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ORIGINAL RESEARCH

Persistent Trends or Pandemic Effects? A Multi-Cohort Longitudinal Study on Student Well-being, Inequality, and Educational Transitions

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Abstract
This cross-cohort longitudinal study examined changes in student well-being and the relationship between student well-being and educational choice during the COVID-19 pandemic. It compared two during-pandemic cohorts (spanning grades 5–9 from 2017 to 2021 and 2019–2023) to a pre-pandemic cohort (2015–2019), thus accounting for typical age-related trends and pre-pandemic cohort differences before isolating the pandemic's impact. The study utilized data from the Danish Student School Well-Being Survey ($N = 150{,}733$), merged with administrative register data on students' social background, academic achievement, and transition to upper secondary education. Key outcomes were school connectedness, academic self-efficacy, and educational choice. Results showed that both indicators for student well-being, namely academic self-efficacy and school connectedness, declined across all cohorts, with only minimal differences attributable to the pandemic. Academic self-efficacy and school connectedness in Year 9 were positively associated with an increased likelihood of choosing academic and vocational tracks over leaving the education system. Unexpectedly, the positive association between academic self-efficacy and academic track choice weakened during the pandemic, while the association with school connectedness remained stable. Decomposition analyses showed that academic self-efficacy and school connectedness consistently explained part of the difference in academic track choices between students from different family backgrounds, with little pandemic impact. The findings suggest that studies overlooking typical age-related trends and long-term pre-pandemic trends may have overstated the pandemic's negative effects. In contrast, our results accounting for these effects, indicate negligible pandemic impacts on academic self-efficacy and school connectedness, and no substantial shift in how they mediate the relationship between family background and educational choice. The results highlight the importance of longitudinal cross-cohort data and the need to consider broader trends in adolescent well-being and educational inequalities.

Keywords COVID-19 · Academic self-efficacy · School Connectedness · Educational Choice · Educational Inequality

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1 Introduction

The COVID-19 pandemic and the resulting extensive closings of schools can be considered one of the most significant disruptions in the education sector in recent times. Since students around the world were suddenly deprived of their regular social environment at school and beyond, social scientists from different disciplines have spent considerable efforts assessing the consequences of these lockdowns for students' well-being.

Several meta-reviews suggest that overall, the COVID-19 pandemic had a negative impact on students' well-being and future orientations (Bevilacqua et al., 2023; Carey et al., 2023; Kauhanen et al., 2022; Mucci et al., 2024) even in light of relevant variation across country contexts *(see for example* Jensen & Reimer, 2021*)*. However, many of these studies are based on limited, often cross-sectional, data sources that make it difficult to separate potential pandemic effects on student well-being from other over-time changes. Even longitudinal studies based on a singular cohort of students that can make within-student comparison at different points in time, might not be able to separate pandemic effects from longer-term trends and developmental and seasonal variation in student well-being across the school year or across students' schooling career. Another shortcoming of previous research is that it is often not clear whether a potential deterioration of student well-being constitutes a passing phenomenon or whether well-being trajectories are also affected in post-pandemic times.

The current study addresses these challenges by utilizing a Danish nationally representative longitudinal dataset, spanning from pre-pandemic (2016) to post-pandemic (2023) periods. The cross-cohort design enables the investigation of adolescents' well-being and educational trajectories, with a pre-pandemic cohort serving as a reference for comparison (for similar designs, see Neugebauer et al., 2023; Repo et al., 2025). This approach provides insights not only into the pandemic's distinct effects but also highlights the importance of longitudinal multi-cohort data for disentangling developmental, cohort and treatment effects. By leveraging an exceptionally comprehensive dataset, this study contributes to understanding typical developmental trajectories in adolescents' school-related subjective well-being, particularly in academic self-efficacy and school connectedness. Finally, we also examine whether potential pandemic effects differed by students' social background.

1.1 Academic Self-Efficacy, School Connectedness, and Educational Choice

While numerous pandemic studies have documented increases in adolescents' mental health symptoms (Kauhanen et al., 2022; Madigan et al., 2023), longitudinal research on schooling-related outcomes apart from learning has been comparatively limited. Longitudinal changes in critical factors like academic self-efficacy, school connectedness, and educational choices have received less attention, despite their importance in shaping long-term academic trajectories and overall well-being (Honicke & Broadbent, 2016; Landgren et al., 2024; Rose et al., 2024).

Academic self-efficacy, or the belief in one's ability to achieve educational goals (Bandura, 1997), may have been compromised by the shift to remote and self-regulated learning, compounded by disruptions in relationships with teachers and peers (Fong, 2022). While some families were able to provide supportive learning environments, others, facing socioeconomic or emotional stressors, likely struggled, potentially exacerbating disparities in

academic self-efficacy (Strasser et al., 2023). Similarly, school connectedness, defined as students' sense of acceptance and support within the school environment, is crucial for both educational and psychosocial outcomes (Raniti et al., 2022; Rose et al., 2024). The loss of regular school routines and face-to-face peer interactions during the pandemic likely disrupted this sense of belonging, with impacts potentially varying according to students' psychological and social resources. Given the pandemic's disruption of both social and emotional domains, this study employs a parallel analysis of these essential areas for adolescent development.

1.2 Linking Student Well-Being and Education Pathways

Very little, if any, research has systematically examined the extent to which potential pandemic induced changes in student well-being are associated with changes in students' further educational trajectories. While it is a well-established finding that students with low levels of well-being are more likely to exit the education system prematurely (Hjorth et al., 2016), the role of student well-being as a mediator between family background and their education pathways has not been systematically studied. An exception is a recent German study that demonstrated how declines in well-being were linked to negative changes in educational and career plans as well as post-secondary transition outcomes (Sandner et al., 2023). To our knowledge, no previous study has specifically examined this issue among adolescents transitioning to upper secondary education.

Declines in self-efficacy and school connectedness may not only affect academic performance but also shape educational choices and risk long-term disengagement from education. The pandemic may have heightened these effects, as uncertainty and disconnection from school communities affected students' decision-making processes. This interplay is crucial to understand, as diminished well-being can impair adolescents' capacity to make informed, confident decisions about their educational paths, with far-reaching consequences for their labour market success and later life health (Landgren et al., 2024; Leopold, 2018).

Understanding these schooling-related outcomes is essential for gaining a comprehensive view of the pandemic's impact. While increases in mental health symptoms may partially reflect a normative, non-pathological response to the unique conditions of the pandemic, this study contributes to the literature by focusing on the pandemic's impact on adolescents' academic self-efficacy, school connectedness, and educational choices regarding upper secondary education. This approach supplements the understanding of the pandemic's potential long-term effects on youth well-being and educational trajectories.

1.3 Socioeconomic Status and the Link between Well-Being and Educational Choice

Finally, educational choice is highly dependent on students' socioeconomic status (SES) in education systems in Europe and beyond (Jackson, 2013; Schindler et al., 2024; Triventi et al., 2020). Given that exposure to stressors and access to stress buffering resources are socially stratified (Pearlin et al., 2005), it is likely that the pandemic had a more adverse impact on school well-being — and consequently on academic choices — for students from lower socioeconomic backgrounds compared to their more privileged peers. Factors such as cramped living conditions, parental unemployment, or higher infection rates may have exacerbated challenges for more disadvantaged students. Moreover, previous research has

highlighted the multifaceted ways in which higher SES parents can compensate for the adversities their children face (Bernardi & Grätz, 2015; Erola & Kilpi-Jakonen, 2017). It seems therefore necessary to explore whether potential pandemic-induced changes in student well-being became a stronger mediating factor for the differences in educational choices between students from different SES backgrounds.

1.4 Current Study

The aim of the present study is therefore to assess the pandemic's impact on adolescent well-being, on the association between well-being and educational choice, and on the mediating effect of well-being in the association between socio-economic status (SES) and educational choice.

The study begins by comparing the longitudinal trajectories of school connectedness and academic self-efficacy in three same-aged early adolescent cohorts before, during, and after the pandemic. The objective is to disentangle developmental changes, longer term trends, and possible pandemic effects. Further, the study investigates whether the association between well-being and educational choice shifted during the pandemic. It also investigates to what extent differences in well-being explain the gap in educational track choices between students from high and low SES backgrounds, both before and during the pandemic.

To address these objectives, the study examines the following research questions:

1. To what extent did the pandemic affect the development of school connectedness and academic self-efficacy in adolescents, and how do these effects compare to typical developmental trajectories and pre-pandemic cohort differences?
2. Did the pandemic amplify the association between student well-being and educational choice, independent of academic achievement?
3. To what extent did the pandemic influence the role of school connectedness and academic self-efficacy in explaining the gap in educational track choice between students from high and low SES backgrounds?

By analysing large-scale data from the Danish Student Well-being Questionnaire (DSWQ) spanning 2016 to 2023, this study aims to provide comprehensive insights into how the pandemic has influenced these critical aspects of adolescent development and educational transitions. The study is set in Denmark, where the COVID-19 pandemic led to extensive school closures in spring of 2020 and winter of 2020/2021 ending in May 2021. However, due to a well-developed digital infrastructure, schools relatively quickly transitioned to regular online teaching (Danish Evaluation Institute, 2021; Qvortrup et al., 2021). Furthermore, in comparative terms, the pandemic was managed somewhat successfully in Denmark in terms of infection rates and COVID-19 induced deaths (Jamison et al., 2020), and no substantial learning losses were observed after the school closings (Birkelund & Karlson, 2023). It can thus be assumed that Denmark constitutes a conservative case in terms of testing potential consequences of the pandemic compared to countries with higher infection or death rates.

2 Method

2.1 Data

The dataset used in this study comprises responses from an annual Danish Student Well-being Questionnaire (DSWQ) survey from years 2016–2023. The survey was administered to students enrolled in grades 5 through 9 across Danish public schools. Annually, the dataset represents approximately 85% of the eligible student population. The DSWQ is a comprehensive tool designed to monitor the well-being of Danish students annually, initiated by the Danish Ministry of Education. The questionnaire consists of 40 items, derived from previous well-being surveys by the Danish Centre for Teaching Environment (DCUM), internationally validated items from the Health Behaviour in School-aged Children (HBSC) survey, and additional items from Norwegian and Swedish surveys. The remaining items were developed by a specialized expert group commissioned by the Ministry of Education (Niclasen et al., 2018). Data collection occurred in the spring of 2016–2023[1], through an online survey conducted during school hours. Sociodemographic data such as age, sex, and ethnicity were obtained from the Danish national registers, ensuring the integration of comprehensive background information with the well-being responses.

Figure 1 provides a timeline showing when each of the cohort we observed entered 5th grade and left compulsory school after grade 9. The sample included 49,252 respondents in the pre-pandemic cohort (48.6% female; mean age at grade 5:11.7), 51,716 respondents in the early-pandemic cohort (48.6% female; mean age at grade 5:11.6), and 49,765 respondents in the full-pandemic cohort (48.9% female; mean age at grade 5:11.6). The proportion of missing responses varied between 8.22 and 59.93% by wave and cohort, whereas the number of respondents ranged from 19,733 (grade 9, pre-pandemic) to 51,716 (grade 5, during-pandemic) by year. The dropout rate due to switching to private schools is estimated to be less than 5%. While the proportions of missing data were comparable across cohorts (see Supplementary Table A1), a higher dropout rate was observed at grade 9 for the pre-pandemic cohort than for the two subsequent cohorts. In supplementary analyses

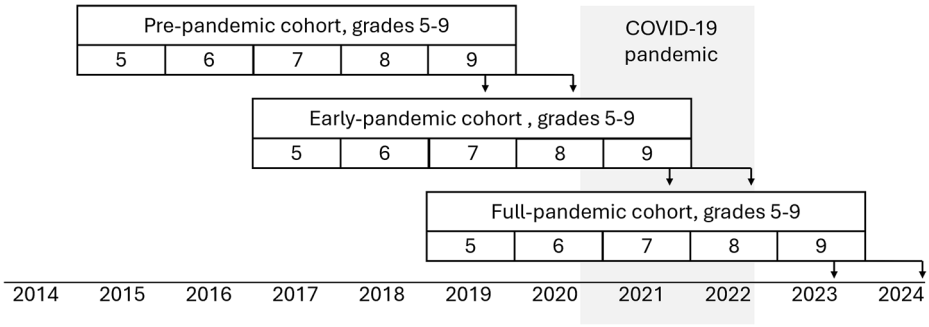

Fig. 1 Timeline for cohorts, educational choice points, and the pandemic. Note: Each cohort had five annual measurement points. Arrows represent the assumed timepoints for applying to upper secondary education, which in Denmark typically occurs in March of Grade 9 or after a year for students who take an optional 10th grade or a gap year

[1] In 2020, data collection occurred primarily between January 20th and March 20th, prior to the first school lockdown.

(Appendix, Table A2) we present estimates of differences between responders and non-responders across cohorts. Overall, the findings suggest that disparities between responders and non-responders are more pronounced in the early- and full-pandemic cohorts than in the pre-pandemic cohort. Specifically, non-responders in the latter two cohorts tend to have parents with lower educational attainment and exhibit lower levels of well-being in grade 5, compared to responders.

2.2 Measures

2.2.1 Sociodemographic Factors

Individual-level information was available from the Danish national registers for students' sex (boy/girl), immigration background (native Danish, first- or second-generation immigrant background), and socio-economic status (SES), operationalized as highest level of parental education (measured in years of education).

2.2.2 Academic Achievement

Academic achievement was measured as a weighted average of students' final exam grades in Danish and mathematics.[2] For the early-pandemic cohort their final exams were partly disrupted by COVID-19 school closings and exams were only held in Danish and mathematics. For the early-pandemic cohort, the Ministry of Education decided that if their exam grade was lower than their year grade in a given subject, the highest grade was to be included in the calculation of their GPA. However, for the analysis we only use exam grades for all cohorts to keep the measure comparable across cohorts.

2.2.3 Educational Transitions

After completing 10 years of compulsory schooling (grades 0–9), students in Denmark must choose between two main paths: vocational upper secondary education, which lasts 3 to 4 years, or academic upper secondary school (gymnasium), which lasts 2 to 3 years. Only the latter typically grants students access to higher education. We observed students' transitions within a two-year period after finishing 9th grade as it is common for students to take a gap year between 9th grade and upper secondary education. For this reason, data on educational transitions was not available for the full-pandemic cohort. Educational choice was categorized into three groups: academic track, vocational track, and leaving the education system altogether.

2.2.4 Well-Being Outcomes

The Danish Student Well-being Questionnaire (DSWQ) assesses various aspects of student well-being. The scales for School connectedness (7 items) and Academic self-efficacy (8 items) are based on the factors identified in the psychometric analysis of the DSWQ questionnaire (Niclasen et al., 2018). Both scales were measured using a 5-point scale varying

[2] GPA = Danish oral exam grade + Danish written, spelling * 0.25 + Danish written, reading * 0.25 + Danish written * 0.5 + Mathematics written, with aids *0.5 + Mathematics written, without aids*0.5.

from 0 to 4. The response choices differ between items. For some items, the categories range from 'very often' to 'never', others from 'really good' to 'less than average', others from 'always' to 'never' and some are rated on a classical Likert scale ranging from 'strongly disagree' to 'strongly agree'. In addition to these answer categories, a 'do not want to answer' category is provided. A mean score was calculated across the items to create a composite score for each student.

School Connectedness measures the degree to which students feel accepted and supported within their school environment. Sample items include "Do you like your school?" and "I feel that I belong at this school." Higher scores indicate a greater sense of connection to the school. The scale had a Cronbach's alpha ranging from 0.86 to 0.87 across years.

Academic Self-efficacy assesses students' confidence in their academic abilities. Sample items include "Do you succeed in learning what you want in school?" and "How often can you find a solution to problems if you try hard enough?". Higher scores reflect higher academic self-efficacy. The scale had a Cronbach's alpha ranging from 0.83 to 0.86 across years.

2.3 Analytical Strategy

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study. Survey responses were combined with register data to include demographic background factors, based on the reference year 2015 for all cohorts. Further, survey responses from all cohorts were merged to create a continuous developmental trajectory spanning grades 5 through 9 for both outcomes, using grade-as-time. Cohort (pre-pandemic/early-pandemic/full-pandemic) was used as a polytomous grouping variable. In the subsequent regression models, the pre-pandemic cohort serves as the reference group.

To ensure the comparability of the cohorts, an examination of all measures was conducted at baseline (grade 5). This step was essential as the interpretation of the results relies on the assumption of baseline similarity between the cohorts. Moreover, intercorrelations among key variables at baseline were explored. Before modeling, we tabulated the mean outcome trajectories for all cohorts.

To address the first research question, we used linear mixed-effects regression models to analyse developmental, cohort, and pandemic effects on school connectedness and academic self-efficacy. Separate models were estimated for both outcomes, including (1) grade level to capture typical developmental trends, (2) cohort (pre-pandemic, early-pandemic, and full-pandemic) to account for baseline differences, and (3) grade level × cohort interactions to examine cohort-specific deviations. Models were run both with and without interaction terms. To distinguish pre-pandemic and during-pandemic changes, we focused on interaction terms for grades affected by pandemic disruptions – grade 9 for the early-pandemic cohort and grades 7–9 for the full-pandemic cohort. Results are reported with coefficients, standard errors, and p-values for individual grade-level × cohort interactions to highlight cohort differences in mean trajectories. Visualizations of predicted trajectories illustrate cohort differences at baseline, pre-pandemic development, and finally, pandemic periods.

As a supplementary analysis, we estimated difference-in-differences (DiD) models (Gertler et al., 2016) as well as fixed effects regression models to also provide parametric estimate of potential pandemic effects. Implementing student fixed effects allowed us to control for all time-invariant student characteristics by examining within-student changes

over time. This approach mitigates bias from unobserved heterogeneity and selective panel attrition. By focusing on within-individual changes rather than relying on between-student comparisons, the fixed effects model provides a more robust assessment of how well-being changed over time while reducing the risk of bias from differential panel attrition. This also strengthens the causal interpretation of our findings, related to research question 1.

For answering the second research question, we fit multinomial logit regression models to estimate the influence of the well-being measures on track choice and whether this influence differs between the pre-pandemic and early-pandemic cohorts (data on track choice for the full-pandemic cohort is not yet available). In the models we included students' well-being in 9th grade, which we interacted with a dummy-variable indicating the early-pandemic cohort (pre-pandemic cohort serves as reference category). In the primary analyses we controlled for students' GPA, as cohorts differ in how grades were assigned (see Sect. 2.2.2). To test the influence of GPA on the results, we also estimated models without controlling for GPA. Finally, as a sensitivity check, we estimated models including the full set of controls (GPA, sex, age, and immigrant background).

Finally, to answer the third research question, we decomposed the gap in academic track choice (leaving school/vocational track serves as the reference category) between students with highly educated and less educated parents, estimating how much of this gap is explained by differences in academic self-efficacy and school connectedness. This decomposition was performed through the KHB method (Karlson et al., 2012), which allows for an appropriate comparison of a logit model including all predictors with a reduced model. Using this decomposition method, we estimated how much of the coefficient for parental education in the logit model is mediated by our well-being measures – academic self-efficacy and school connectedness. Again, we considered the 9th grade level of academic self-efficacy and school connectedness. We performed this decomposition separately by cohort to consider whether the pandemic altered the extent to which well-being measures explain the gap in track choice by parental education.

All regression models were estimated using cluster-adjusted standard errors to account for the hierarchical data structure, with students nested in schools. Missing data were handled in two steps: (1) excluding respondents missing all well-being survey waves and (2) using maximum likelihood estimation (MLE) to account for missing values on the dependent variable (Allison, 2012). MLE leverages all available data without imputation, providing efficient parameter estimates and robust standard errors while preserving the variance–covariance structure of the data. All calculations were performed in Stata 18.1.

3 Results

3.1 Descriptive Results

The means and standard deviations for the demographic variables, GPA, and baseline values of the outcomes with cohort comparisons are shown in Table 1. According to t-tests, the cohort differences in demographic factors were generally minor, though in many cases statistically significant. The latter two cohorts have slightly higher levels of parental education and a lower share of students with immigration background, due to higher levels of

Table 1 Descriptive statistics at baseline (grade 5) and educational choice by cohort

	Pre-pandemic	Early-pandemic	Difference (Ref: pre-pandemic)	Full-pandemic	Difference (Ref: pre-pandemic)	Total
	Mean (SD)	Mean (SD)	Difference	Mean (SD)	Difference	Mean (SD)
Demographics						
Age	11.659 (0.413)	11.625 (0.406)	0.034***	11.603 (0.392)	0.056***	11.629 (0.405)
Female	0.486 (0.500)	0.486 (0.500)	0.000	0.489 (0.500)	-0.003	0.487 (0.500)
Native	0.897 (0.305)	0.891 (0.312)	0.005***	0.883 (0.321)	0.013***	0.890 (0.313)
First generation	0.021 (0.142)	0.035 (0.183)	-0.014***	0.046 (0.210)	-0.026***	0.034 (0.181)
Second generation	0.083 (0.276)	0.074 (0.262)	0.009***	0.071 (0.256)	0.012***	0.076 (0.265)
Parental education	13.777 (2.435)	13.849 (2.481)	-0.072*** (-0.029)	13.938 (2.504)	-0.161*** (-0.065)	13.855 (2.475)
Outcomes						
School connectedness	0.054 (0. 989)	0.137 (0.682)	-0.082***	0.038 (1.020)	0.017***	4.090 (0.690)
Academic self-efficacy	0.088 (0.975)	0.080 (1.009)	0.009	0.011 (1.024)	0.077 ***	3.627 (0.584)
Educational choice and achievement						
Academic track	0.708 (0.454)	0.689 (0.463)	0.019***	0.793 (0.405)	-0.085***	0.713 (0.452)
Vocational track	0.214 (0.410)	0.218 (0.413)	-0.004**	0.207(0.405)	0.007***	0.214 (0.410)
No secondary educat. after 2 years	0.078 (0.268)	0.093 (0.291)	0.015***	-	-	0.072 (0.259)
GPA	7.218 (2.485)	7.866 (2.553)	-0.647*** (-0.257)	6.997 (2.495)	0.222*** (0.088)	7.369 (2.539)

Note: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Differences tested with t-tests for continuous measures and chi-squared tests for categorical measures.

non-response among these groups. In addition, GPA was substantially higher for the early-pandemic cohort (d = 0.26).

For academic self-efficacy at baseline, the full-pandemic cohort scored somewhat lower than the pre-pandemic cohort (Mean(SD) = 3.60(0.60) and 3.64(0.58) respectively,

d = 0.077). For school connectedness, the early-pandemic cohort scored somewhat higher than the pre-pandemic cohort (Mean(SD) = 4.13(0.68) and 4.07(0.68) respectively, d = -0.082), while the full-pandemic cohort scored slightly lower (Mean(SD) = 4.06(0.70), d = 0.02). No other significant baseline cohort differences were found.

3.2 Development of School Connectedness and Academic Self-Efficacy before and during the Pandemic

We examined potential pandemic effects by distinguishing them from age-related developmental trends and pre-pandemic cohort effects. Results from random effects regression models predicting growth in school connectedness and academic self-efficacy are summarized in Table 2 and visualized in Fig. 2 (see supplementary Tables A4 and A5 for tabularized means and standard deviations).

Estimating developmental effects – the overall mean-level trajectories by grade – while constraining changes to be the same across cohorts (Models 1a and 2a in Table 2) and adjusting for mean cohort differences, suggested consistent age-related declines for both outcomes starting in grade 7. However, the decline in academic self-efficacy appeared to plateau in grade 9.

To assess cohort differences in growth, we introduced the interaction term between grade and cohort, using the pre-pandemic cohort as the reference group (Models 1b and

Table 2 Random effects regressions predicting growth in school connectedness and academic self-efficacy

	Model 1a: School Connectedness	Model 1b: School Connectedness, interactions	Model 2a: Academic Self-Efficacy	Model 2b: Academic Self-Efficacy, interactions
Baseline Cohort Differences				
Early pandemic	-0.001 (0.009)	0.082*** (0.011)	-0.043*** (0.007)	-0.009 (0.009)
Full pandemic	-0.112*** (0.009)	-0.017 (0.011)	-0.124*** (0.008)	-0.078*** (0.010)
Developmental Effects / Age-related Growth				
Grade level 6	-0.004 (0.004)	0.059*** (0.007)	0.003 (0.003)	0.029*** (0.006)
Grade level 7	-0.126*** (0.005)	-0.037*** (0.008)	-0.131*** (0.004)	-0.069*** (0.007)
Grade level 8	-0.196*** (0.005)	-0.117*** (0.009)	-0.174*** (0.005)	-0.143*** (0.008)
Grade level 9	-0.285*** (0.007)	-0.160*** (0.012)	-0.153*** (0.006)	-0.133*** (0.011)
Pre-pandemic Cohort Differences in Growth				
Grade level 6 # Early pandemic		-0.104*** (0.010)		-0.037*** (0.009)
Grade level 6 # Full pandemic		-0.080*** (0.009)		-0.041*** (0.008)
Grade level 7 # Early pandemic		-0.148*** (0.012)		-0.093*** (0.010)
Grade level 8 # Early pandemic		-0.086*** (0.012)		-0.027** (0.010)
During-pandemic Cohort Differences in Growth				
Grade level 7 # Full pandemic		-0.119*** (0.011)		-0.094*** (0.009)
Grade level 8 # Full pandemic		-0.153*** (0.012)		-0.066*** (0.011)
Grade level 9 # Early pandemic		-0.137*** (0.015)		-0.016 (0.013)
Grade level 9 # Full pandemic		-0.208*** (0.016)		-0.047*** (0.013)
Constant	0.114*** (0.008)	0.054*** (0.009)	0.115*** (0.008)	0.088*** (0.008)
Observations	608,961	608,961	608,373	608,373

Note. Estimates for the interaction terms in Model 1b and 2b represent the rate of change from the baseline until the current grade level, compared to those of the pre-pandemic cohort. The reference category for cohort is the pre-pandemic cohort, and for grade level it is grade 5. Standard errors in parentheses. *$p<0.05$, **$p<0.01$, ***$p<0.001$

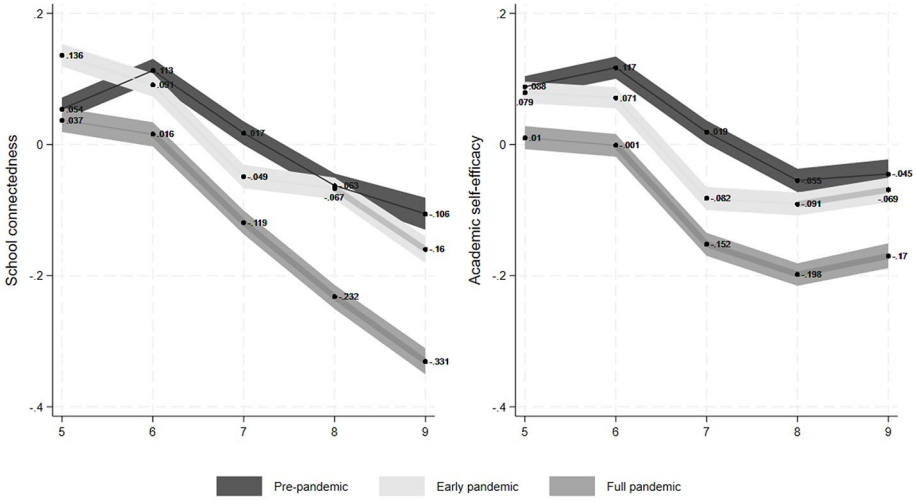

Fig. 2 *Outcome trajectories with 95% confidence intervals*, *by cohort*. Note. Measurement points after the onset of the pandemic were grade 9 for the early-pandemic cohort and grades 7, 8 and 9 for the full-pandemic cohort

2b); the coefficients correspond to the deviation from the pre-pandemic cohort. The results indicated that both pandemic cohorts experienced steeper declines compared to the pre-pandemic cohort, suggesting a pre-pandemic cohort effect. For example, regarding school connectedness, the full-pandemic cohort showed a stronger decline in grade 6 (b = -0.080, SE = 0.009, $p < 0.001$), and the early-pandemic cohort exhibited a similar trend in grade 8 (b = -0.086, SE = 0.012, $p < 0.001$), both of these being measurement points before the onset of the pandemic.

Examining the early-pandemic cohort, the so-called pandemic impact can be seen in the grade 9 interaction. For school connectedness the interaction is significant and negative, but it is in-line with the trend prior to the pandemic. This suggests that while this cohort already differed from the pre-pandemic cohort, it did not experience an additional pandemic-induced effect. For academic self-efficacy, the interaction is negligible in size and not statistically significant. Therefore, despite a more negative trend among this cohort before the pandemic, if anything the pandemic brought the cohort closer to the pre-pandemic cohort.

For the full pandemic cohort, there was a steady decline in school connectedness during the pandemic (grades 7–9) at a steeper rate than for the earlier cohorts. However, this was to some extent already evident before the pandemic (grade 6) with the pandemic period only increasing this trend to a minor extent. The largest difference can be seen in grade 9, after the pandemic restrictions had been lifted. With regard to academic self-efficacy, the full pandemic cohort's difference in comparison to the pre-pandemic cohort remained relatively similar as the difference before the pandemic (grade 6) and reduced to non-significance in grade 9.

In an additional check we quantified the proportion of each cohort's decline that was already in place before the pandemic (cohort effect) from any extra downturn that coincided with the pandemic. For the full-pandemic cohort in school connectedness, a gap of

−0.097 at grade 6 (pre-pandemic, March 2020) widened to −0.225 by grade 9, implying about −0.128 of extra decline during the pandemic years. For their academic self-efficacy, the gap changed only slightly, from −0.119 at grade 6 to −0.125 at grade 9, suggesting negligible (-0.006) additional impact. For the early-pandemic cohort, academic self-efficacy was −0.036 below the pre-pandemic cohort at grade 8 (March 2020) and −0.025 at grade 9, indicating no net pandemic effect. By contrast, school connectedness stayed nearly on par (−0.004) at grade 8 but widened to −0.055 by grade 9, suggesting a modest pandemic-specific shortfall.

As a sensitivity analysis, the models were re-estimated including gender, GPA, parental education, and immigration status as control variables. This adjustment did not substantially alter the results (see Table A6). Results from the DiD models, presented in Table A16, were broadly consistent with the previous findings. School connectedness showed a modest statistically significant pandemic-related decline across grades, while academic self-efficacy showed signs of some recovery, as indicated by a positive interaction between pandemic exposure and grade level.[3] Furthermore, analyses with student fixed effects showed highly similar patterns of change in the well-being measures over time to those reported in Table 2, suggesting that the observed trends were not driven by selective panel attrition or unobserved student heterogeneity (see Table A17).

3.3 Association of Student Well-Being and Educational Choice during the Pandemic

To address the research question of whether the pandemic amplified the association between student well-being and educational choice, we estimated multinomial logistic regression analyses. Educational choice was categorized into three groups: academic track, vocational track, and leaving the education system, with the latter serving as the reference category. Separate models were run for academic self-efficacy and school connectedness, and the pandemic effect was tested with cohort interactions with the 9th grade level of well-being (see Table A7 for full results). In the primary analyses we controlled for GPA, however as supplementary analyses we also estimated models without controlling for GPA as well as models including the full set of controls (GPA sex, age, and immigrant background) these are presented in table A8 and A9, respectively.

The findings indicate that higher levels of academic self-efficacy in 9th grade are significantly associated with an increased likelihood of choosing the academic track ($b=0.428$, $p<0.001$) and the vocational track ($b=0.198$, $p<0.001$) compared to leaving the education system. The interaction term for the early-pandemic cohort was significant and negative for the academic track (early-pandemic cohort = -0.866, $p<0.001$; early-pandemic cohort # academic self-efficacy = -0.113, $p<0.01$), suggesting that the positive association between academic self-efficacy and choosing the academic track was weaker during the pandemic. However, the interaction term was not significant for the vocational track, indicating no significant change in the association between academic self-efficacy and choosing the voca-

[3] A key assumption of difference-in-difference models is that "treated" and "non-treated" groups (here cohorts) should be on parallel trends prior to the treatment under consideration (here the pandemic). Figure 2 shows a general pattern of parallel trends across the three cohorts, except for the period between 5th and 6th grade, where the pre-pandemic cohort exhibits a steeper decline in school connectedness and a more pronounced increase in academic self-efficacy. However, this divergence occurs well before the pandemic, and from that point onward, the cohorts follow parallel trends.

tional track during the pandemic. We did not observe a statistically significant interaction term between cohort and academic self-efficacy when not controlling for GPA.

The results for school connectedness, also reported in Table A7, demonstrate that higher levels of school connectedness are significantly associated with a higher likelihood of choosing the academic track ($b=0.307$, $p<0.001$) and the vocational track ($b=0.224$, $p<0.001$). The interaction term for the pandemic cohort was not significant for either educational track, suggesting that the association between school connectedness and educational choice did not significantly change during the pandemic.

These interactions are plotted in Fig. 3, for the probability of choosing the academic track. While both academic and vocational tracks were analysed, we report results solely for the academic track as students' social background tends to be most influential when choosing this compared to the other tracks. Furthermore, the academic track yields the most favourable labour market outcomes (Birkelund et al., 2021). Across both models, higher GPA was consistently associated with higher odds of choosing both academic and vocational tracks, compared to leaving the education system. The weaker association of academic self-efficacy with choosing the academic track among the early pandemic cohort can be seen in how the predicted probabilities between the two cohorts diverge with increased academic self-efficacy.

3.4 Mediation of Well-being Development and Educational Choice by Family Background during the Pandemic

Next, we present the results from the KHB decomposition, to examine whether the influence of well-being on the gap in academic track choice by parental education varies by cohort. In addition to the well-being measure we include GPA in this analysis. Specifically, we assess whether the mediating role of academic self-efficacy and school connectedness in explaining this gap changed between the pre-pandemic and early-pandemic cohorts.

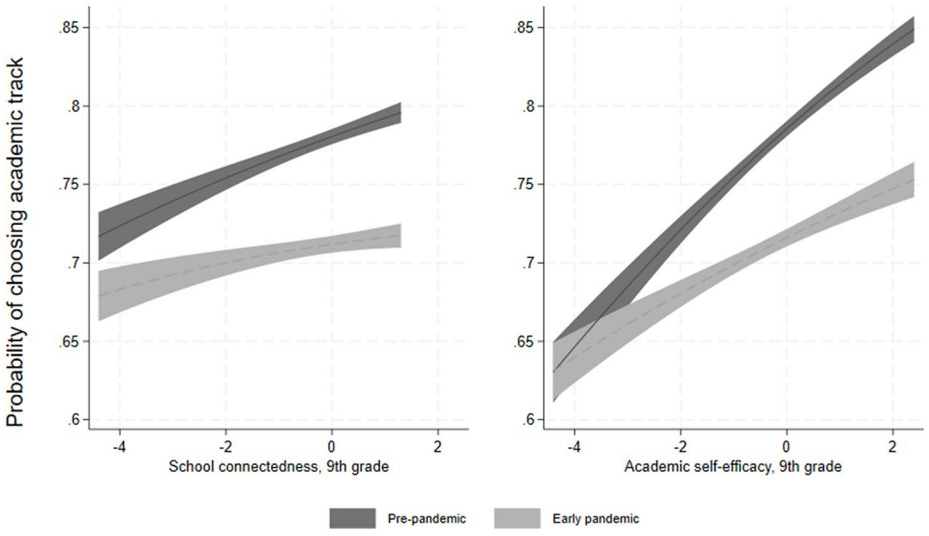

Fig. 3 Predicted probability of choosing academic track by level of well-being and cohort

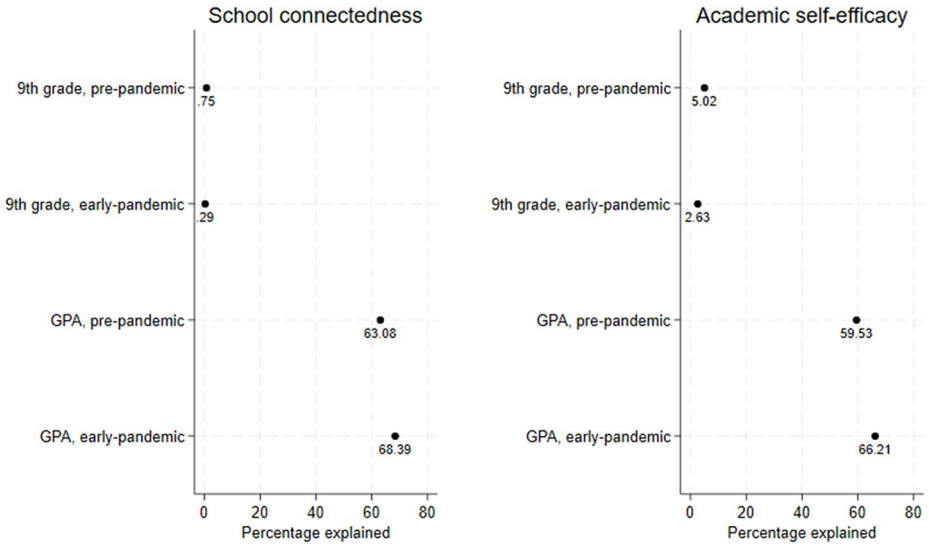

Fig. 4 Percentage of gap in choice of the academic track by parental education explained by academic self-efficacy and school connectedness, by cohort

The results of the decomposition are presented in Supplementary Tables A10-A15 and plotted in Fig. 4. For both outcomes, the percentage of the gap in academic track choice by parental education was similar across cohorts, though the pre-pandemic cohort consistently showed a slightly higher percentage. Yet, despite the minor differences observed between cohorts, the results suggest that the pandemic did not substantially alter the mediating role of academic self-efficacy or school connectedness in explaining the effect of parental education on educational choice. However, GPA did explain about 5% more of the gap for the early-pandemic cohort, indicating that differences in GPA by SES played a larger role in predicting track choice for the early-pandemic cohort compared to the pre-pandemic cohort.

4 Discussion

This longitudinal multi-cohort study aimed to investigate the long-term effects of the COVID-19 pandemic on adolescents' well-being, the association between well-being and educational choice, and the extent to which differences in well-being mediate the effect of family background on educational choice. Using data from the Danish Student Well-being Questionnaire (DSWQ) collected between 2016 and 2023, the study tracked three cohorts over four years: one that experienced early adolescence (11–15 years) before the pandemic (2015–2019), one during the early pandemic (2017–2021), and one across the full pandemic (2019–2023). This design allowed a comprehensive analysis of the developmental trajectories of two essential dimensions of student well-being in a school context: academic self-efficacy and school connectedness, as well as the potential for increasing educational inequalities related to these domains.

4.1 Development of School Connectedness and Academic Self-Efficacy

Our findings indicate that mean-level trajectories for school connectedness and academic self-efficacy declined across all cohorts, particularly during grades 6, 7, and 8 (age 12–14). This is notable, as our study captures typical age-related patterns in these outcomes among adolescents on such a large scale. Crucially, adjusting for these developmental changes using the pre-pandemic cohort as a reference allowed us to better isolate possible pandemic effects.

Interestingly, cohort differences were already evident before the pandemic, both at baseline and more importantly, in pre-pandemic trajectories, with younger cohorts showing steeper declines. This suggests a pre-pandemic vulnerability that, to our knowledge, has not been previously reported.

After accounting for these pre-pandemic trends, we found no evidence for pandemic effects on academic self-efficacy – neither for the early-pandemic cohort, who transitioned to upper secondary education during the pandemic, nor for the full-pandemic cohort, who experienced lower secondary education throughout the pandemic. A separate comparison of 'cohort' versus 'pandemic' gaps showed that the pandemic-specific shortfall was overshadowed by the already steeper decline in younger cohorts, reinforcing the minimal additional impact of pandemic disruptions on academic self-efficacy. For school connectedness, we observed a marginal pandemic effect in the full-pandemic cohort, but no effect in the early-pandemic cohort. A similar breakdown of pre-existing versus pandemic-specific gaps suggested that while the full-pandemic cohort's connectedness dipped slightly more during the pandemic years, most of the decline could be traced to the younger cohort's already steeper downward trend. Overall, while well-being declined in all cohorts from grade 5 to grade 9 – and more so in the full-pandemic cohort – evidence for any substantial pandemic-induced mean-level effects remains marginal to null. Additional difference-in-differences analysis confirmed that pandemic effects were modest to negligible, supporting the interpretation that the observed changes reflect broader developmental and cohort trends rather than pandemic-related disruptions.

The results on academic self-efficacy are unexpected but align with findings from a previous study using a similar cross-cohort analysis of South Australian data (Repo et al., 2025). The same applies to the findings on school connectedness, which align with a recent study comparing PISA cohorts pre- and post-pandemic, showing no evidence of an average decline in school connectedness among mid-adolescents (Repo et al., in review).

4.2 Association between Well-being and Educational Choice

The multinomial logistic regression analyses revealed that higher levels of academic self-efficacy and school connectedness were significantly associated with an increased likelihood of choosing academic and vocational tracks over leaving the education system. These findings are consistent with previous research highlighting the importance of well-being in academic decision-making processes (Suldo et al., 2011).

Interestingly, the positive association between academic self-efficacy and choosing the academic track was weaker during the pandemic. While self-efficacy remained a significant predictor of educational choices, its influence was somewhat diminished during the crisis, potentially due to increased uncertainty and stress (Bandura, 1997). Importantly, we

only observe this cohort difference when controlling for GPA. In other words, it is only the academic self-efficacy net of achievement that differs in the relationship with track choice. Because exams were disrupted for the early pandemic cohort, their GPA was primarily based on year grades and any exam grades could be replace by year grades if exam grades were lower. Therefore, early-pandemic students may be less affected by their academic self-efficacy, when choosing track, as their GPA may have provided them with a stronger signal of academic ability (Holm et al., 2019), that partly overruled their academic self-efficacy.

For school connectedness, the pandemic did not significantly alter the association with educational choice, indicating a stable relationship between feeling connected to school and making educational choices, even during the pandemic disruptions. Thus, our analyses failed to find evidence that the pandemic increased educational inequalities in this regard.

4.3 Well-Being as a Mediator between Family Background and Educational Choice

Finally, our analysis addressed whether the contribution of well-being to the gap in academic track choice between students from different family backgrounds changed across cohorts. While the gap was slightly larger for the pre-pandemic cohort, the pandemic did not significantly alter how academic self-efficacy or school connectedness mediated the relationship between family background and educational choice. Overall, this suggests that the pandemic did not substantially alter existing social inequalities in educational choices, particularly in how family background and well-being affected educational decisions. These findings align with a recent study indicating that the pandemic did not significantly increase socioeconomic differences in positive future orientations among Dutch adolescents (Fakkel et al., 2023). Interestingly, this contrasts with several studies on older adolescents who completed their secondary education during the pandemic (Carey et al., 2023). However, GPA did explain more of the gap in the early-pandemic cohort. Because year grades contributed more to the GPA for the early-pandemic cohort, than the pre-pandemic cohort, and low-SES students are awarded lower year grades than high-SES students compared to exam grades (Rangvid, 2015), GPA may have contributed more to inequality in track choice for the early-pandemic cohort.

4.4 Strengths and Limitations

To our knowledge, this study represents the largest longitudinal study to date examining developmental trends in school connectedness and academic self-efficacy across early adolescence to date. The use of a pre-pandemic reference cohort allowed us to differentiate typical developmental changes from potential pandemic effects, providing a unique perspective on the resilience of student well-being and educational choices during a major global disruption. Moreover, the combination of survey data with administrative registers strengthened the validity and comprehensiveness of the findings, particularly regarding socio-economic background and educational transitions.

However, it is important to note the limitations. First, the study relies on two self-reported well-being measures. Second, while we were able to control for key confounders like GPA, other unmeasured factors, such as home learning environments may have influenced the relationship between well-being and educational choice. Thirdly, missing data analyses indicate that differences between responders and non-responders were more pronounced in

the early- and full-pandemic cohorts compared to the pre-pandemic cohort. Non-responders in the latter two cohorts had parents with lower educational attainment and reported lower well-being in grade 5. Because non-responders had lower initial well-being in the pandemic cohorts compared to the pre-pandemic cohort, we consider our estimates of steeper declines in well-being among the pandemic cohorts to be conservative. Finally, the generalizability of the findings may be limited to the Danish context, as educational systems and the impact of the pandemic on well-being may vary across countries.

5 Conclusion

Using large-scale data and a pre-pandemic reference cohort, this study was able to distinguish possible pandemic effects from typical aging patterns and pre-pandemic cohort effects. The findings suggest that the pandemic had null to marginal long-term effects on school connectedness and academic self-efficacy among early adolescents and did not significantly change how well-being mediates the relationship between family background and educational choice. Indeed, the steeper declines already observed in younger cohorts generally outweighed any additional dip linked to the pandemic itself. While some aspects of the relationship between student well-being and educational choices were affected, educational inequalities largely remained stable. These results underscore the resilience of educational choices to external disruptions like the pandemic and emphasize the importance of maintaining supportive school environments to promote student well-being.

Beyond the pandemic, ongoing declines in both emotional and academic outcomes among adolescents have been documented across various countries (Armitage et al., 2024; Kiviruusu, 2024; OECD, 2024). Our longitudinal cross-cohort comparison, accounting for pre-pandemic trends, revealed that younger cohorts appeared more vulnerable during adolescent years, independent of the pandemic. We argue that many prior studies, due to insufficient data and methodological limitations, have misattributed both age-related and pre-pandemic cohort effects to the pandemic. Alarmingly, this has diverted attention from deeper, underlying causes of these long-term trends (Repo, 2024). Rather than fixating on potential pandemic effects, policy efforts should address broader challenges in adolescent well-being and educational inequalities, while investing in better data infrastructures and methods to monitor youth well-being.

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Data Availability To adhere to data protection agreements, the data, materials, and analytic code necessary to reproduce the analyses presented in this paper are not publicly accessible.

Declarations

Competing Interests The authors declare that they have no competing interests.

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