergency was declared on 19 March and lockdown was implemented until early June 2020 (Jarvie, 2020). Since then, Tasmania has exploited natural island boundaries and distributed vaccinations to manage the disease. As a result, Tasmania has implemented fewer lockdowns that impacted on schooling than some other states in Australia.

A substantive lockdown commenced in March 2020, with schools closed from 30 March to 25 May 2020 for upper secondary (years 11 and 12) and primary school aged students, and
until 9 June 2020 students in years 7–10. During this period, students learned remotely from their residences. Students for whom it was unsafe or impractical to do so were encouraged to continue to learn from school. It is estimated that 10% students did this.

Overall, primary and upper secondary students spent thirty school days learning from home and students in years 7 to 10 spent forty school days learning from home in 2020. Students learned from home via online or paper-based lessons, with hard copy schoolwork posted to students. Many students relied on the Internet to engage with their schooling. However, the lockdown highlighted significant deficiencies in the digital infrastructure available in Tasmania (PESRAC, 2021; TasCOSS, 2019). In the 2020 Australian Digital Inclusion Index (ADII), Tasmania had the lowest ADII score of all states and territories: 59.6 vs. 63.0 Australia-wide (Thomas et al., 2020). Students who did not have adequate access to digital hardware (devices, WI-FI and data) and software (programs) to effectively learn from home were affected more by the 2020 lockdown in Tasmania.

4.1 | Empirical strategy

We employ a quasi-experimental design to estimate the effect of COVID-19 on the extent of SES-related educational disadvantage, as captured by shifts in attendance rates following return to classroom-based learning. The effect is defined as a change in the SES-related attendance gap that can be associated with pandemic-related school closures. In other words, we evaluate whether COVID-19 impacted on low-SES students’ attendance to a greater extent than it did on high-SES students’ attendance.

To capture the early effects of COVID-19 on shifts in attendance rates, we compare over-time changes in the SES-related attendance gap among two student cohorts, the “during-COVID-19 cohort” and the “pre-COVID-19 cohort.” While the former comprises students who experienced the pandemic, the latter consists of students who did not experience the pandemic-induced disruptions, with data sourced from pre-pandemic years. Having the pre-COVID-19 cohort is needed to control for the baseline (before COVID-19) levels of educational disadvantage and enables attribution of any observed changes to the effects of the pandemic. The underlying assumption is that in the absence of COVID-19, we would observe the same differential trends in attendance across SES groups in both cohorts.

For each cohort, we capture changes in attendance rates between two time points, designated as T1 and T2. For the during-COVID-19 cohort, T1 and T2 represent attendance captured prior to and after school closures, respectively. Specifically, we define T2 for the during-COVID-19 cohort as the period between the school reopening on 9/06/2020 (following the return to classroom-based learning) and the end of Term 2 on 3/07/2020. We specify T1 as a corresponding period 1 year earlier, in 2019, when students were in a lower grade. Capturing prior attendance (at T1) is important to account for between-individual variations in attendance levels across different students when estimating the effects of COVID-19 on attendance at T2. In the case of the pre-COVID cohort, which serves as a control group in our study, we capture T1 and T2 attendance in the corresponding periods of the pre-pandemic years, that is 2018 and 2019, respectively.

Designating attendance rate, our dependent variable, as Y, the SES disadvantage effect under COVID-19 pandemic (i.e. for the during-COVID-19 cohort), contrasting low- and high-SES students is given by the following formula:

\[
\text{during – COVID – 19 SES effect} = \left( \frac{Y_{2020, \text{high SES}} - Y_{2019, \text{high SES}}}{Y_{2020, \text{low SES}} - Y_{2019, \text{low SES}}} \right)
\]

(1)

where the first subscript indexes the school year, and the second subscript denotes SES.
In the pre-pandemic data (i.e. the pre-COVID-19 sample), which serve as controls in our analyses, the SES disadvantage effect comparing low- and high-SES students can be defined as:

\[
\text{pre – COVID – 19 SES effect} = \left( Y_{2019, \text{high SES}} - Y_{2018, \text{high SES}} \right) - \left( Y_{2019, \text{low SES}} - Y_{2018, \text{low SES}} \right)
\]

Our hypothesis of interest is that the difference between these differences in difference (SES effects) is greater than zero:

\[
\text{pre – COVID – 19 SES effect} - \text{pre – COVID – 19 SES effect} > 0
\]

which is equivalent to:

\[
\left( \left( Y_{2020, \text{high SES}} - Y_{2019, \text{high SES}} \right) - \left( Y_{2020, \text{low SES}} - Y_{2019, \text{low SES}} \right) \right) - \left( \left( Y_{2019, \text{high SES}} - Y_{2018, \text{high SES}} \right) - \left( Y_{2019, \text{low SES}} - Y_{2018, \text{low SES}} \right) \right) > 0
\]

In other words, we want to assess whether the magnitude of the SES education disadvantage, as measured by the attendance gap between high- and low-SES students, is bigger among the during-COVID-19 cohort than among the pre-COVID-19 cohort. If this is the case, we will observe a COVID-19 effect. We need to compare a during-COVID-19 cohort to a pre-COVID-19 cohort, because students’ individual attendance patterns change over time regardless of the pandemic. If we simply observe the attendance gap between high- and low-SES students growing between 2019 and 2020, this could be due to normal “growth” in SES inequalities in attendance as students’ progress. A pre-COVID control group lets us compare the COVID-19 experience to the corresponding change in attendance gaps for students who have not experienced COVID-19 school closures.

Our analytical approach requires using longitudinal data, that is, data that follow individual students over time. This makes the results more robust, as longitudinal data allow us to measure changes in attendance between T1 and T2 while controlling for individual-level characteristics that might drive patterns in the data but are, in fact, unrelated to the effects of COVID-19.

### 4.2 Dataset and sample selection

This research utilises data on Tasmanian government school students obtained from the Tasmanian Department of Education. The dataset comprised information on students enrolled in Year 9, Year 10, Year 11 and Year 12 between 2018 and 2020 in government schools. Data included information on enrolment, attendance, school characteristics and students’ social background.

The data allow us to estimate the effects of pandemic-related school closures on the attendance rates of three groups of students: those enrolled in Year 10 (Y10), Year 11 (Y11) and Year 12 (Y12) in 2020. Since the experiences of students enrolled in different scholastic years might vary, we construct three separate subsamples, one for each scholastic year, and analyse them separately. These subsamples consist of students who experienced pandemic-related school closures in 2020 and constitute the during-COVID-19 cohort and students belonging to a corresponding pre-COVID-19 cohort, that is students who were enrolled in the same scholastic year in 2019. For example, in the Y10 subsample, these cohorts comprise students enrolled in Y10 in 2020 and students enrolled in Y10 in 2019, respectively. Of note, we are labelling these sub-samples with reference to the scholastic year at T2, while also capturing their baseline attendance levels 1 year prior (T1), when they were enrolled in a lower grade.
Figure 1 shows the data structure schematically.

As noted before, the analysis requires two measurements (in T1 and T2) for every student in each cohort. For example, to be a part of the during-COVID-19 cohort in the Y10 sample, a student needs to have records for both Y9 enrolment in 2019 and Y10 enrolment in 2020. As a result, we had to exclude around 5% cases from the Y10 subsample, 21% from the Y11 subsample and 5% from the Y12 subsample due to missing data at T1. This missingness could be a result of transfers between school systems, for example a student transferring from a Catholic or independent school to a government school, or moving between states or countries. Furthermore, we removed 5% of the remaining cases due to missing data on analytic variables. The final subsample sizes were 7059, 6463 and 6478, respectively. The total number of unique observations in the dataset used in our analyses is 14,312.

5 | MEASURES

5.1 | Attendance rate

Attendance rate is the dependent variable in our analyses. It is defined as the share of time students were marked as present during the period between the schools reopening and the end of Term 2 in 2020, and in the corresponding periods in 2019 and 2018. As shown in Table 1, the attendance rate in the pooled sample is 0.78 (SD = 0.26).

5.2 | Socioeconomic status (SES)

Socioeconomic status is the key independent variable in this study. Our measure of SES is based on parental education and occupation. The original data, collected in accordance with the Australian National Standards (ACARA, 2019), include the most recent available information on the highest occupational level and the highest educational level of parents. Using these two variables, we categorised students into five SES groups, following broadly the approach documented in Houng & Justman, (2014), adapted to the data at hand. In doing so, we further distinguish between “low-SES” households where parents are employed in low-status
occupations from a category of students from “jobless” households, with neither parent in paid work in the last 12 months, which have been identified in previous literature as particularly likely to experience various facets of disadvantage (Curry et al., 2021; Mooi-Reci et al., 2020). However, in the interest of brevity, when discussing the results we sometimes collectively refer to students from low-SES and jobless households as “socially disadvantaged” students.

The identified categories are as follows:

- **High SES**, which includes students whose parents/guardians/carers have an advanced diploma, diploma or a university degree and belong to occupation category 1 (senior management in a large business organisation, government administration and defence, and qualified professionals) or 2 (other business managers, arts/media/sportspersons and associate professionals);
- **Medium SES**, which includes students whose parents/guardians/carers either finished at least Year 11 or belong to occupation category 1 (senior management in a large business organisation, government administration and defence, and qualified professionals) or 2 (other business managers, arts/media/sportspersons and associate professionals);
- **Low SES**, which includes students whose parents/guardians/carers finished at most Year 10 and belong to occupation category 3 (tradespeople, clerks and skilled office, sales and service staff) or 4 (machine operators, hospitality staff, assistants, labourers and related workers);
- **Jobless households**: neither parent/guardian/carer was in paid work in the last 12 months;
- **Occupation not stated or unknown**.

### TABLE 1

|                         | Total    | Y10 subsample | Y11 subsample | Y12 subsample |
|-------------------------|----------|---------------|---------------|---------------|
| Attendance rate (mean)  | 0.78     | 0.81          | 0.77          | 0.77          |
| Socioeconomic status (%)|          |               |               |               |
| Occupation unknown      | 7.2      | 4.3           | 5.8           | 9.9           |
| Jobless households      | 10.1     | 10.7          | 11.2          | 9.2           |
| Low SES                 | 8.0      | 8.8           | 8.0           | 6.7           |
| Medium SES              | 49.3     | 52.1          | 50.0          | 46.1          |
| High SES                | 25.4     | 24.1          | 24.9          | 28.0          |
| Gender (%)              |          |               |               |               |
| Female                  | 49.6     | 47.4          | 50.0          | 52.3          |
| Male                    | 50.4     | 52.6          | 50.0          | 47.7          |
| Indigenous (%)          | 10.1     | 10.9          | 10.4          | 9.0           |
| Has a disability (%)    | 7.2      | 8.0           | 7.4           | 6.3           |
| ICSEA (%)               |          |               |               |               |
| below 900               | 11.5     | 15.0          | 15.1          | 2.5           |
| 900–999                 | 73.6     | 70.9          | 70.6          | 80.8          |
| 1000+                   | 13.4     | 12.8          | 12.3          | 15.2          |
| Special school          | 1.5      | 1.3           | 1.9           | 1.5           |
| Missing indigenous status (%) | 4.4 | 2.5 | 3.0 | 6.2 |
| Changed school (%)      | 25.1     | 4.4           | 89.0          | 6.4           |
| Observations            | 14,312   | 7059          | 6463          | 6478          |

*Notes: Based on data on government schools in 2018, 2019 and 2020 provided by Tasmanian Department of Education. ICSEA: Index of Community Socio-Educational Advantage, higher values indicate higher levels of advantage.*
Pooling all observations in our dataset results in 25.4% of students classified as coming from a high-SES background, 49.3% from a medium-SES background, 8.0% from a low-SES background, plus 10.1% of students in jobless households. For 7.2% of students, we do not have enough data to classify them into one of the SES categories—these students are included in the analysis as a separate category, although we do not include these results in the figures to improve the clarity of the presentation (they are, however, included in the tables).

5.3 | Control variables

Our models control for a set of student and school characteristics that are potential confounders. These include gender, having a disability (yes/no), Indigenous status (yes/no) and school's Index of Community Socio-Educational Advantage (ICSEA) with higher values indicating higher advantage of students attending the school, and a flag indicating that a student changed their school between T1 and T2 (yes/no). Table 1 presents summary statistics of all variables included in the analyses in the pooled sample and subsamples.

6 | STATISTICAL MODELLING

Our analytical strategy belongs to the family of difference-in-differences (DiD) approaches. Technically, it is implemented via random effects estimation with third-order interaction. Specifically, the models have the following form:

\[ Y_{st} = \alpha + \beta_1 \text{SES}_s + \beta_2 T + \beta_3 C + \beta_4 (\text{SES}_s \times T) + \beta_5 (\text{SES}_s \times C) \\
+ \beta_6 (T \times C) + \beta_7 (\text{SES}_s \times T \times C) + \beta_8 \text{Cont} + u_s + e_{st} \]

where the \( s \) and \( t \) subscripts denote students and time points, respectively; \( Y \) is the attendance rate; \( \alpha \) is the model's grand intercept; \( \text{SES}_s \) is a set of dummy variables representing socioeconomic background; \( T \) is a variable representing time points (T1 or T2); \( C \) is a variable representing cohort (pre-COVID or during-COVID); \( \text{SES}_s \times T \), \( \text{SES}_s \times C \), and \( C \times T \) are two-way interaction effects between the previous three variables, and \( \text{SES}_s \times T \times C \) is the three-way interaction effect between all three previous variables; \( \text{Cont} \) is a set of control variables, as described before; \( \beta_1 \) to \( \beta_8 \) are coefficients (or vectors of coefficients) to be estimated; \( u \) is an individual-level random effect (or random intercept) capturing unobserved effects assumed to be normally distributed and orthogonal to the model variables; and \( e \) is the usual individual-level regression error.

The key parameter of interest is \( \beta_7 \) on the three-way interaction effect, which indicates whether the effects of SES observed as students' progress from T1 to T2 differs between the pre-COVID-19 and during-COVID-19 cohorts. To make the interpretation of the models easier, we present and discuss the results as average adjusted predictions (predictive margins), holding the random effects at zero.

7 | RESULTS

Table 2 presents regression model results for each subsample. The results indicate that SES is statistically significantly associated with the attendance rate in all three subsamples. Students from jobless households and low-SES students tend to have lower attendance rates. Furthermore, we observe that regression coefficients on the three-way interaction are statistically significant, suggesting that the gap in attendance between students from different SES categories widens faster in during-COVID-19 than pre-COVID-19 cohorts.
TABLE 2  Results from random-effects regression models

|                          | Y10 subsample | Y11 subsample | Y12 subsample |
|--------------------------|---------------|---------------|---------------|
| **SES (ref. High SES)**  |               |               |               |
| Occupation unknown       | −0.10***      | −0.09***      | −0.04**       |
| Jobless households       | −0.13***      | −0.09***      | −0.09***      |
| Low SES                  | −0.06***      | −0.06***      | −0.04*        |
| Medium SES               | −0.01         | −0.03*        | −0.02*        |
| Time: T2                 | −0.02**       | −0.05***      | −0.02*        |
| **Time × SES**           |               |               |               |
| Occupation unknown × T2  | −0.06**       | −0.04*        | −0.00         |
| Jobless households × T2  | −0.02         | −0.06**       | −0.07***      |
| Low SES × T2             | −0.02         | −0.07***      | −0.03         |
| Medium SES × T2          | −0.01         | −0.05***      | −0.03**       |
| **Cohort: during-COVID-19** | −0.00         | −0.02         | −0.00         |
| **SES × cohort**         |               |               |               |
| Occupation unknown × during-COVID-19 | 0.01        | −0.04         | −0.02         |
| Jobless households × during-COVID-19 | −0.01    | −0.03         | −0.03         |
| Low SES × during-COVID-19 | −0.01        | 0.02          | −0.03         |
| Medium SES × during-COVID-19 | −0.02       | 0.02          | −0.02         |
| **T2 × during-COVID-19** | 0.02*         | 0.03*         | −0.00         |
| **SES × time × cohort**  |               |               |               |
| Occupation unknown × T2 × during-COVID-19 | 0.01       | −0.02         | −0.04         |
| Jobless households × T2 × during-COVID-19 | −0.05*       | −0.07**       | −0.01         |
| Low SES × T2 × during-COVID-19 | −0.05*       | −0.06*        | −0.00         |
| Medium SES × T2 × during-COVID-19 | −0.02        | −0.02         | −0.00         |
| **Gender: Male**         | 0.01          | 0.01*         | 0.00          |
| Indigenous               | −0.05***      | −0.05***      | −0.05***      |
| Has a disability         | −0.03**       | 0.01          | 0.00          |
| **ICSEA (ref. below 900)** |             |               |               |
| 900–999                  | 0.05***       | 0.02**        | 0.09***       |
| 1000+                    | 0.04***       | 0.03**        | 0.10***       |
| Special school           | 0.06**        | −0.03         | 0.14***       |
| Missing indigenous status| 0.03          | 0.03*         | 0.01          |
| Changed school           | −0.16***      | 0.06***       | −0.13***      |
| Constant                 | 0.83***       | 0.78***       | 0.75***       |
| Level-2 error standard deviation | 0.167       | 0.179         | 0.170         |
| Level-1 error standard deviation | 0.164       | 0.188         | 0.176         |
| R2 for overall model     | 0.0892        | 0.0877        | 0.0683        |
| N (observations)         | 14,118        | 12,926        | 12,956        |
| N (individuals)          | 7059          | 6463          | 6478          |

Notes: Based on data on government schools in 2018, 2019 and 2020 provided by Tasmanian Department of Education. SES: Socioeconomic status. ICSEA: Index of Community Socio-Educational Advantage. Statistical significance: *p < 0.05, **p < 0.01, ***p < 0.001.
To better visualise the trends in attendance and magnitude of the above effects, we calculated average adjusted predictions based on the regression results. Figure 2 plots the adjusted attendance rates for students of different SES within all subsamples and cohorts. It demonstrates marked differences between SES categories in each grade both pre- and during-COVID-19. For example, even before COVID-19, the attendance rate among high-SES Y10 students stood at 0.84 and was 0.08 higher than among low-SES students, and 0.15 higher than among those whose parents were not in paid work (Y10 subsample, pre-COVID-19, T2).

The falling attendance rate is another pattern common to all subsamples and cohorts. The attendance rate drops as students transition from T1 to T2, that is progress through scholastic years. This pattern is visible among almost all SES groups in each cohort and subsample. The

FIGURE 2 Predicted attendance rates by socioeconomic status, subsample, cohort and time. Notes: Based on data on government schools in 2018, 2019 and 2020 provided by Tasmanian Department of Education. SES, Socioeconomic status. Based on the model results presented in Table 2. Results for the “occupation unknow” SES category not presented. The shaded areas denote 95% confidence intervals.
sole exception is high-SES students from the during-COVID-19 cohort in the Y10 subsample, whose attendance rate remains at the same level.

However, the rate by which attendance rates falls varies by students' SES. High-SES students tend to exhibit noticeably smaller falls in attendance rates, compared with low-SES students or students from jobless households. For example, in the pre-COVID-19 cohort of the Y11 subsample, the attendance rate among high-SES students dropped by 6.3% between T1 and T2, from 0.86 to 0.80. At the same time, it dropped from 0.77 to 0.66 among students from jobless households and from 0.80 to 0.68 among low-SES students, that is by 14.2% and 15.6%, respectively. As a result, the gap in attendance between high-SES students and their socioeconomically disadvantaged peers widens as student progress through scholastic years. Similar patterns are evident across all subsamples and cohorts.

Comparing the rate by which the gap between advantaged and disadvantaged students expands when they transition from T1 to T2 across cohorts allows us to ascertain the extent to which COVID-19-related school closure exacerbated the educational disadvantage of socioeconomically disadvantaged students as captured by attendance rates. As the results show, the observed COVID-19 effect varies across the subsamples defined by the scholastic year.

For students in Y10 and Y11 subsamples, the effect of COVID-19 on growing SES gaps in attendance is evident. In the Y10 subsample, while the difference between high-SES and low-SES students among the pre-COVID-19 cohort rose by 0.02 from 0.13 to 0.15, it did so by 0.07, from 0.14 to 0.21, among the during-COVID-19 cohort. Similarly, the gap between high-SES students and those from jobless households increased from 0.13 in T1 to 0.15 in T2 in the pre-COVID-19 cohort and from 0.14 to 0.21 in the during-COVID-19 cohort.

The COVID-19 effect is apparent in the Y11 subsample, too. The gap in attendance rate between high-SES and low-SES students grows from 0.6 in T1 to 0.13 in T2 among the pre-COVID-19 cohort and from 0.03 in T1 to 0.16 in T2 among the during-COVID-19 cohort, indicating that the high–low SES gap in attendance went up from 0.07 to 0.13 under COVID-19. Very similar patterns can be observed for the gap between high-SES students and those whose parents were not in paid work (jobless households). The gap in attendance rate grows from 0.9 in T1 to 0.15 in T2 among the pre-COVID-19 cohort and from 0.12 in T1 to 0.24 in T2 among the during-COVID-19 cohort.

However, among Y12 students, there seems to be little evidence of the SES gap in attendance rates becoming wider due to COVID-19. Regression coefficients on the three-way interaction are all close to zero and non-significant in the Y12 subsample, and the gap in attendance seems to grow at an almost identical pace in both cohorts (Figure 2). Among the pre-COVID-19 cohort, the difference between high-SES and low-SES students grew from 0.04 to 0.07, that is by 0.03. Almost identical change occurred in the during-COVID-19 cohort; the difference between high-SES and low-SES students increased from less than 0.07 to slightly more than 0.10. Similarly, the gap between high-SES students and those whose parents were not in paid work grew by 0.07 in the pre-COVID-19 cohort and 0.08 in the during-COVID-19 cohort. Some of the plausible reasons for the lack of COVID-19 effect in the Y12 subsample are discussed below.

8 | DISCUSSION AND CONCLUSIONS

While the international evidence on the overall effects of COVID-19 on educational outcomes has been somewhat mixed, there has been increased concern that the pandemic might be affecting different groups of students in different ways (Brom et al., 2020; Education Endowment Foundation, 2020; Hammerstein et al., 2021). This paper contributes to this emerging body of research by investigating whether the gaps in attendance rates (following the return to in-class learning) between students of different SES backgrounds increased due to COVID-19. Overall,
our empirical analyses support the hypothesis that they did, although not among all school grades. Through providing unique insights into the impact of relatively short school closures experienced by students in Tasmania in 2020 on attendance, the study helps to identify the points at which students are likely to adjust their attendance because of remote learning, which can assist policy makers and educators in managing remote learning during future school closures. Using data from multiple cohorts of Year 10 and Year 11 students in government schools in Tasmania, we found that while the attendance rates for high-SES students were similar pre- and during-COVID-19, there was a significant drop in attendance rates under COVID-19 among low-SES students and those from jobless households, demonstrating the more pronounced impacts of COVID-19 for these students. For instance, the attendance gap between high- and low-SES students increased during COVID-19 from 0.14 to 0.21 for Year 10 students, and from 0.07 to 0.13 for Year 11 students; even wider gaps were observed between high SES students and those from jobless households.

There are several reasons for why attendance gaps might increase during COVID for socio-economically disadvantaged students. First, attendance is strongly correlated with other forms of engagement with school and learning, and COVID-19 school closures could worsen these forms of engagement more for low-SES students and those from jobless households, resulting in poorer attendance after schools reopened. Second, it is plausible that socioeconomically disadvantaged students experienced more learning loss during school closures, which might have contributed to growing attendance gaps on return to in-class learning. Third, low-SES students and those from jobless households could experience other challenges in the home and family that higher SES families did not, including changes to family finances, interpersonal relationships and family dynamics, housing instability, and health and mental health, and these could affect their subsequent return to school, including their attendance patterns.

However, the results for students who attended Year 12 during COVID-19 were different. Here, we found no evidence of growing SES gaps in attendance, compared with similar Year 12 students in the pre-COVID-19 cohort. There are plausible reasons for why we do not observe a COVID-19 effect for Year 12 similar to the ones observed in younger students. With high stakes final examinations looming for Year 12 students only a few months after the 2020 lockdown in Tasmania ended, they may have had relatively high motivation to return to school and attend classes to “catch up” on missed learning. For instance, a survey of 1800 Tasmanian students in Year 11, 12 and 13 in May 2020 (during the lockdown) by the Office of Tasmanian Assessment, Standards and Certification (TASC, 2020) found that 90% considered that COVID-19 had an impact on their learning and 81% were “concerned about end-of-year assessment and impact on the future.” To return to learning at school was listed by many students in the survey as an important support for their learning in 2020.

While we do observe consistent increases in the SES attendance gap during the COVID-19 pandemic for students in years 10 and 11, one limitation of the present study is that it focuses on upper secondary school only. Literature shows that, on average, and attendance rates tend to fall as students’ progress through school (Zubrick, 2014), with primary school students having higher attendance than secondary school students. Furthermore, as discussed earlier, some Tasmanian students change their school between Year 10 and Year 11 due to the college system. Consequently, students in Year 11 might not have developed bonds with their new school and can therefore be at higher risk of disengagement, and consequently—lower attendance. It would therefore be important to explore whether similar SES gaps to those documented in this paper are also evident in younger students, including those attending primary schools.

Another limitation of the study was its limited jurisdictional coverage, with data including Tasmanian government schools only. In this context, it is worth noting that the duration of school closures has varied widely across the globe. Between March and August 2020, Australia had partial school closure of 17 weeks (UNESCO, 2021), caused largely by long lockdowns in some states. Tasmania is a useful case study for this paper, with 6 weeks (in primary school)
and 8 weeks (in high school) duration of remote learning. This is quite typical internationally, in the March–August 2020 period school closures between 5 and 9 weeks on a partial or full basis applied in 78 countries, including Western countries such as Germany, France, the Netherlands and the United Kingdom (UNESCO, 2021). The duration of school closures in Tasmania means the analysis in this paper offers insight into the impact of even relatively short lockdowns on attendance rates of students experiencing disadvantage.

Nevertheless, future studies could employ comparative designs to replicate the analyses presented here across different Australian states and territories, and across different school sectors. In particular, based on the results presented here, we would hypothesise that more pronounced effects of COVID-19-related school closures and home-based learning could be observed in jurisdictions that went through longer and more frequent lockdowns in 2020 or 2021, such as those in Victoria and New South Wales. According to our results, the pandemic seems to have worsened attendance gaps in years 10 and 11 at least, and we would expect larger effects in jurisdictions where school closures were longer, particularly if it seems likely that “COVID-19 exhaustion” compounds over time and affects all the systems and institutions (work, family, school, etc.) responsible for education outcomes.

School attendance is recognised as integral to student achievement, and the results presented here should be considered alongside the broader set of educational outcomes investigated in relation to the impact of COVID-19. While measures of school achievement have dominated empirical work in this area, more research is needed to understand the impacts that the pandemic might have had on other outcomes, including engagement with school, attitudes to learning, sense of belonging and students' mental health and overall well-being. Throughout the “Learning through COVID-19” study, the data on the lived experiences of children and young people and the perspectives of stakeholders and service providers responding to COVID-19 pointed to adverse impacts on mental health and well-being, and on social connections and engagement with school (McDaid et al., 2021). Future studies should aim to further leverage administrative data resources to look at such a broader set of outcomes, as well as student retention and dropout, high school completion rates as well as outcomes related to post-school destinations such as university application and deferral rates. Previous research shows that low-SES students are already underrepresented in higher education (Tomaszewski et al., 2018), so it would be important to establish whether COVID-19 might have further exacerbated this pattern. More broadly, it would be important for future studies to undertake research aimed at understanding how the pandemic might have impacted decision making and career choices in upper secondary school among different groups of students, including those from different socioeconomic backgrounds.

While limited in scope and jurisdictional coverage, the present study constitutes an important step toward a comprehensive description of the potential impact of COVID-19 on educational outcomes of students from different socioeconomic backgrounds. Using high-quality administrative data from Tasmanian government schools and robust statistical methodology, we provide evidence of growing SES gaps in student attendance that could be attributed to COVID-19. These findings resonate with the patterns identified in the literature for the broader impacts of COVID-19, including that equity gaps have worsened during the pandemic (Shi et al., 2022; Sonneman & Goss, 2020), and that the challenges faced by some equity-seeking groups, including loss of income and linguistic barriers were exacerbated by COVID-19 (Couch et al., 2021; Mupenzi et al., 2020; Weng et al., 2021). These impacts are likely to have compounded the socioeconomic disadvantage already experienced by students from low SES and jobless backgrounds, who are more likely to live in conditions that are not conducive to “learning from home,” such as overcrowded housing. It is also important to note that schools provide a range of services—such as breakfast and homework club—that students from socioeconomically disadvantaged backgrounds use, and which became unavailable during “school closures” (Brown et al., 2020).
The implications of this study are that even “relatively short” lockdowns, as those experienced in Tasmania in 2020, can significantly affect the learning experiences of students from low-SES backgrounds, particularly in combination with the broader impacts of COVID-19 on these families, including their finances, health and other factors. This study contributes to general understanding of the link between educational disadvantage and school attendance within the context of disaster and crisis. As the pandemic continues, and as Australia faces ongoing disruption from natural disasters, such as storms and bushfires, it is important for policy makers and educational practitioners to explore how to mitigate the disruption associated with potential school closures (or exclusions from school for individual students as schools manage and amend their responses to the ongoing COVID-19 pandemic). There is a need to look beyond measures of academic achievement to understand the impacts on students, particularly those from lower socioeconomic backgrounds. The findings point to the fact that dedicated effort may be needed to rebuild student engagement with school and support attendance following periods of disruption, such as those induced by lockdowns and school closures.

AUTHOR CONTRIBUTIONS
Wojtek Tomaszewski: Conceptualization; formal analysis; funding acquisition; investigation; methodology; supervision; writing – original draft; writing – review and editing. Tomasz Zajac: Data curation; formal analysis; methodology; writing – original draft; writing – review and editing. Emily Rudling: Writing – original draft; writing – review and editing. Kitty te Riele: Data curation; investigation; writing – original draft; writing – review and editing. Lisa McDaid: Conceptualization; writing – original draft; writing – review and editing. Mark Western: Conceptualization; funding acquisition; methodology; writing – original draft; writing – review and editing.

CONFLICT OF INTEREST
The authors declared no conflicts of interest related to this research.

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ENDNOTES
1 While a small proportion of students did attend school (including children of essential workers and children considered vulnerable), these children also experienced the effect of school closures because their on-site experience tended to be similar to learning at home (e.g. using the same online and hard copy lesson as students at home) rather than resembling pre-COVID teaching and learning.
2 See also McDaid et al. (2021) in this edition for qualitative data from study, which demonstrates the impact of the disruption to school routines and face-to-face learning and the strategies employed by children and young people to enable educational participation.
3 School systems typically distinguish between authorised and unauthorised absences. Authorised absences are when a parent/carer has provided a reason for the absence that is formally accepted by the school, for example due to illness. Conversely, unauthorised absences are when the absence has not been approved by the school. This second type is associated with greater declines in student achievement over time (Gershenson, Jacknowitz & Brannegan, 2017; Hancock et al., 2013; Zubrick, 2014).
4 Y11 and Y12 students returned to schools earlier, on 25/05/2020, but we decided to capture attendance in the same period for all students. Therefore, we use the date when Y10 students went back to schools as the starting date of T2.
As the terms do not start on the same day, the observation windows, during which attendance is measured, begin and end on different days each year. They span from 11/06/2019 to 5/07/2019 for 2019 school year, and from 12/06/2018 to 6/07/2018 for 2018 school year.

Note that, for simplicity, the above equations focus on the direct contrast between low- and high-SES group. In practice, we estimate these effects using a multi-categorical specification of SES, performing multiple comparisons between various SES categories.

The higher rate of missingness in the Y11 subsample is likely driven by the division of the Tasmanian secondary education into lower secondary education (high schools) and upper secondary education (colleges) and the fact that some students would make a transition between these schools between years 10 and 11, as well as due to transfers of students between school sectors. Our data only capture students attending government schools.

The original data are very detailed and include records on fractions of a day spent at school. The outcome variable summarises the level of attendance for a given period by averaging these data.

This includes data for both parents/guardians/carers in two-parent households, or for one parent/guardian/carer in single-parent households.

It is worth noting that the share of the jobless household category could not be affected by job losses resulting from the COVID-19 pandemic. This category includes people without a job for at least 12 months. As the data were extracted in 2020, the job loss had to occur before the onset of the pandemic for any parent to be included in the “not in paid work in last 12 months” category.

In sensitivity analyses, we also considered an alternative measure of socioeconomic status. We followed previous studies (Landolt et al., 2005; Tomaszewski et al., 2022; Werner et al., 2014) and aggregated SES information by averaging scores representing educational and occupational levels. First, we assigned scores to educational and occupational categories and then averaged the scores within a family. Next, we used the scores to identify four categories of SES: (1) no information (4%), (2) low SES (23% of students with lowest scores), (3) medium SES (52%) and (4) high SES (21% of students with highest scores). The patterns of results remained unchanged.

The high share of students changing schools in the Y11 subsample is likely driven by the division of the Tasmanian secondary education into lower secondary education (high schools) and upper secondary education (colleges).

A key assumption here is the so-called “parallel trend assumption,” which is important for the model's internal validity, and which requires that in the absence of treatment, the difference between the “treatment” and “control” group is constant over time. Violation of the assumption will result in biased estimation. While there is no statistical test for the assumption, visual inspection might be useful when multiple data points are available over time. In our case, it is helpful to compare observations at T1, which are captured before COVID-19 in both “during COVID-19” and “pre-COVID-19” cohorts.

Of note, second-order interactiuon effects SESxCohort are not significant in the model (see Table 2), indicating that the baseline attendance levels for different SES categories are estimated to be similar for the “during-COVID-19” and “pre-COVID-19” cohorts.

These outcomes are already related to students’ SES. However, we could not assess whether the pandemic exacerbated the disadvantage of low-SES students and those from jobless households with our data. The data cover a relatively short period after school closures in which we are unlikely to observe changes in dropout patterns. However, if the pandemic widened the gap in school drop out rates between students of different SES backgrounds, the effects of the pandemic on attendance might be underestimated in our analyses.

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