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Stability in student well-being and educational disparities across the pandemic: a latent profile analysis of PISA 2018 and 2022 in Finland, Sweden, and Iceland

Juuso Repo[1*], David Reimer[2] and Elina Kilpi-Jakonen[1]

*Correspondence:
juuso.repo@utu.fi

[1] INVEST Research Flagship Centre, University of Turku, Turku, Finland
[2] School of Social Sciences and School of Education, University of Iceland, Reykjavik, Iceland

Abstract

This study examined changes in student well-being and its relationship with academic performance, in light of concerns about rising inequalities caused by the COVID-19 pandemic. It utilized PISA student surveys and reading and math assessments from 2018 and 2022 (N = 33,147) among 15-year-old adolescents from Finland, Sweden, and Iceland. Adopting a person-centred approach, the study aimed to identify distinct well-being profiles based on their school attendance, life satisfaction, and sense of school belonging. Four well-being profiles were identified in both cohorts: High Well-being, Moderate Well-being, Present but Disconnected, and Disengaged. Unexpectedly, the proportions of students within each profile remained stable over time. Lower socioeconomic status (SES) was consistently associated with less favourable well-being profiles, though the interaction between SES and cohort was not significant, indicating persistent but not worsening disparities. Academic performance declined across all profiles, with smaller losses observed among students with lower well-being, suggesting a slight levelling effect. The association of SES and academic performance intensified only within the High and Moderate Well-being profiles. Mediation analysis indicated that well-being had a minimal impact on the relationship between SES and academic performance, with no increase in the mediation effect over time. In conclusion, the study challenges the prevailing narrative that the pandemic exacerbated educational disparities related to well-being. Instead, it shows a pattern of stability and modest levelling in academic outcomes across well-being profiles. This research contributes to ongoing discussion on students' academic well-being and socio-educational inequalities in the post-pandemic era.

Keywords: Educational inequalities, Adolescents, Well-being, COVID-19, Socioeconomic disparities

Introduction

The COVID-19 pandemic underscored systemic disparities in education, with remote schooling and other disruptions disproportionately impacting adolescents based on their capabilities and socio-ecological resources. Public concerns have highlighted the pandemic's potential to worsen existing inequalities among youth, particularly affecting those with pre-existing disadvantages. However, robust research on whether and to what extent inequalities have increased due to the pandemic remains scarce. To our knowledge, very few studies have used nationally representative samples of pre- and post-pandemic data on adolescents to explore socioeconomic (SES)-related inequalities and the association between well-being and learning outcomes.

This study addresses this gap by examining socio-educational disparities from three perspectives: shifts in student well-being, well-being effects on learning, and SES effects on learning moderated or mediated by well-being. By comparing cohorts of 15-year-old adolescents in 2018 and 2022 across three Nordic countries, we explore whether these associations shifted and whether disparities were amplified during the COVID-19 pandemic.

Prior research on student well-being during the pandemic

Although considerable research has explored the impacts of the pandemic on adolescent well-being and learning, there is still a lack of systematic and comparable evidence from cross-national studies. Most research on student well-being during the pandemic has focused on negative outcomes such as depression and anxiety, often reporting worsening trends (Kauhanen et al., 2022; Mucci et al., 2024). However, subjective well-being should not be assessed solely by the absence of mental health problems but also include positive indicators such as life satisfaction and belonging (Suldo & Shaffer, 2008). The pandemic, while potentially disrupting subjective well-being, also presented opportunities for individuals, families, and schools to develop new skills, connect in new ways, and build socio-emotional competencies (Hartz et al., 2023).

While prior research has highlighted important negative trends, it often overlooks the positive aspects of well-being that contribute to resilience and success. Moreover, much of the existing research has been variable-centred, examining well-being indicators in isolation and failing to capture the multi-dimensional nature of subjective well-being (Suldo & Shaffer, 2008). This approach provides a fragmented view of well-being, missing the complex interplay between different well-being components.

To address these limitations, a person-centred approach, such as latent profile analysis, can offer a more comprehensive understanding of student well-being (Bergman & Magnusson, 1997; Salmela-Aro et al., 2016). This approach considers the multifaceted nature of well-being, recognizing that some individuals may be high on certain aspects of well-being and low on others. Tracking distinct well-being profiles over time can provide richer insights that inform more effective interventions and complement existing research.

Further, the majority of pandemic studies on youth well-being have relied on convenience samples and cross-sectional retrospective assessments, which are often not suitable for inferring true pandemic effects (Gorman, 2023; Vaillancourt et al., 2021a, 2021b;

Zhang & Storey, 2022). Even longitudinal studies often provide limited insights, as initial impacts may not reflect the long-term consequences of pandemic conditions (Werner & Woessmann, 2023). Furthermore, most longitudinal studies suffer from attrition and lack a non-pandemic reference group. Without a pre-pandemic cohort for comparison, observed changes in adolescent well-being may reflect normative developmental trends rather than genuine pandemic-related effects, as demonstrated by some recent studies (Repo et al., 2025a, 2025b; Wright et al., 2024). Large-scale assessments such as Programme for International Student Assessment (PISA) (OECD, 2023), which span beyond the pandemic era, are therefore essential for disentangling possible pandemic effects from pre-existing long-term trends.

Conceptualising well-being in PISA research

Building on the need for robust, comparable data, PISA offers a valuable resource for studying adolescent well-being across countries and time. The current study leverages these strengths by applying a latent profile analysis to identify student well-being profiles based on life satisfaction, school belonging, and school attendance.

While the broader educational literature often conceptualises well-being as a multidimensional construct including psychological, social, cognitive, economic, and physical domains (Pollard & Lee, 2003), PISA adopts a more pragmatic school-oriented approach. Its main questionnaire includes indicators on general life satisfaction, sense of school belonging, and self-reported school attendance. These align partially with established frameworks, capturing aspects of both hedonic psychological well-being (life satisfaction) and social well-being (belonging), while omitting more granular constructs such as positive affect, mental health symptoms, self-efficacy, and cognitive engagement (Suldo & Shaffer, 2008).

Despite these limitations, PISA's indicators provide a valuable lens into adolescents' school-related well-being at the population level—particularly when comparing trends across countries and over time. Using nationally representative samples from PISA 2018 and 2022, this study explores how well-being and its links to family background and academic performance have changed between the two cohorts.

In the following, three critical indicators of adolescent well-being are investigated: (1) Life satisfaction, in PISA studies, is defined as an overall evaluation that an individual makes about his or her perceived quality of life, according to his or her chosen criteria (OECD, 2019). (2) A *sense of school belonging* reflects how accepted, respected, and supported students feel in their social context at school (Goodenow, 1993). Pre-pandemic PISA studies reported declining trends in both life satisfaction and school belonging across most OECD countries.

(3) Finally, *school attendance*, while not a direct component of most well-being frameworks, has received increasing attention as a behavioural indicator of student engagement and functioning (Kearney, 2008; OECD, 2019). Absenteeism is also associated with increased risk of mental health problems, high-risk behaviours, and school dropout (Keppens & Spruyt, 2018).

Given the pre-pandemic trends and evidence of increased emotional problems among adolescents during the pandemic, we expect our analysis to indicate an overall deterioration in adolescents' subjective well-being between 2018 and 2022.

Family background effects on student well-being

In PISA, family socioeconomic background is measured by the index of economic, social and cultural status (ESCS), which combines parents' education, occupational status, and family wealth in terms of possessions. Higher SES is generally linked to better physical and mental health and greater access to resources. PISA studies have consistently shown a strong association between student SES and life satisfaction, school belonging, and school attendance (OECD, 2017, 2019). Prior research has robustly shown a link between children's socioeconomic background and school attendance (Gubbels et al., 2019; Klein et al., 2020). Furthermore, a recent study demonstrated that low family SES predicts lower school belonging even in Finland, despite the country's relatively low levels of economic and educational inequality (Hautala et al., 2022).

During the pandemic, lower SES families faced more financial and health-related stressors, which likely increased household tension and worsened adolescents' well-being (Reim et al., 2024). Youth from lower SES backgrounds faced a higher risk of COVID-19 infection, leading to increased school absences (Lessler et al., 2021; Tomaszewski et al., 2023). Adults with higher educational background had a greater chance of working from home during the pandemic, which reduced the risk of COVID-19 infection, unemployment or income loss. This potentially allowed these parents to better support their children, reducing stress within the family (Andrade et al., 2022). Recent studies based on Health Behaviour in School-aged Children (HBSC) data from 22 countries reported that adolescents from low SES families were more likely to report negative pandemic impacts on their well-being (Reiss et al., 2024; Residori et al., 2023). Therefore, we expect to observe a strengthened SES effect on student well-being during the pandemic.

Association of well-being and learning during the pandemic

Previous studies show that life satisfaction—and more generally, subjective well-being—positively correlates with academic performance (Suldo & Shaffer, 2008; Ubago-Jiménez et al., 2023). School attendance has been directly linked to higher levels of reading and math performance (Aucejo & Romano, 2016; Gottfried, 2010; Smerillo et al., 2018). The evidence on the link between school belonging and academic performance is more mixed. Social acceptance is not always contingent on academic achievement and among some student groups, academic achievement may even be devalued (Ogbu, 2003).

Given the challenges of the COVID-19 pandemic, the well-being of students likely became even more critical for maintaining focus and engagement in learning. Remote learning required greater self-regulation and intrinsic motivation—skills that are supported by positive well-being (Grassinger et al., 2024; Holzer et al., 2021). Additionally, a strong sense of school belonging, even during school lockdowns, may have become more important for sustaining student motivation and performance (Hamilton, 2024; Šeboková & Uhláriková, 2023). Therefore, we expect that the association between well-being and academic performance strengthened during the pandemic.

The role of well-being in educational inequalities

The interconnectedness of students' family background, subjective well-being, and academic performance is well established (Heffner & Antaramian, 2016; Karvonen et al., 2018; OECD, 2017). Family background affects academic performance not only through material means but also through social cognitive processes and subjective well-being (Destin et al., 2012; Dixson et al., 2018; Kraus et al., 2012). Consequently, low levels of subjective well-being may have severe consequences especially for adolescents from lower-SES backgrounds. For instance, low school attendance has been shown to have a more pronounced negative impact on test scores among adolescents from lower-SES backgrounds than among their higher-SES peers (Aucejo & Romano, 2016; Hancock et al., 2017). The differential SES effects are often attributed to the accumulation of multiple disadvantages and the limited time, economic resources, or educational support that lower-SES parents can provide to compensate for missed lessons or learning difficulties stemming from mental health challenges (Bernardi, 2014; Klein & Sosu, 2023; Madarasova Geckova et al., 2010). Importantly, these effects have been observed across schools, regardless of the school-level SES (Hancock et al., 2017).

During distance education, family resources have been shown to play a significant role in adolescents' ability to thrive and maintain academic progress (Jakubowski et al., 2025; Reim et al., 2024). This suggests that the negative impact of low well-being on academic performance was likely more significant for students from low-SES backgrounds compared to their high-SES peers. Therefore, it is expected that the indirect effect of SES on academic performance through well-being was amplified during the pandemic.

The Nordic context

The Nordics—in this study, Finland, Sweden, and Iceland—provide a unique context for studying the pandemic's impact on educational inequalities.[1] These countries share similar historical, cultural, and economic foundations, and their education systems have long emphasised equity and comprehensive schooling. However, in recent decades, several systemic differences have emerged. Most notably, Sweden has undergone significant school privatisation and marketisation (Lundahl, 2016), which may shape the impact of disruptions on learning outcomes.

Moreover, education policies and school-level responses to the pandemic varied across countries: Sweden kept schools largely open, while Finland and Iceland implemented relatively short, targeted closures (OECD, 2022). Despite these differences, the Nordic countries are generally known for their educational equity, high PISA scores, and advanced digital infrastructure—factors that likely supported a relatively smooth transition to distance learning. The OECD (2023) highlights that these countries have the highest average socio-economic status and some of the narrowest socio-economic gaps between the most and least advantaged students. In Finland, for example, social transfers appear to have mitigated the most vulnerable families from the economic impacts of the pandemic (Kärkkäinen et al., 2023).

[1] Due to missing measurements of life satisfaction, Norway and Denmark were not included in the study.

Despite these structural strengths, the past decade has shown a decline in educational equality across the Nordics. Corell et al. (2024) documented widening SES gradients in adolescent life satisfaction and subjective health complaints between 2002 and 2018, particularly in Sweden and Iceland. This period has also been marked by growing economic inequality, immigration, segregation, and a shift towards more utilitarian, market-oriented education policies, such as Sweden's free school choice reforms (Lundahl, 2016; Siebecke & Jarl, 2022). Despite differences in national trends (Teig & Steinmann, 2023), PISA 2022 results indicated declines in academic performance across all Nordic countries since 2018, with the steepest drops in reading scores observed in Finland, Sweden, and Iceland (OECD, 2023).

Current study

This study compares two PISA cohorts to explore shifts in educational inequalities between 2018 and 2022. More precisely, we examine changes in well-being profiles, family background effects on well-being, the association between well-being and academic performance, and the mediating role of well-being. Our research questions are:

1. Are there differences in well-being profiles between the 2018 and 2022 cohorts, based on latent profile analysis of school attendance, life satisfaction, and school belonging?
2. Has the association between family background and well-being changed over time?
3. Has the association between well-being and academic performance, measured as PISA reading and math scores, changed over time?
4. Has the relationship between family background and academic performance become more pronounced within specific well-being profiles?
5. Has the mediating role of well-being in the relationship between family background and academic performance changed over time?

Following the discussion above, we expect to identify distinct well-being profiles and an increase in the proportion of students classified in lower well-being profiles as a result of the pandemic. Additionally, we anticipate widened socioeconomic gaps in well-being

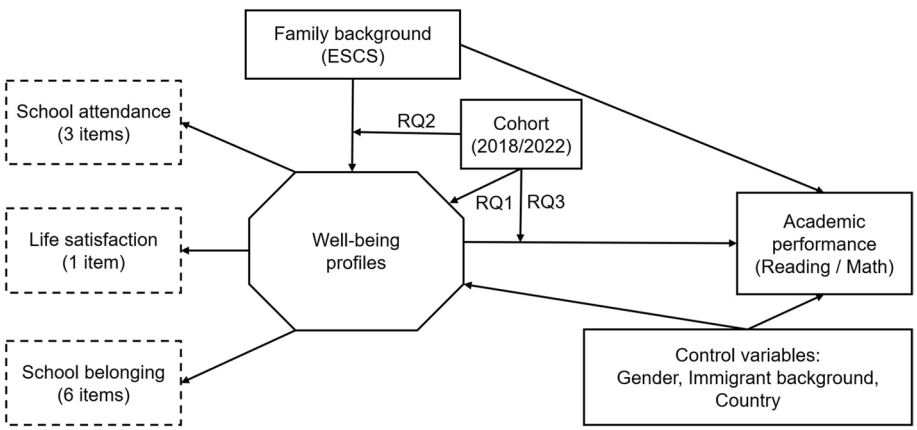

Fig. 1 Conceptual model and key variables

and learning, with strengthened associations between well-being and academic performance, building on negative pre-pandemic trends and presumed pandemic-related impacts, especially on disadvantaged students. The study design is illustrated in Fig. 1.

Method

Data

We used two cross-sectional datasets: PISA 2018 and 2022. Specifically, we used the learning assessments and student questionnaires from three Nordic countries (Sweden, Finland, and Iceland). Detailed information on the PISA data is available at www.oecd.org/pisa. After excluding cases with missing data on all three well-being indicators (2018: n = 597; 2022: n = 376), we analysed data from 5,452 (2018) and 10,036 (2022) Finnish adolescents; 5,288 (2018) and 5,952 (2022) Swedish adolescents; and 3,112 (2018) and 3,307 (2022) adolescents from Iceland. The pooled sample size was N = 33,147; with 50.34% boys and 49.66% girls. Sample sizes and proportions by country are shown in Table S1. Remaining missing data were handled using full information maximum likelihood (FIML; Arbuckle, 1996).

Measures

Indicators of student well-being

School belonging was measured using a 6-item scale with four response options ranging from "strongly disagree" to "strongly agree". Sample items were "I feel like an outsider (or left out of things) at school"; "I make friends easily at school"; "I feel like I belong at school"; "I feel awkward and out of place in my school"; "Other students seem to like me"; and "I feel lonely at school". After recoding the reversed items, higher scores on the combined index indicated higher levels of school belonging. In terms of reliability, Cronbach's alpha in the full sample was 0.86.

School attendance was measured using three items: (1) skipping the whole school day; (2) skipping some classes; or (3) arriving late to school in the previous 2 weeks. Responses included 1 (never), 2 (one or two times), 3 (three or four times), and 4 (five or more times). Items were log-transformed to reduce skewness and reverse-coded to create a combined index, where higher scores indicate higher school attendance. The internal consistency of the scale was modest (Cronbach's $\alpha = 0.66$), which may reflect the differing behaviours captured by the items.

Life satisfaction was measured using a single item "Overall, how satisfied are you with your life as a whole these days?" with possible answers ranging from 0 to 10, with higher scores reflecting higher life satisfaction. The single-item measure is commonly used in large-scale surveys and its validity has been assessed in several studies (Cheung & Lucas, 2014; Raudenská, 2023). The three indicators were standardised by country, resulting in a mean of 0 and a standard deviation of 1 in each country.

Family background

The PISA index of Economic, social, and cultural status (ESCS) represents student socioeconomic status, derived from three variables related to family background: parents' highest occupational status, parents' highest level of education, and home possessions (OECD, 2019). ESCS scores are transformed into a scale with a mean of zero and a

standard deviation of one. For 2018, rescaled indices provided by the OECD were used to correspond to the scaling in the 2022 dataset.

Academic performance

Reading and math performance were measured comparably in PISA 2018 and PISA 2022. Reading performance reflects students' capabilities to "access and retrieve information, understand, use, evaluate, reflect on and engage with one or more texts", and math performance reflects one's capabilities to "formulate situations mathematically, employ mathematical concepts, facts, procedures and reasoning, and interpret, apply and evaluate mathematical outcomes" (OECD, 2019). Due to the study design, students' achievement was estimated with ten plausible values.

Control variables

Student gender was dichotomously recorded, with 0 = female and 1 = male. The PISA index of a student's immigration status was dichotomised into two dummy variables: first-generation (both parents and student born abroad) and second-generation (student born in the test country, but both parents born abroad) with values of 0 = no and 1 = yes. To take into account possible country differences we created dummies for country to be used as control variables in the analyses.

Analytic plan

To identify distinct patterns of student well-being, latent profile analyses (LPA) were performed on school attendance, life satisfaction, and school belonging. First, LPAs were conducted separately for the two cohorts (2018, 2022), applying an increasing number of classes under six model specifications with different variance–covariance structures. The optimal model and number of classes were determined by comparing the models using information criteria (Bayesian Information Criterion, BIC, Sample-adjusted Bayesian Information Criterion, aBIC), classification diagnostics (entropy), parsimony, and interpretability of the patterns (Nylund et al., 2007). Lower values of the information criteria indicate a better balance between model fit and model parsimony.

After the optimal unconditional LPA model was determined, we specified a multigroup LPA to compare cohorts in the pooled sample. For RQ1, we conducted invariance testing to determine whether the structure or prevalence of the classes differed across cohorts (Morin et al., 2016). Given that the invariance testing indicated that the cohorts had similarity in profile means, variances, and proportions of students assigned to each derived profile (see Table S7 for results), we used cohort interaction as a covariate instead of a multigroup approach to test differences between cohorts. As a sensitivity analysis, we ran corresponding analyses with the multigroup approach.

Consistent with current best practises for modelling relations between LPA-derived variables and auxiliary covariates and outcomes, we applied a three-step correction approach that accounts for classification uncertainty while maintaining the character of the identified latent variable (Vermunt, 2017). Three-step approaches are recommended because they first create classes using only the desired indicators. In subsequent analytic steps, predictors of classes and how classes relate to distal outcomes can be examined

without influencing class composition. This helps to isolate the effects of class and covariates.

For RQ2, we explored cohort differences in the association between ESCS and well-being profile membership. ESCS-cohort interaction was included as a predictor of profile membership, adjusting for the control variables and the ESCS main effect. We used the Wald test to test the statistical significance of the interaction effects. In a multinomial logistic regression analysis, the profile with the highest mean scores was selected as the reference group to simplify interpretation.

For RQ3, we examined cohort differences in outcome means across the well-being profiles, separately for reading and math scores. The cohort variable was included as a predictor of outcome scores within each profile, and both outcome and profile membership were adjusted for ESCS and the control variables. The model estimated the cohort effect on reading/math scores separately for each latent profile, and we used the Wald test to compare these effects across profiles. In the PISA testing environment, respondents complete only a subset of assigned assessments. PISA data includes 10 sets of estimated plausible values for each respondent for each skill (reading/math). The analyses were run with 10 distinct datasets, each using a distinct set of plausible values. Parameter estimates reported represent the pooled estimates from these analyses. Due to a limitation in Mplus that prevents the use of replication weights in latent profile analysis, we employed the MIXTURE COMPLEX method and pooled error estimates using robust standard errors.

For RQ4, we examined cohort differences in the association between ESCS and reading/math scores across the well-being profiles. The model included ESCS, cohort, and ESCS-cohort interaction as predictors of reading/math scores, separately for each profile while adjusting for control variables. The Wald test was used to compare whether the interaction effects differed across the profiles.

For RQ5, we assessed whether well-being profiles mediated the association between ESCS and academic performance across the cohorts. For mediation analysis, we followed the four-way decomposition approach, as it allows noncontinuous mediators as well as incorporation of exposure-mediator interactions (Hilkens et al., 2024; McLarnon & O'Neill, 2018). Specifically, the total effect of an exposure on the outcome is decomposed into four elements: (1) reference interaction (interaction only), (2) total indirect effect (mediation and interaction), (3) pure indirect effect (mediation but not interaction), and (4) controlled direct effect (no mediation and no interaction). We specified a multigroup mediation model with ESCS as a continuous exposure variable, standardised reading/math scores as the outcome, and nominal latent variable (well-being profiles) as the mediating mechanism between ESCS and the outcome. The model was adjusted for the control variables. The aim of the analysis was to quantify the indirect effect of the well-being profiles and test whether it differed across the cohorts.

Data analyses were conducted in R and Mplus (Muthén & Muthén, 2017). All models used robust estimation to account for any non-normality in the data. All analyses accounted for the nested nature of data (school-level) with COMPLEX command in Mplus. The PISA surveys adopted a rotated design; thus, student-level weights were considered in the analysis to obtain more generalisable and reliable estimates. For reading/math scores, data imputation was applied with all available plausible values. To ensure

full and transparent methods reproducibility, we conducted all data preparation and analysis in R, used the MplusAutomation package (Hallquist & Wiley, 2018), and created custom functions for automatic extraction of Mplus analysis results into R. Details of software versions, R libraries, and reproducible analytic code are available at https://doi.org/10.17605/OSF.IO/V48CS and the datasets at the PISA repository, https://www.oecd.org/pisa.

Results

Descriptive statistics

Summary statistics across the two cohorts are shown in Table 1, while correlations between variables separately for both cohorts are reported in Tables S2 and S3. Based on the effect sizes, the largest cohort mean differences were in math scores (2018: M = 505.50, 2022: M = 475.85, $d = -0.35$), reading scores (2018: M = 507.75, 2022: M = 475.08, $d = -0.32$) and second-generation immigrant background (2018: 5%, 2022: 9%, $d = 0.15$). From 2018 to 2022, life satisfaction decreased ($d = -0.10$), school belonging increased ($d = 0.08$), and school attendance showed no clear change at the average level ($d = -0.02$). The largest correlations were between reading and math scores ($r = 0.85$ in both cohorts), life satisfaction and school belonging (2018: $r = 0.37$, 2022: $r = 0.39$), and ESCS and math score (2018: $r = 0.35$, 2022: $r = 0.37$). The well-being indicators (school attendance, life satisfaction, and school belonging) correlated somewhat more strongly with reading and math in 2018 than in 2022.

Corresponding descriptives by country are shown in Table S4. All countries showed declines in academic achievement outcomes and life satisfaction and increases in school belonging. Only Sweden showed a change (decline) in school attendance. Finland showed the strongest increase in the proportion of students with an immigrant background from 2018 to 2022.

Patterns of latent profiles and invariance across cohorts

After testing 72 LPA models, we found that the four-class solution with profile-varying variances and no covariances among indicators was the best-fit model in both cohorts (see model comparisons in Tables S5 and S6). Considering the best-fit four-class solution, we conducted a multigroup LPA in the pooled sample and assessed invariance across the cohorts. This indicated that the cohorts had similarity in profile means,

Table 1 Descriptive statistics with cohort comparison

	N	Range	NA %	2018 Mean (SD)	2022 Mean (SD)	*t*	*d*
Gender (1 = male)	33,147	0–1	0.0%	0.50 (0.50)	0.51 (0.50)	2.45	0.03
Immigrant (1st.gen.)	32,482	0–1	2.0%	0.05 (0.23)	0.08 (0.27)	9.19	0.10
Immigrant (2nd.gen.)	32,482	0–1	2.0%	0.05 (0.22)	0.09 (0.29)	12.92	0.15
ESCS	32,790	−7–5	1.1%	0.38 (0.84)	0.27 (0.84)	−12.15	−0.14
School attendance	31,293	−3–1	5.6%	0.01 (1.00)	−0.01 (1.00)	−1.93	−0.02
Life satisfaction	32,581	−3–1	1.7%	0.06 (1.00)	−0.04 (1.00)	−8.57	−0.10
School belonging	31,892	−3–2	3.8%	−0.05 (1.00)	0.03 (1.00)	7.20	0.08
Reading	33,147	141–822	0.0%	507.75 (99.91)	475.08 (102.69)	−28.88	−0.32
Math	33,147	150–764	0.0%	505.50 (79.36)	475.85 (88.82)	−31.33	−0.35

N(2018) = 20,379, N(2022) = 25,263, d = Effect size (Cohen's d). NA% = Proportion of missing values

Table 2 Profile means in the full sample and profile size differences across cohorts

Profile	Cohort		Means		
	2018	2022	School attendance	Life satisfaction	School belonging
1 Disengaged	28.1%	30.0%	−1.223	−0.281	−0.189
2 Present but disconnected	16.9%	16.8%	0.848	−0.589	−0.633
3 Moderate well-being	26.0%	25.5%	−0.066	0.093	0.106
4 High well-being	29.1%	27.8%	0.844	0.574	0.491

Profile means set similar and profile distributions set free across cohorts. BIC: 222 659, Entropy: 0.844

Table 3 Multinomial logistic regression results for ESCS And ESCS-cohort interaction predicting profile membership. reference group: 'high well-being'

Profile	Predictor	Estimate (SE)	OR	Marginal Effect (95% CI)
1 Disengaged	ESCS	−0.304* (0.041)	0.738	−0.010 [−0.013, −0.008]
	ESCS * Cohort	0.081 (0.056)	1.084	0.003 [−0.001, 0.006]
2 Present but disconnected	ESCS	−0.259* (0.06)	0.772	−0.025 [−0.036, −0.013]
	ESCS * Cohort	0.102 (0.089)	1.108	0.010 [−0.007, 0.026]
3 Moderate Well-being	ESCS	−0.046 (0.039)	0.955	−0.002 [−0.007, 0.002]
	ESCS * Cohort	−0.014 (0.057)	0.986	−0.001 [−0.007, 0.005]

Reference group: '4 High well-being', *OR* odds ratio

*$p < .05$. Adjusted for gender, immigrant background, and country. Marginal effects adjusted for uncertainty in class membership predictions

variances, and proportions of students assigned to each derived profile. See Table S7 for model fit comparisons.

After an optimal four-profile solution was obtained, the derived profiles were labelled according to their mean scores of the three indicators, as presented in Table 2 (and plotted in Figure S1). Since higher scores reflected higher well-being, the four profiles were labelled as Disengaged (1), Present but disconnected (2), Moderate well-being (3), and High well-being (4). Interestingly, profile 2 had the lowest average scores in life satisfaction and school belonging, but the highest in school attendance. As seen in Table 2, differences in profile size were small across cohorts, with the disengaged profile being somewhat larger in 2022 (30.0%) than in 2018 (28.1%).

ESCS effects on profile membership

The next model included ESCS and cohort-ESCS interaction as well as gender, immigrant background, and country dummies as predictors of profile membership in multinomial logistic regression. Table 3 presents the results using the "High well-being" profile as the reference group. ESCS was negatively associated with two profile memberships, indicating that students with lower ESCS were more likely to belong to the profiles "Disengaged" (Est. (SE) = −0.304 (0.041), OR = 0.738) and"Present but disconnected"(Est. (SE) = −0.259 (0.060), OR = 0.772). The cohort-ESCS interaction was positive yet marginal in these two profiles, indicating that individuals with higher socio-economic status were increasingly more likely to belong to these profiles in 2022 compared to 2018. However, none of the interactions reached conventional levels of statistical significance (Wald $\chi^2 =$ 4.778, $df = 3$, $p = .189$). indicating no evidence for a pandemic-related amplification of

inequalities in the association of ESCS and well-being. If anything, the results suggest a trend in the opposite direction, as high SES youth exhibited an increased, though statistically insignificant, tendency to belong to the low well-being profiles.

Academic performance by well-being profiles

Including math/reading scores as distal outcomes, we tested whether well-being moderated the cohort difference in academic performance. As shown in Table 4, adjusted reading and math scores were consistently highest in profiles with high school attendance (High well-being and Present but disconnected), and lowest among the Disenga ged profile. The cohort effect, representing the adjusted mean difference in outcome scores between 2018 and 2022, was negative in all well-being profiles for both outcomes, indicating a general decline in academic performance across time. However, the magnitude of the decline varied by profile, being smallest in the Disengaged profile and highest in the Present but disconnected profile, for both outcomes. These profile differences were statistically significant in reading but not in math. (Reading: Wald $\chi^2 = 14.259$, $df = 3$, $p = .003$; Math: Wald $\chi^2 = 4.750$, $df = 3$, $p = .191$). Overall, the mean differences across profiles were smaller in 2022 than in 2018, indicating a moderate levelling effect: disengaged students seemed to have smaller learning losses compared to students with higher well-being.

Family background effects across time and by well-being profiles

To explore whether the relationship between family background and academic performance became more pronounced within specific well-being profiles from 2018 to 2022, we tested the ESCS–cohort interaction effect on reading and math scores across the well-being profiles. A positive interaction would imply that the ESCS effect on academic performance became more pronounced over time.

As shown in Table 5, the main effects of ESCS were positive, and the main effects of cohort were negative across all well-being profiles for both reading and math scores. Notably, the point estimates of the interaction effects varied across profiles, suggesting that the relationship between ESCS and academic performance may have been differentially influenced within each well-being profile.

Table 4 Estimated cohort effects on academic performance by well-being profiles

Profile	Outcome	2018 Mean (SE)	Cohort effect	
			Estimate (SE)	95% CI
1 Disengaged	Reading	445.95 (3.52)	−12.45* (3.81)	[−19.92, −4.97]
	Math	453.10 (3.10)	−15.75* (3.33)	[−22.26, −9.23]
2 Present but disconnected	Reading	487.56 (3.94)	−27.35* (4.49)	[−36.16, −18.54]
	Math	485.68 (3.64)	−23.59* (3.83)	[− 31.09, −16.09]
3 Moderate well-being	Reading	477.94 (3.39)	−21.21* (3.46)	[−27.98, −14.44]
	Math	480.97 (3.01)	−21.64* (2.95)	[−27.41, − 5.86]
4 High well-being	Reading	493.84 (3.29)	−23.62* (3.27)	[−30.02, −17.22]
	Math	490.72 (2.87)	−18.54* (3.09)	[−24.59, −12.49]

SE standard error, *CI* confidence interval

* = $p < .05$. Models adjusted for gender, ESCS, immigrant background, and country

Table 5 ESCS-cohort interaction effects on academic performance across the well-being profiles

Profile	Parameter	Reading		Math	
		Estimate (SE)	95% CI	Estimate (SE)	95% CI
1 Disengaged	Cohort	−13.17* (3.84)	[−20.70, −5.64]	−16.26* (3.41)	[−22.94, −9.58]
	ESCS	26.17* (2.28)	[21.71, 30.63]	26.67* (2.36)	[22.04, 31.30]
	ESCS * Cohort	4.02 (3.63)	[−3.10, 11.14]	2.69 (3.49)	[−4.15, 9.54]
2 Present but disconnected	Cohort	−27.19* (4.89)	[−36.77, −17.61]	−24.16* (3.95)	[−31.90, −16.42]
	ESCS	34.02* (3.72)	[26.73, 41.31]	29.98* (3.36)	[23.40, 36.57]
	ESCS * Cohort	1.11 (5.54)	[−9.74, 11.96]	2.76 (4.77)	[−6.60, 12.11]
3 Moderate Well-being	Cohort	−24.45* (3.63)	[−31.57, −17.32]	−23.56* (2.97)	[−29.38, −17.74]
	ESCS	28.24* (2.54)	[23.27, 33.21]	31.15* (2.36)	[26.52, 35.79]
	ESCS * Cohort	8.08* (3.84)	[0.56, 15.61]	5.09 (3.56)	[−1.87, 12.06]
4 High Well-being	Cohort	−28.52* (3.79)	[−35.94, −21.09]	−22.14* (3.36)	[−28.72, −15.56]
	ESCS	31.58* (2.87)	[25.96, 37.21]	33.41* (2.38)	[28.75, 38.08]
	ESCS * Cohort	10.91* (4.28)	[2.53, 19.29]	8.09* (3.58)	[1.06, 15.11]

SE standard error, *CI* confidence interval

* = p <.05. Models adjusted for gender, ESCS, immigrant background, and country

For the Disengaged profile, the interaction effect on reading was 4.02 (SE: 3.63, $p > .05$) and on math was 2.69 (SE: 3.49, $p > .05$). In the Present but Disconnected profile, the interaction effect was 1.11 (SE: 5.54, $p > .05$) for reading and 2.76 (SE: 4.77, $p > .05$) for math. The Moderate Well-being profile exhibited an interaction effect of 8.08 (SE: 3.84, $p < .05$) for reading and 5.09 (SE: 3.56, $p > .05$) for math. Lastly, the High Well-being profile had an interaction effect of 10.91 (SE: 4.28, $p < .05$) for reading and 8.09 (SE: 3.58, $p < .05$) for math.

These results suggest a potential amplification of the ESCS effect on academic performance, particularly within the High Well-being profile, where the largest positive interaction effects were observed. However, it is important to note that a Wald test, which was conducted to assess the equality of the interaction effects across profiles, yielded non-significant results for both reading (Wald $\chi^2(3) = 2.03$, $p = .566$) and math (Wald $\chi^2(3) = 1.27$, $p = .737$). This indicates that statistically, the interaction effects of ESCS and cohort did not significantly differ across the well-being profiles. Despite this, the variation in point estimates across profiles suggests that certain subgroups, particularly those with high well-being, may experience a modest amplification of the ESCS effect on academic performance. The models were adjusted for gender, immigrant background, and country.

Well-being mediating the family background effects across time

Finally, we assessed whether well-being mediated the association between ESCS and academic performance across the cohorts. According to the multigroup mediation model, the total ESCS effect in 2018 was 0.294 (SE = 0.014) on reading and 0.350 (SE = 0.014) on math, and statistically significant for both outcomes. The results of the four-way decomposition of these total effects are shown in Table 6. The results indicated that most of the total effect was due to the controlled direct effect, which showed statistically significant increase from 2018 to 2022, both in reading (Est. = 0.061, SE = 0.020) and in math (Est. = 0.059, SE = 0.020). The indirect effect was very small and mostly due to the pure

Table 6 Mediation parameters with cohort comparison

Outcome	Effect	Est. (SE) 2018	Est. (SE) 2022	Cohort diff
Reading				
	Controlled direct effect	0.281* (0.014)	0.342* (0.013)	0.061* (0.020)
	Pure indirect effect	0.013* (0.002)	0.007* (0.002)	−0.005 (0.003)
	Total indirect effect	0.013* (0.003)	0.011* (0.002)	−0.002 (0.004)
	Total effect	0.294* (0.014)	0.353* (0.013)	0.059* (0.020)
Math				
	Controlled direct effect	0.335* (0.015)	0.394* (0.014)	0.059* (0.020)
	Pure indirect effect	0.012* (0.002)	0.008* (0.002)	−0.004 (0.003)
	Total indirect effect	0.015* (0.003)	0.012* (0.003)	−0.002 (0.004)
	Total effect	0.350* (0.014)	0.406* (0.014)	0.057* (0.020)

Adjusted for gender, immigrant background and country

* = p <.05. Outcome scores standardized

indirect effect varying from 0.007 to 0.013 across the two outcomes and cohorts. Over time, the total indirect effect became smaller on both outcomes, yet the change was not statistically significant. In contrast to the indirect effect, the cohort comparison showed a statistically significant increase in controlled direct effects for both outcomes (Reading: Est. = 0.061, SE = 0.020, $p < 0.05$; Math: Est. = 0.059, SE = 0.020, $p < 0.05$), indicating a moderate increase in ESCS-related inequalities from 2018 to 2022, not mediated by well-being. In sum, over time, the indirect effect accounted for a decreasing proportion of the increasing total effect; from 4.4% (2018) to 3.1% (2022) for reading and from 4.3% to 3.0% for math.

Sensitivity analyses

As a sensitivity analysis, we ran the corresponding analyses with a multigroup approach, which confirmed that control variable associations with profile memberships did not differ across cohorts. Results from mediation models with ESCS dichotomised as high vs. low followed a similar pattern as in the main analyses. Additionally, we ran the analyses with a five-class solution, and the results followed a similar pattern.

Discussion

This study examined shifts in inequalities related to education and well-being among 15-year-old adolescents in three Nordic countries between 2018 and 2022. In contrast to dominant assumptions, our findings do not support the narrative of a general pandemic-induced decline in adolescent well-being or a widening of SES-based disparities in well-being. Although academic performance declined across all well-being groups, the sharpest declines occurred among students with higher well-being, suggesting a modest levelling effect. Furthermore, SES-related disparities in academic performance widened only within these higher well-being groups.

Interpreting stability in student well-being

These results call for a reconsideration of the dominant framing of COVID-19 as a universal cause for declining well-being and exacerbator of inequality—at least with respect to the selected Nordic countries. While many studies have emphasized rising mental

health issues (Kauhanen et al., 2022; Mucci et al., 2024), our analysis—drawing on large-scale, pre- and post-pandemic PISA cohorts—provides a clear population-level perspective that contrasts with more alarmist findings based on less rigorous designs. Using latent profile analysis, we identified four similar well-being profiles in both 2018 and 2022 cohorts. The stability in the number, structure, and relative proportions of these profiles suggests a level of population-level resilience. This echoes Ann Masten's concept of 'ordinary magic,' highlighting the capacity of adolescents to maintain stable functioning even amidst widespread disruption, particularly when embedded in supportive socio-ecological environments (Hartz et al., 2023; Masten, 2001).

That said, the broader context and literature on pandemic impacts is vast and methodologically diverse. Several high-impact studies have reported deteriorations in adolescent well-being, but many of these relied on convenience samples, retrospective self-assessments of pandemic impact, or single-cohort longitudinal designs with limited time span and, most notably, lacking a control/reference group (Gorman, 2023; Neugebauer et al., 2023; Vaillancourt et al., 2021a, 2021b). Such approaches risk over-interpreting short-term effects and conflating age-related or long-term trajectories with pandemic-specific impacts. Even studies using repeated measures often lacked sufficient temporal depth or failed to account for normative developmental declines in adolescence and long-term trends in well-being (Kiviruusu et al., 2024; Repo, 2024; Wright et al., 2024).

By contrast, this study includes a pre-pandemic reference group, enabling stronger inferences about change than studies without such a baseline. While it does not track individuals over time, its repeated cross-sectional design and person-centred approach offer robust population-level estimates. Our earlier longitudinal studies, which followed the same adolescents before and across the pandemic, reached similar conclusions (Repo et al., 2025a; Repo, et al., 2025b), reinforcing the credibility of the present findings and suggesting that the observed stability in well-being and inequalities is not simply due to study design.

The Nordic welfare context—including strong digital infrastructure, social safety nets, and shorter school closures (OECD, 2022)—may have buffered some effects. However, we argue that methodological design is the more decisive factor explaining why our findings diverge from many earlier reports. Indeed, even within the Nordic countries, studies have often reached differing conclusions (Källmen & Hallgren, 2024; Rimpelä et al., 2023; Thorisdottir et al., 2023).

Socioeconomic disparities in well-being: persistent, not escalating

The person-centred approach used here highlights the persistence of disparities: students from lower-SES backgrounds remained more likely to belong to low well-being profiles in both cohorts. However, the lack of a cohort interaction effect on SES suggests that these disparities did not worsen during the pandemic. This result contrasts with expectations rooted in research showing that lower-SES families experienced greater pandemic-related burdens (Andrade et al., 2022; Reiss et al., 2024; Residori et al., 2023). It is important to interpret this finding within the Nordic welfare context, where "low SES" does not carry the same material deprivation as in many other settings. For instance, even lower-SES adolescents in Nordic countries are more likely to live in households with stable housing, healthcare coverage, and

internet access. As such, material conditions may not have deteriorated enough to cause further psychological or academic disruption during the pandemic. Moreover, substantial emergency funding and social transfers in Nordic countries likely mitigated unequal pandemic effects (Birkelund & Karlson, 2023; Kärkkäinen et al., 2023).

Learning losses and the role of well-being

The finding that well-being did not mediate the relationship between SES and academic performance more strongly in 2022 than in 2018 also challenges assumptions of compounded disadvantage. Rather than well-being becoming a greater bottleneck for learning, the direct effects of SES on performance increased modestly. This suggests that pandemic-era academic inequalities were more likely to be driven by differences in access to instructional quality and learning environments—factors largely independent of adolescents' subjective well-being. This interpretation aligns with prior research highlighting the critical role of direct support (e.g., home learning environments, teacher engagement) in sustaining academic performance during remote learning (Engzell et al., 2021).

Reading and math performance declined across all well-being profiles from 2018 to 2022, reflecting a long-term trend rather than a specific pandemic effect. Interestingly, profiles with higher well-being showed the steepest declines. While this finding was unexpected, it may reflect differential adaptation to remote learning. Well-adjusted, high-performing students may have been more affected by the loss of in-person schooling and structured environments. In contrast, students with lower well-being—who may have had more inconsistent school engagement prior to the pandemic—could have experienced less relative disruption, or even benefitted from alternative learning formats such as blended instruction, reduced social stress, or more flexible pacing (Farrell et al., 2024; Vaillancourt, Brittain, Krygsman, Farrell, et al., 2021a, 2021b).

This interpretation aligns with recent research suggesting that several vulnerable subgroups experienced unexpected relief during periods of restricted school attendance (Bouter et al., 2022; Havik & Ingul, 2021; Holm et al., 2024; Lorijn et al., 2023; Repo et al., 2022). Moreover, in Finland and Iceland, schools remained open for students with special educational needs during lockdowns, and in Sweden, schools largely stayed open throughout the whole crisis.

Although our findings challenge dominant narratives about large-scale pandemic impacts and widening inequalities, they do not imply uniform experiences among students. Socioeconomic gradients in well-being and learning remain a persistent concern. At the same time, the results highlight the need for context-sensitive analyses. For example, a recent study using PISA 2018 and 2022 from six high-happiness countries (Li et al., 2025), reported clear declines in life satisfaction and school belonging, underscoring that patterns observed elsewhere may differ. However, that study did not account for pre-existing long-term trends within those countries. Future research should replicate these analyses across countries and multiple PISA cycles to better distinguish pandemic-related changes from broader developments related to adolescent well-being.

Implications and future research

Taken together, these findings challenge prevailing assumptions and highlight the need to ground policy responses in nuanced, context-sensitive, and rigorous evidence. The absence of clear pandemic effects on adolescent well-being and inequalities in our data invites a shift in focus: rather than amplifying alarmist narratives, we should consider what these results reveal about adolescent resilience, the protective role of context, and the design of future policies and practices.

Oversimplifying the pandemic's effects may have several negative unintended consequences. It can reinforce self-fulfilling prophecies, perpetuate a fatalistic outlook on social disparities, and obscure the adaptive strengths demonstrated by disadvantaged adolescents and their families. Recognizing these forms of resilience can inform more effective, strength-based interventions.

Emphasizing only the detrimental effects may also obscure unexpected benefits for vulnerable groups. For example, blended learning, reduced class sizes, increased teacher supervision, and reductions in bullying seemed to create more equitable conditions for some students (Lorijn et al., 2023; Vaillancourt et al., 2021a, 2021b). Acknowledging such positive developments can inform more inclusive educational practices post-pandemic (Sonuga-Barke, 2021).

The emergency measures during the pandemic—enhanced access to digital learning tools, independent learning modules, and modified assessment criteria—may have particularly supported disengaged students. These findings suggest reevaluating traditional engagement-focused strategies and considering some direct support mechanisms introduced during the pandemic as permanent features to better support disengaged students. Exaggerating growing inequalities without considering policy responses and interventions may hinder meaningful change. It is essential to critically assess the efficacy of existing interventions and leverage lessons learned from both the challenges and successes of pandemic-era policies.

Attributing negative trends in youth well-being and learning solely to the pandemic risks diverting attention from broader trends and underlying causes. Many of these trends—such as rising anxiety or declining academic achievement—were already underway before the pandemic (Armitage et al., 2024; OECD, 2023). Speculating about pandemic effects should not delay action on these broader, ongoing challenges.

Future research should prioritize longitudinal, cross-cohort designs that can disentangle crisis-specific disruptions from long-term systemic shifts—both to understand what went wrong and to build on what unexpectedly went right.

Strengths and limitations

To our knowledge, this study is among the first to apply a person-centred, cross-cohort design to examine the interplay between adolescent well-being and learning during the pandemic using nationally representative data. We identified comparable latent profiles across two PISA cohorts, offering avenues for future research. By applying a three-step approach (Vermunt, 2017), we accounted for classification uncertainty in profile assignments, thereby strengthening the robustness of downstream

analyses. The use of open data and fully reproducible code aligns with open science standards, supporting transparency and replication.

Despite these strengths, several limitations should be noted. First, reliance on two cross-sectional cohorts makes it impossible to track individual-level changes over time. Differences between cohorts in both measured and unmeasured variables may have affected the results. Second, the study focused exclusively on 15-year-olds, whereas the pandemic may have influenced other age groups differently (Bevilacqua et al., 2023; Sandner et al., 2023). Additionally, standardized assessment scores reflect only the performance of students who attended scheduled exams, potentially excluding vulnerable students who were absent on exam days. This potential selection bias may lead to an underestimation of the pandemic's impact on disadvantaged students.

Furthermore, measuring school attendance with subjective survey items has limitations; linking survey data to objective attendance records would provide more reliable estimates. Additionally, the use of robust standard errors from the MIXTURE COMPLEX method instead of replication weights in Mplus may affect the precision of our estimates. Lastly, the study focused on reading and math, leaving potential disparities in other learning domains unexamined, and the well-being measures were limited to items in the PISA main questionnaire. Future studies should test the generalizability of these results using more comprehensive well-being measures, particularly once data from the PISA 2022 student well-being questionnaire become available.

Conclusion

This study provides a comprehensive analysis of shifts in educational inequalities in Nordic countries during the pandemic, focusing on well-being and academic performance among 15-year-olds. Contrary to expectations, we found no evidence of an overall negative impact of the pandemic on well-being. Moreover, the results advise against a simplistic view that individuals with pre-pandemic disadvantages faced the worst pandemic effects.

Oversimplifying or exaggerating the pandemic's effects can be misleading. Pandemic-era measures—such as blended learning, reduced class sizes, modified assessments, and increased teacher contact—may have contributed to more equitable conditions for disadvantaged students. Recognizing these benefits can inform more effective interventions and equitable educational practices.

Attributing negative trends solely to the pandemic diverts attention from long-term issues. Ongoing declines in well-being and academic performance predate the pandemic. Addressing these broader trends should remain a priority. Persistent disparities linked to family background highlight the need for continued efforts to promote educational equity.

Future studies could replicate this analysis in other countries and across multiple time points to capture long-term trends in educational disparities. Understanding these dynamics—and the role of robust, comparable data—can help policymakers and educators respond more effectively to future crises.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40536-025-00251-0.

Additional file1

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Author contributions
The authors made the following contributions. JR: Conceptualization (lead), Writing—original draft, Writing—review & editing, Methodology, Formal analysis; DR: Conceptualization (supporting), Writing—review & editing; EK-J: Conceptualization (supporting), Writing—review & editing.

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Data availability
The datasets analysed during the current study are available in the PISA repository: https://www.oecd.org/pisa. Reproducible analytic code is available at https://doi.org/10.17605/OSF.IO/V48CS.

Declarations

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Not applicable.

Consent for publication
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Competing interests
The authors declare that they have no competing interests.

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