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Students' Well-Being Fluctuations during COVID-19—A Matter of Grade, State, or Trait?

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Abstract: As part of the large-scale 'COVID-19, Building Back Better'-project, longitudinal student survey data were collected (n = 774) from four subsequent survey rounds (grade 3–9) in a period with COVID-19 related school closures and re-openings in Denmark (December 2020 to June 2022). Students' responses to questions related to three well-being dimensions: social, emotional, and academic well-being, were analyzed with factor analysis and latent state-trait analysis to investigate fluctuations in the well-being dimensions across time and the extent to which fluctuations can be attributed to the COVID-19 context (state), individual differences (trait) or simply the natural maturation of students over time (grade). All three well-being dimensions were consistently high (between 3 and 4 out of 5) during the data collection period, however, there was a decrease in emotional well-being and particularly in academic well-being during the period. We show that the size and determinant effects of the fluctuations in the differentiated well-being dimensions differ. Academic well-being generally was the most trait-like dimension, whereas social well-being was more state-like. However, a purposeful analysis of one of the youngest cohorts indicated a critical phase from grade 3–6 corresponding to the time for declines in emotional and academic well-being, where the social well-being shifted from a trait-like to state-like and academic well-being shifted from state-like to trait-like nature. With this in mind, the article discusses how schools can support students' well-being in the post-pandemic era.

Keywords: academic well-being; social well-being; emotional well-being; COVID-19; survey; explorative analyses; factor analysis; latent state-trait analysis; primary school; teaching

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1. Introduction

There is and always has been a global interest in students' well-being [1,2], but research on wellbeing has proliferated over the last decade and a recent study identified at least 45 ways of conceptualising and measuring wellbeing [3]. Despite—or because of—this, childrens' and young people's well-being has become increasingly shrouded in uncertainty. In addition to the impact of an increased expectation of performance and competition, and an unpredictable labor market, increased individualization and self-representation in real life and on social media [4–6], the prolonged and devastating COVID-19 pandemic has prompted a global call to address the impact on the well-being of children and young people [7], but lack of knowledge about the long-term impact resulting from the many, mutually interacting, factors, makes it difficult to act on this call. Multiple studies conducted across various countries have reported a decline in students' well-being during the pandemic [8–13]. Some of these studies have also identified variations regarding age and gender [12,13]. Now, several years after the initial outbreak of COVID-19, uncertainties and doubts persist regarding the state of students' well-being. Extensive reviews highlight the potential long-term repercussions of the pandemic, e.g., Brooks et al. conducted a literature review on the psychological consequences of school closures and concluded that "Most reviewed studies reported negative psychological effects including post-traumatic stress

symptoms, confusion, and anger" [14] (p. 912). Additionally, the growing body of research on the impact of early-life adversity on children's well-being and development indicates that prolonged encountering of perceived adverse situations or circumstances during childhood can reach toxic levels, particularly in the absence of protective relationships and caring frameworks during the period [15–17]. In a Danish context, there have been recurrent reports of declining well-being among students [18,19]. Interestingly, however, the national well-being measure has consistently shown a high level of well-being over time with very little variation between age groups [20]. Researchers [21,22] even Katznelson, et al. [23], who independently of the COVID-19 pandemic, previously emphasized declines in well-being are increasingly advocating for caution in relation to alarmism about declines in well-being [24,25].

While the existing studies have provided valuable insights into the various consequences of COVID-19 on well-being, there remains a need for further research to understand contemporary students' well-being in a long-term perspective. What distinguishes this study from its predecessors is, firstly, our exploration of fluctuations of a multifaceted well-being conceptualization (as described below) encompassing academic, social, and emotional well-being [26,27]. Secondly, that we study the extent to which these fluctuations can be attributed to the COVID-19 context (state), as opposed to individual differences (trait) or simply the natural maturation of students over time (grade). Some researchers believe the main factors that influence the well-being of individuals are daily mood and situation, suggesting that well-being has state characteristics [28]. However, more scholars believe that well-being is a stable trait [29]. Recent studies from Germany [30] and from South Korea and Netherlands [31], find that state and trait variance contribute approximately equally to the reliable variance in well-being measures. A growing body of studies also investigate time (both daily and grade) variations in mood and subjective well-being [28,32,33] However, no studies have investigated these issues during the COVID-19 period.

The exploratory research questions guiding this study are as follows:

1. How do students' academic, social, and emotional well-being fluctuate over time?
2. To what extent are well-being fluctuations determined by contextual (state) factors (such as the pandemic), individual differences (trait), and student maturation (grade)?

In line with recent developments in theoretical conceptualisations of well-being, the article defines well-being as both feeling and functioning well [27,34–38]. It adopts a multifaceted perspective of well-being, that encompasses three dimensions: emotional well-being, social well-being, and academic well-being [26,27], see Table 1. The three well-being dimensions, while presented as separate columns in the table, should not be understood as discrete categories. Instead, they are to be perceived as interrelated facets contributing to a broader realm of well-being. This understanding is developed as a response to previous studies which point to a tendency to use a concept of well-being that is too narrow to understand well-being in an educational context [39–41]. As Shah and Marks assert, "Well-being is more than just happiness. As well as feeling satisfied and happy, well-being means developing as a person, being fulfilled, and making a contribution to the community" [39], (p. 2). Furthermore, Aspelin suggests that well-being is rooted in relational actions and attitudes in ongoing communicative processes [40]. Schapira and Aram further dissect the concept of well-being, dividing it into an emotional component, encapsulating children's emotions, understanding and empathy, and a social component, measuring the effectiveness of an individual's social interactions across a variety of contexts [41]. In the context of school, we previously, drawing on Hochschild's 'emotion work' concept, which revolves around individuals managing emotions related to their professional roles [42], have proposed to distinguish between the social contexts and academic contexts within schools and classrooms [27]. The acknowledgement of these differentiations leads us to our three dimensions of well-being [27].

Table 1. Three dimensions of well-being.

The emotional dimension of well-being encompasses individuals' tendency to be satisfied with daily life, experience life positive, feel self-confident and think positively [43].	**The social dimension of well-being** refers to the experience of belonging to a social group or a social community in which participation and the engagement of the individual are recognized and valued [44].	**Academic dimension of well-being** refers to the experience of feeling happy in school, motivated about and engaged in school work [45]

When it comes to the levels of each of the three well-being dimensions across time (addressed in research question 1) the article concludes that well-being remains high throughout the period (between 3 and 4 out of 5). However, the individual well-being dimensions do fluctuate, and particularly we see a decline in both emotionally and academically well-being. We demonstrate that fluctuations in distinct dimensions of well-being not only vary in terms of their magnitude but also in their determinants. Specifically, academic well-being exhibits a more trait-like nature, while social well-being tends to be more state-like. However, upon conducting a deliberate examination of one of the younger cohorts, it becomes evident that a critical phase, occurring between grades 3 and 6, is associated with shifts in emotional and academic well-being. During this phase, the emotional and academic well-being dimensions transition from being predominantly trait-like to predominantly state-like, respectively.

2. Materials and Methods

To comprehensively address the research questions, this study was carried out longitudinally, involving four successive survey data collections.

2.1. Survey Data

This article is based on data collected through surveys as part of the research project "COVID-19, Building Back Better" conducted from December 2020 to June 2022. The dataset encompasses four successive half-yearly survey rounds targeting primary and lower secondary school students in grades 3 to 9.

In this article, we focus on a set of 16 survey items (see Table 2) related to students' well-being [27], answered using a five-point Likert scale, along with two background items (gender and grade). Participants were provided the option to respond "I don't know/I do not wish to answer" for all questions, and these responses were treated as missing values in the analysis. A missing data analysis [46] revealed no discernible patterns related to participant attrition or the questions participants chose to answer with "I don't know/I do not wish to answer".

Table 2. Summary statistics and factor loadings for input items in factor analyses. One loading below 0.4 is excluded (indicated with grey shading and no factor loading). 1 item that would otherwise improve the alpha value, is nonetheless retained in the factor, marked with α. Resulting α are calculated without the item marked by grey shading.

	Items	Empirical Factors	Factor Loading	Cronbach's Alpha
Item 1 [a]	The activities in school are boring *	Academic well-being	0.733	0.878
Item 2	The activities in school make me want to learn more *		0.835	
Item 3	The activities in school help me get new ideas *		0.679	
Item 4	Learning new things in school is fun *		0.803	
Item 5	I like class activities in school *		0.798	

Table 2. *Cont.*

	Items	Empirical Factors	Factor Loading	Cronbach's Alpha
Item 6	I am happy **	Emotional well-being	0.798	0.851
Item 7	I am in a good mood **		0.789	
Item 8 [a]	I am unhappy **			
Item 9	I am motivated in school **		0.717	
Item 10	I am happy to attend school **		0.768	
Item 11	I like my teachers **		0.585	
Item 12	I feel understood ***	Social well-being	0.761	0.839
Item 13	I feel like I fit in ***		0.827	
Item 14	I feel heard ***		0.761	
Item 15 [a]	I feel excluded ***		0.541 α	
Item 16	I have good classmates ***		0.693	

Response scales: * 1 "Entirely disagree," 2 "disagree," 3 "Neither/nor", 4 "Agree," 5 "Entirely agree" ** 1 "Never or almost never," 2 "Occasionally," 3 "Some of the time," 4 "Most of the time, 5 "All or almost all the time"; *** 1 "Not at all", 2 "Slightly", 3 "Neither/nor", 4 "Somewhat", 5 "To a large degree" [a] Item scores were inverted prior to analysis.

2.2. Sample

8 Danish municipalities volunteered to participate in the study. The municipalities had a variety of socio-economic statuses. Schools in the participating municipalities distributed the surveys during school hours, with pedagogical staff providing support to younger respondents to minimize overall dropout, particularly among those students who struggled to comprehend and respond to the surveys.

The survey rounds received between 3.580 and 6.186 responses. In this article, we focus on a sub-sample of students (n = 774) who had completed at least three of the four surveys. The sub-sample had an anticipated distribution of gender and grades (see Appendix A). We performed multivariate imputation by chained equations [47] in two steps. First, on the full sample for each survey round, using the 16 well-being items as predictors. Subsequently, on the sub-sample for those who had answered three of the four surveys (n = 691) across survey rounds. Although the responses were not missing at random, we believe that the data available from three rounds of survey responses can reasonably predict responses for the fourth round. This approach allows us to utilize the available data, rather than discarding participants.

Based on our focus on students with repeated survey completions and only from selected municipalities, there is no guarantee that the sample is representative of the population of Danish students in general. However, the variation in municipalities and schools, as well as the fact that the surveys were answered in class guided by a teacher, means that we have a variation of students regarding backgrounds. Furthermore, we do have transferability [48], that invites readers to make connections between elements of our study and their own contexts and experiences.

2.3. Analysis

All analyses were conducted in SPSS and AMOS v. 28.0.

2.3.1. Factor Analysis and Fluctuations

We initiated the factor-analytical process by conducting an exploratory factor analysis (EFA). The dataset's suitability for factor analysis was firstly evaluated using the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO > 0.5). We then conducted the EFA (Principal Axis Factoring) for each of the domains; emotional, social, and academic well-being. We used a Promax rotation (useful for large datasets). Internal consistency of the factors was tested using Cronbach's alpha (standardized α, $\alpha > 0.7$) [49]. One item (item 8) in the domain of emotional well-being was removed due to low factor loading (<0.4) [50]

(see Table 2). Finally, resulting factors which met Kaiser's criteria (eigenvalues ≥ 1) [51] were included.

Maximum likelihood confirmatory factor analysis (CFA), where the first-order latent factors were allowed to covary was then conducted on the factors extracted through EFA. One additional item (item 6) was removed due to covariance issues. The model was tested for measurement invariance across gender, grade, and data collections.

To properly specify our conceptual CFA model (see Appendix B), we had to insert covariances between error terms, which introduces a methodological limitation as error terms ideally are uncorrelated. We attribute this issue in part to the measurement instrument, due to sequential presentation of items potentially causing autocorrelation [52] as well as to the complexity of the latent wellbeing phenomenon. Correlations between academic and emotional well-being were problematic (see Appendix B). While this could pose an issue regarding factor trueness, we find the risk is mediated by all three factors correlating to a medium degree or more [53]. We proceeded with the model, as we found no evidence of a second order factor structure providing a better model fit.

Model fit statistics as well as statistical validity, reliability and ecological validity of the latent factors were satisfactory, bordering excellent [54,55], for the final CFA model (Model 3-3, see Appendix B). The model conformed to the assumption of strong measurement invariance across time and gender, which allowed us to compare means [56]. To compare means over time, we computed composite weighted factor scores for each survey round. These weighted factor scores were subjected to significance testing using one-way ANOVA with post-hoc corrections for multiple comparisons [57–59]. True-mean changes in the well-being dimensions was calculated (see Appendix B) and plotted as a function of collection rounds (state) and students' age (grade).

2.3.2. Latent State-Trait Analysis

The state-trait composition of the well-being dimensions was tested by conducting a latent state-trait (LST) analysis [60–63] for each well-being dimension. We adopted the LST analyses approach employed by Burns et al. (2020) [64], allowing us to explore changes in factor means as more flexible than just as linear changes [64,65]. This approach allowed us to determine if the well-being dimensions became more trait-like across time. Unlike Latent Growth Curve Models [66], which models long-lasting trait-changes over time, the LST models allows us to measure variability with some degree of reversibility by breaking down variance components into state- and trait-variability around a fixed trait [67]. Measurement invariance procedures and model fits are presented in Appendix C. The model resulted in an excellent fit to the data for academic and emotional well-being, and an acceptable fit for social well-being.

The model was furthermore fitted on a sub-sample of participant, i.e., the student who matriculated grade 1 in 2017. For this sample (Start Grade 1 in 2017), the model resulted in an excellent fit to the data for emotional well-being, a good fit for academic well-being, and an acceptable fit for social well-being (see Appendix C).

The resulting amount of variance in each well-being dimension explained over time by state and trait (see Appendix C) was plotted together with the unexplained variance for both the students who matriculated grade 1 in 2017 and for all students matriculated in 2014–2019.

3. Results and Discussion

Results will be presented in two sub-sections. Section 3.1 will address research question 1, regarding fluctuations in the three well-being dimensions, while Section 3.2 will address research question 2, regarding whether the dimensions are best conceived as trait, state, or grade dependent.

3.1. Fluctuations in Students' Well-Being

In Figures 1A, 2A and 3A, below, we have graphically represented the fluctuations in the three well-being dimensions over time, corresponding to the four survey collection points, for the student cohorts who matriculated grade 1 in 2014–2019. All three well-being dimensions are consistently high across the four measurement points, ranging between 3 and 4 out of 5, but statistically significant changes ($p < 0.05$) were observed in all well-being dimensions from time-point 1 to time-point 4 (see Appendix B). In particular, we observed some noticeable fluctuations, primarily in academic well-being (Figure 3A), and secondarily in emotional well-being (Figure 1A). The CFA for the sample does not meet the assumption of strong measurement invariance across grades. Particularly noteworthy is the variation at the first data collection point, which appears to differ across grades. One cannot preclude that this is due to COVID-19 and lockdowns. At the onset of March 2020, Danish parents were instructed to keep their children at home, leading to a shift of all school activities to remote learning. After a five-week period of closure, schools gradually reopened, starting with the youngest students (grade 0–5, start grade 1 in 2015–2020), and then older students (grade 6–10, start grade 1 in 2010–2014) rejoining four weeks later. The re-openings were carried out with specific protocols and measures to ensure adherence to official health and hygiene guidelines, which meant that the students entered unfamiliar school settings. Throughout the summer and autumn, 2020, there was a climate of considerable uncertainty due to fluctuating infection rates, resulting in numerous instances of short and long-term local school closures. This continued until the end of the year 2020 when all schools had to close once more, at the time of survey collection 1. The second re-opening occurred on 8 February 2021, for the youngest students (grade 0–4, start grade 1 in 2016–2020). Older students returned every second week starting on 15 March 2021 (grade 9, graduating students, start grade 1 in 2011) or 6 April 2021 (grade 5–8, start grade 1 in 2012–2015). On 18 May 2021, all students resumed full-time in-person classes just before the second survey collection point. After a fairly stable period in the continuation of the summer holidays, infection rates rose again over the autumn and winter of 2021, where at times large percentages of students and also teachers were absent either because they themselves were ill, because infection among close relatives or due to local school closures. At the time of the third data collection point, just before the Christmas holidays, schools were closed down again due to sky-high infection rates. Schools reopened in January 2022, and remained open for the rest of the studied period, hence data collection point four.

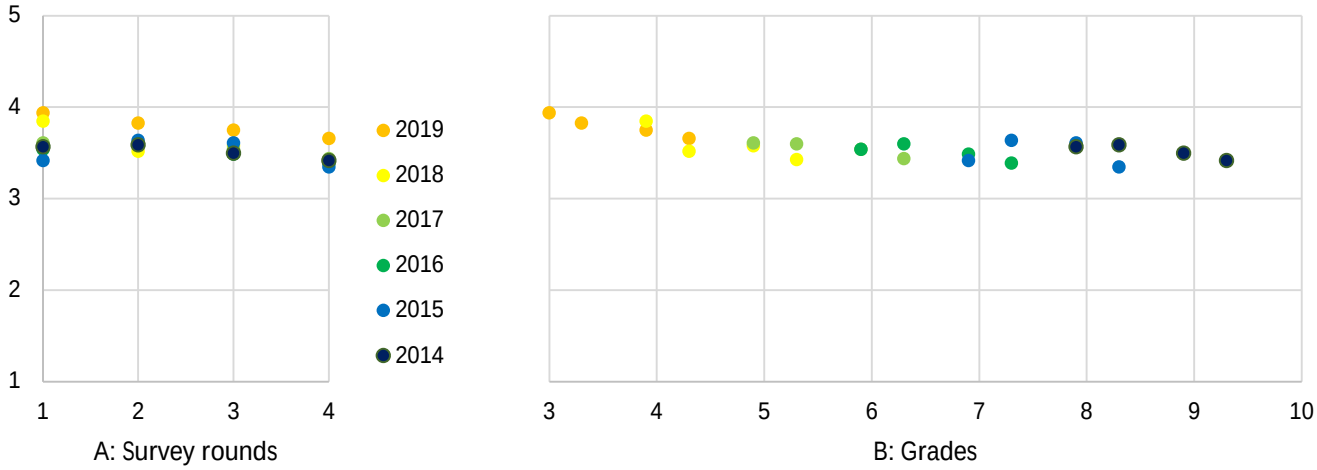

Figure 1. Change in emotional well-being Within (**A**) Survey rounds and (**B**) Grades.

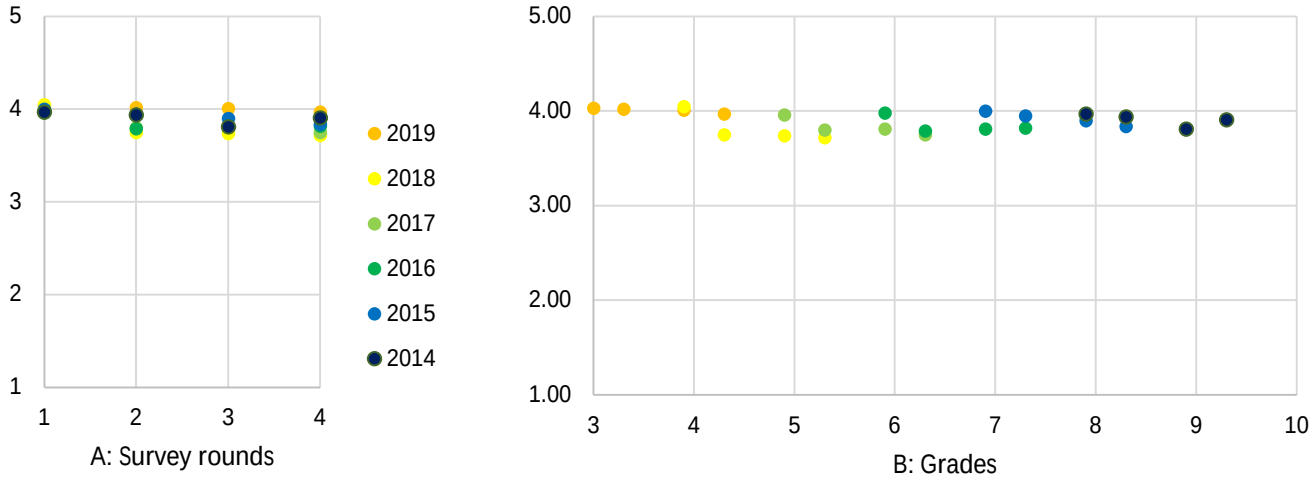

Figure 2. Change in social well-being Within (**A**) Survey Rounds and (**B**) Grades.

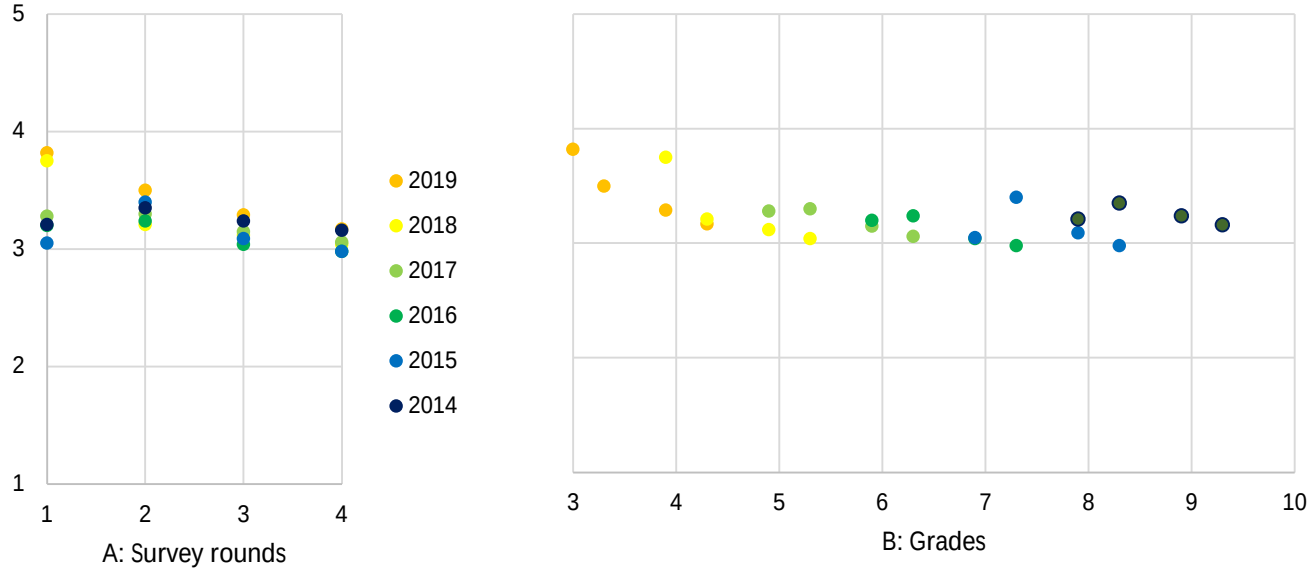

Figure 3. Change in academic well-being within (**A**) Survey rounds and (**B**) Grades.

Considering the description of grade-related school closures and re-openings above, it is probable that Danish students have experienced diverse impacts on well-being during the COVID-19 school closures and re-openings, contingent upon their grade level.

In Figures 1B, 2B and 3B we have plotted fluctuations in the three well-being dimensions as a function of student grades (grade-specific means are reported in Appendix B as well). Once more, fluctuations are predominantly in academic well-being (Figure 3B), and to a lesser extent in emotional well-being (Figure 1B). Nevertheless, these variations now underscore discernible declines in emotional and, especially, academic well-being as students advance in their education. The decline is most pronounced from grade 3 to 6, after which it appears to level off. This gives us a particular interest in the youngest participants in our study, as they are the only ones who have responded to our questionnaire during this critical grade 3 to 6 phase. In fact, when grades were analyzed separately, it was only the three youngest cohorts that displayed significant changes in the well-being dimensions throughout the course of the data collections (see Appendix C). Specifically, students who began grade 1 in 2017 showed significant changes in social and academic well-being, those who started in 2018 exhibited significant changes in all three well-being dimensions, and those who commenced in 2019 experienced significant changes in academic well-being.

3.2. State and/or Trait Dependent Well-Being Fluctuations

To delve into the underlying causes of the well-being fluctuations depicted in Figures 1–3 above and to address research question 2, we now present the results of the LST analysis for both the entire cohort of students entering grade 1 from 2014 to 2019 in a broader sense and, more specifically, for the cohort entering in 2017, who are the oldest students in our sample experiencing the anticipated critical period from grade 3 to 6.

Figure 4 below, illustrates the division of trait- and state-like variance in the three well-being dimensions alongside the unexplained variance for the two longitudinal datasets (see Appendix C).

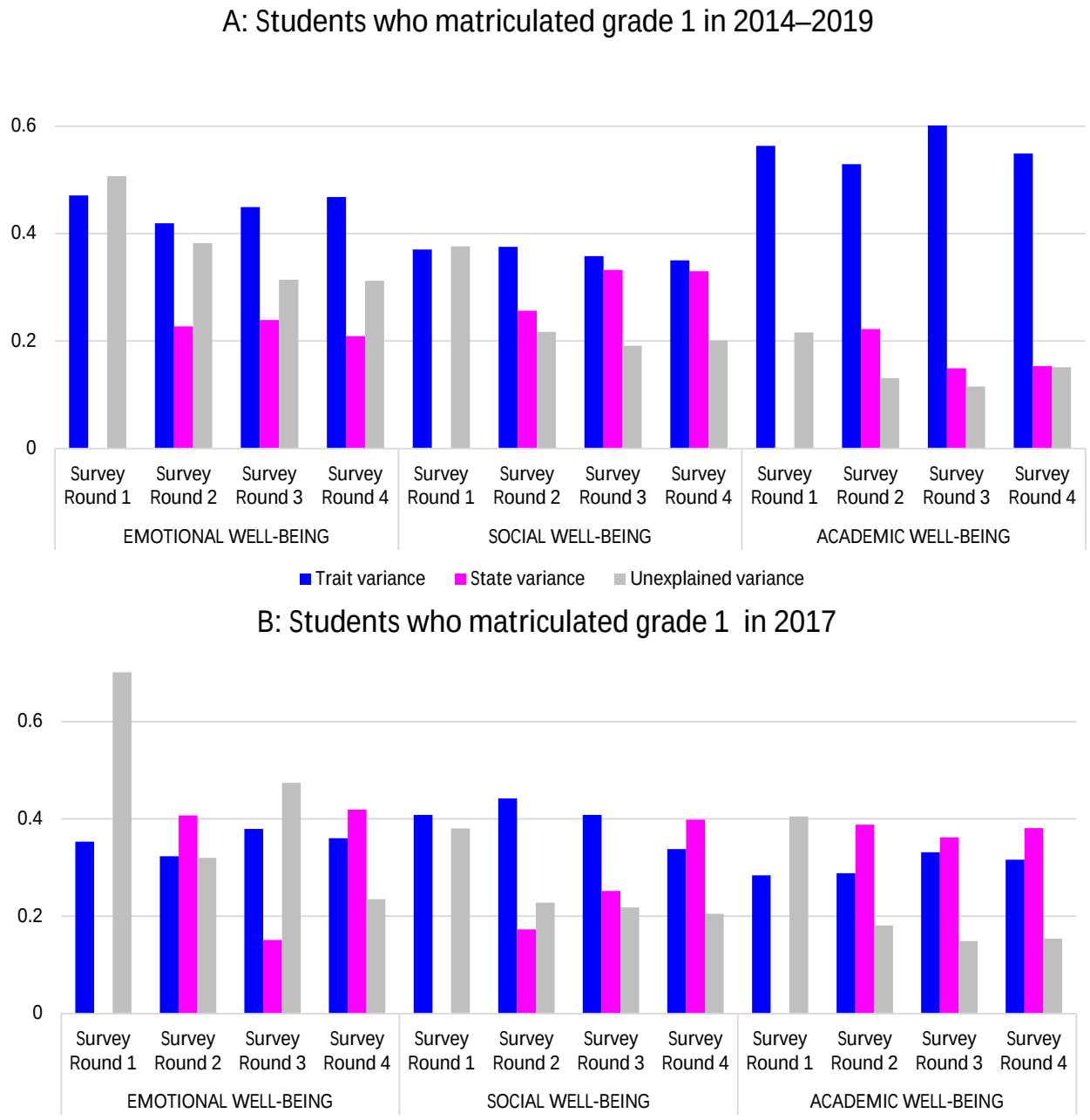

Figure 4. Amount of variation in the three well-being dimensions described by trait and state respectively, for (**A**): Students who matriculated in 2014–2019 and (**B**): Only in 2017. The lack of state variance at Survey Round 1 is expected to be partly explained by the inability to account for auto-regressive effects before this time.

In Figure 4A, concerning the full cohort of students matriculating grade 1 between 2014 and 2019, all well-being dimensions exhibit a higher degree of trait variance than state variance. Nevertheless, there are variations in the distributions among the individual well-being dimensions. Academic well-being stands out as the most trait-like dimensions, with a trait consistency range of 0.53–0.60 and an occasion-specificity range of 0.15–0.22. Following this, emotional well-being has a trait consistency range of 0.42–0.47 and an occasion-specificity range of 0.21–0.24. Finally, social well-being has a trait consistency range of 0.35–0.38 and an occasion-specificity range of 0.26–0.33. Notably, social well-being, in particular, is almost equally explained by trait and state variance for the full cohort. We cannot help but consider whether this is connected to the observation that social well-being remains relatively consistent over the timeframe (Figure 2B), whereas emotional well-being tends to decrease (Figure 1B), and, in contrast, academic well-being undergoes a notable decline (Figure 3B).

We find ourselves faced with the paradox that the least state-like well-being dimension (academic well-being) is the one that declines the most over time. Our hypothesis is, therefore, that the fluctuations in well-being are, at least in part, a result of students simply growing older, and thus grade dependent. The question that arises is, what can be done to improve students' academic well-being moving forward? We have two suggestions in this regard.

Firstly, there is an intriguing development in the state variance of social and academic well-being, where it appears to respectively increase and decrease over time. As students progress, they seem to exhibit greater independence from state factors in their academic well-being, while simultaneously becoming more state reliant in their social well-being. It is shown that academic well-being is correlated with students' perceived coping, i.e., their perceived ability to cope with activities or tasks they are faced with in specific contexts [68], and that repeated experiences of perceived coping or lack of perceived coping will affect the more context-independent self-efficacy or belief in own abilities [69]. Therefore, it is—especially in the period when academic well-being is state reliant—important to support the students' perceived coping. We know from attribution theory that perceived causes of achievement-related successes and failures are important to understand students' perceived coping and self-efficacy in school-contexts [70,71]. Students for whom dominant attributions for success or failure are conditions inherent in themselves (e.g., ability, interest) will be negatively affected on the perceived coping and self-efficacy, while students for whom dominant attributions are conditions outside themselves (e.g., the task, their effort, their preparation) will not to the same extent be negatively affected [72]). By pointing to these differences and the possibilities of changing students' attributed causes, attribution theory might give possible fruitful ways of dealing with students' declining academic well-being, like advocating teachers to consciously attribute students' work to internal and controllable factors, such as their effort.

Secondly, there is a strong correlation between emotional and academic well-being (and, to a lesser extent, with social well-being) (Appendix B). Therefore, one approach to enhancing the trait-like and academic well-being might involve addressing emotional well-being. Some aspects of emotional well-being can be difficult to intervene on in school, but it will be relevant to focus on the students' enjoyment of and motivation for school and also on the relationship with teachers.

In Figure 4B, concerning the specific cohort of students who entered grade 1 in 2017, a different pattern emerges in the relationship between trait and state-specific variance compared to the general 2014–2019 cohort described above. In this cohort, it appears that social well-being is the most trait-like of the well-being dimensions, with a trait consistency range of 0.34–0.44, and an occasion-specificity range of 0.17–0.40. Emotional well-being follows, with a trait consistency range of 0.32–0.38 and an occasion-specificity range of 0.15–0.42. Finally academic well-being is more state-like, with a trait consistency range of 0.28–0.33 and an occasion-specificity range of 0.36–0.39.

In the case of the 2017 cohort, emotional well-being displays stable trait variance but experiences significant fluctuations in state variance. This variation might be influenced by the timing of the individual data collection, which alternated between December and June. Intriguingly, social well-being becomes more state-dependent over time, with a decrease in trait variance and a steady rise in state variance. Concurrently, academic well-being becomes slightly more trait-like over time, although it is still predominantly explained by state variance. It is possible that we, with the 2017 cohort, have observed a complete transformation in the nature of social well-being, transitioning from predominantly trait to state variance during this deliberately selected, and anticipated critical period. Additionally, we may have captured the initial stages of academic well-being's transition from a state-like construct into a more trait-like construct. Notably, the decline in academic well-being (as seen in Figure 3B) aligns with this hypothetical shift from a state-like to a trait-like nature. The foundations for a healthy and successful life as an adult are laid during childhood and the youth period (the 15–24 years), and thus it is important to support students' well-being in the post-pandemic era. Above, we have suggested that it is important to support students' enjoyment of and motivation for school, the relationship with teachers and their perceived coping and self-efficacy. There are several ways to do this, but for example positive feedback is important. Furthermore, during the COVID19-period, studies found that student-centered activities, such as guided discovery, project oriented, problem-based, and inquiry-based activities, positively affected students' social and academic well-being [68].

Based on the presented results, we encourage future studies to systematically investigate the longitudinal development of well-being dimensions, particularly in relation to our hypothesized critical phase from grade 3 to 6. During this phase, a decline in social and particularly in academic well-being appears to correlate with opposite-directed shifts in trait/state variations in the well-being dimensions.

4. Conclusions

As described in the introduction, previous research finds that individual well-being has state and trait characteristics. We nuance these findings by differentiating this knowledge concerning the three well-being dimensions, mental, social and academic well-being. Additionally, there is a growing body of research exploring time variations in mood and subjective well-being. We find grade variations in mental and academic well-being. What distinguishes this study from its predecessors is, firstly, our exploration of fluctuations of the multifaceted well-being conceptualization encompassing academic, social, and emotional well-being. Secondly, that we study the extent to which these fluctuations can be attributed to the COVID-19 context (state), as opposed to individual differences (trait) or simply the natural maturation of students over time (grade).

This article firstly addresses research question one by openly examining and illustrating the fluctuations of students' experienced emotional, social, and academic well-being (Figure 3) in a longitudinal perspective from April 2020–June 2022. We did this both as a function of state (during school closures and re-openings) and as a function of grade (as students progressed through the school system). Students consistently scored the three well-being dimensions high (between 3 and 4 out of 5). However, we did observe statistically significant fluctuations in all three dimensions. Particularly, decreases in academic and emotional well-being. When analyzing student cohorts individually, only the youngest cohorts exhibited significant changes in well-being dimensions. We thus hypothesized a critical period (of declining mental and academic well-being) from grade 3 to 6.

Secondly, we addressed research question two, by building a Latent State-Trait Model for each well-being dimension individually, to investigate the factor's state-trait composition. The model reveals that academic well-being is the most trait-like dimension, with emotional well-being following, and social well-being showing almost equal trait and state variance for the general cohort matriculating grade 1 in 2014–2019. Particularly the decline in academic well-being together with its trait-like nature is a school-related paradox. And we thus discuss how schools and teachers can influence students' academic well-being. For

the cohort who matriculated grade 1 in 2017, deliberately chosen, as they went through the hypothesized critical period from grade 3–6, social well-being gradually becomes more trait-like, while academic well-being evolves from state-like to trait-like, indicating that this indeed is a significant well-being transition period.

The article's findings encourage future studies to longitudinally explore well-being dimensions, especially during the hypothesized critical grade 3–6 phase. New insights might further inform strategies to support student well-being post-pandemic, considering their trait, state, and grade dependencies.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of University of Southern Denmark (protocol code: 11.417, date of approval: 23 June 2021).

Informed Consent Statement: Informed consent was obtained from all respondents as part of their survey response.

Data Availability Statement: Data can be obtained by contacting the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Distribution

Table A1. Sub-sample distribution.

Variables	Frequency	Percentage
Gender		
Male	381	49.2%
Female	384	49.6%
Other	9	1.2%
Total	774	100.0%
Grade		
Start grade 1 in 2019 (n = 66)	66	8.53%
Start grade 1 in 2018 (n = 198)	198	25.58%
Start grade 1 in 2017 (n = 195)	195	25.19%
Start grade 1 in 2016 (n = 163)	163	21.06%
Start grade 1 in 2015 (n = 59)	59	7.62%
Start grade 1 in 2014 (n = 89)	89	11.50%
Start grade 1 in 2013 (n = 4)	4	0.52%
Total	774	100.0%

Due to the low number of respondents who started grade 1 in 2013, this cohort is left out of analyses.

Appendix B. Factor Analysis and Fluctuations

Model fits (see Table A2) were gauged according to the following criteria for acceptable model fit: CFI $\geq$ 0.90, RMSEA $\leq$ 0.08, SRMR $\leq$ 0.08 (cf. [73,74]). Any observed decrease in model fit was considered significant if ΔCFI $\geq$ 0.01 [75]. We opted not to use χ^2 for model fit comparisons, as it has been shown to be volatile regarding sample size. Based on this Model 3-3 was selected. This model is illustrated in Figure A1. Standardized loadings are presented in Table A3, while validity and reliability of Model 3-3 is presented in Table A4.

Table A5 includes scores for Levene's test of homogeneity of variance, and Table A6 the ANOVA post-hoc tests for multiple comparisons of true-means across survey rounds. For the full sample, from time-point 1 to time-point 4, statistically significant changes ($p < 0.05$) were observed in all well-being dimensions. However, the CFA for the full sample does not meet the assumption of strong measurement invariance across grades.

Weighted composite scores for each latent factor for each survey round, as presented in Table A7.

Table A2. CFA Model fit statistics. The chosen model is marked with blue.

Model	χ^2	Df	CFI	RMSEA	SRMR
Model 0-1: Configural/Unconstrained model without item 6	919.32	59	0.961	0.069	0.054
Model 1-1: Configural/Unconstrained Gender	912.04	118	0.963	0.047	0.052
Model 1-2: Weak invariance Gender	950.98	129	0.962	0.046	0.052
Model 1-3: Strong invariance Gender	1105.99	140	0.955	0.048	0.052
Model 1-4: Strict invariance Gender	1173.27	154	0.953	0.047	0.054
Model 2-1: Configural/Unconstrained Grades	1319.26	354	0.955	0.030	0.045
Model 2-2: Weak invariance Grades	1430.57	409	0.953	0.029	0.051
Model 2-3: Strong invariance Grades	1820.43	464	0.937	0.031	0.057
Model 3-1: Longitudinal Configural/Unconstrained model	1225.57	236	0.955	0.037	0.052
Model 3-2: Longitudinal Weak invariance	1284.44	269	0.954	0.035	0.052
Model 3-3: Longitudinal Strong invariance	1527.54	302	0.945	0.036	0.055
Model 3-4: Longitudinal Strict invariance	1823.29	344	0.933	0.037	0.054

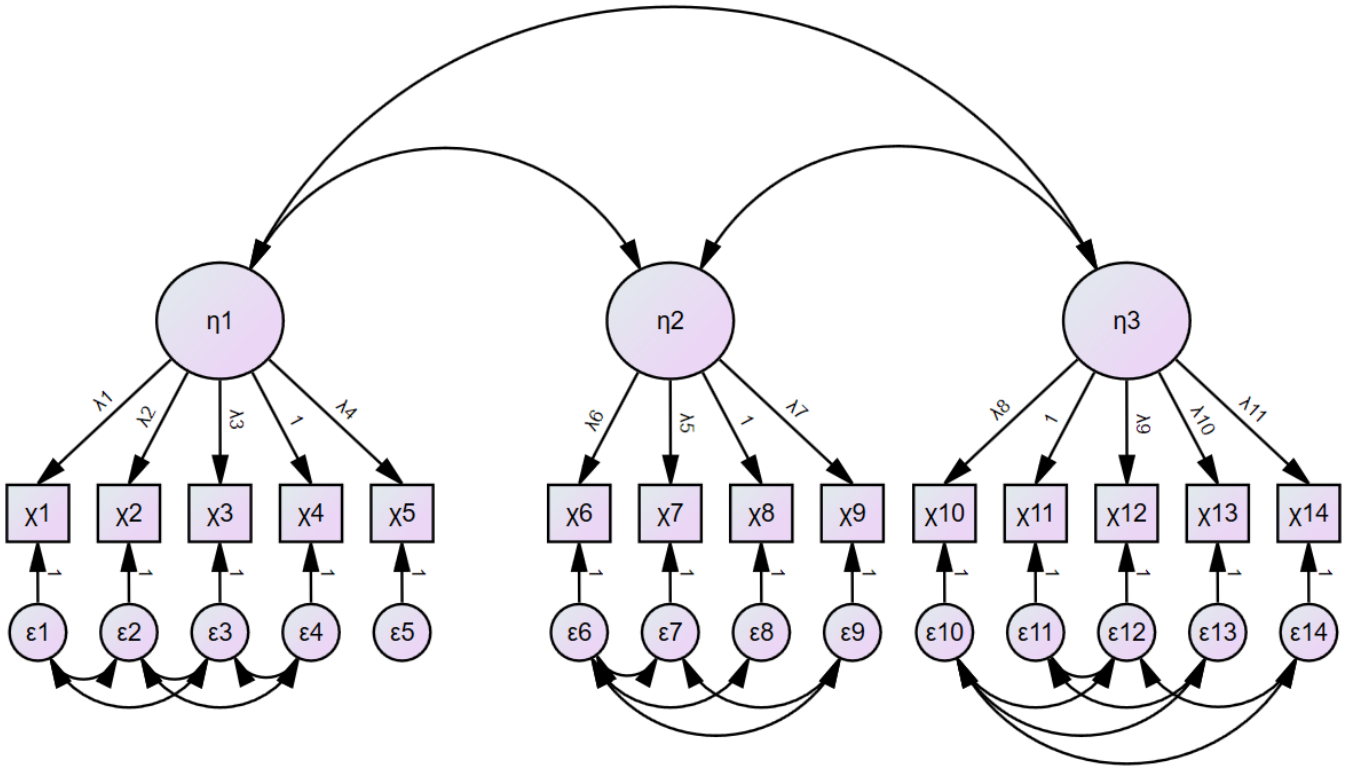

Figure A1. Model 3-3—Confirmatory factor model with strong measurement invariance constraints. η = latent factor, λ = factor loading, χ = indicator, ε = measurement error. Valid covariances were added between items down to a lower limit of MI = 4. Item 6 removed due to homogeneity issues.

Table A3. Items loadings.

Factor	Item	Std. Loading
η 1	Item 1	0.750
	Item 2	0.740
	Item 3	0.619
	Item 4	0.741
	Item 5	0.859
η 2	Item 7	0.520
	Item 9	0.785
	Item 10	0.817
	Item 11	0.727
η 3	Item 12	0.822
	Item 13	0.750
	Item 14	0.742
	Item 15	0.521
	Item 16	0.796

Table A4. Validity and Reliability of Model 3-3.

	CR	AVE	MSV	Cor. H 1	Cor. H 2	Cor. H 3
η 1-1	0.850	0.535	0.697	**0.732**		
η 2-1	0.796	0.501	0.697	0.835	**0.708**	
η 3-1	0.840	0.520	0.288	0.410	0.537	0.721
η 1-2	0.846	0.525	0.637	**0.725**		
η 2-2	0.797	0.503	0.637	0.798	**0.709**	
η 3-2	0.840	0.517	0.370	0.489	0.608	0.719
η 1-3	0.861	0.555	0.637	**0.745**		
η 2-3	0.821	0.538	0.637	0.798	**0.734**	
η 3-3	0.858	0.553	0.480	0.515	0.693	0.743
η 1-4	0.877	0.590	0.728	**0.768**		
η 2-4	0.821	0.540	0.728	0.853	**0.735**	
η 3-4	0.875	0.588	0.389	0.484	0.624	0.767

Notes: CR = Composite Reliability; AVE = Average Variance Extracted; MSV = Maximum Shared Variance; Cor. = Correlations between latent factors (the square-root of AVE is on the diagonal). Problematic values highlighted in **bold.**

Table A5. Levene's test of homogeneity of variance.

		Levene Statistic		Degrees of Freedom	
Sample	**Factor**	**Mean**	**Trimmed Mean**	**Df1**	**Df2**
Full Sample (*n* = 774)	Academic well-being	1.953	1.985	3	3092
	Emotional well-being	2.457	2.406	3	3092
	Social well-being	0.655	0.651	3	3092
Start grade 1 in 2019 (*n* = 66)	Academic well-being	0.219	0.211	3	260
	Emotional well-being	2.956 *	2.902 *	3	260
	Social well-being	0.799	0.775	3	260
Start grade 1 in 2018 (*n* = 198)	Academic well-being	0.738	0.738	3	788
	Emotional well-being	1.517	1.599	3	788
	Social well-being	0.064	0.066	3	788
Start grade 1 in 2017 (*n* = 195)	Academic well-being	2.529	2.513	3	766
	Emotional well-being	2.179	2.097	3	766
	Social well-being	2.262	2.180	3	766

Table A5. *Cont.*

		Levene Statistic		Degrees of Freedom	
Sample	**Factor**	**Mean**	**Trimmed Mean**	**Df1**	**Df2**
Start grade 1 in 2016 (n = 163)	Academic well-being	0.392	0.359	3	648
	Emotional well-being	2.632 *	2.572	3	648
	Social well-being	0.580	0.594	3	648
Start grade 1 in 2015 (n = 59)	Academic well-being	0.489	0.504	3	232
	Emotional well-being	1.010	0.915	3	232
	Social well-being	1.121	1.070	3	232
Start grade 1 in 2014 (n = 89)	Academic well-being	4.089 **	4.095 **	3	352
	Emotional well-being	0.703	0.707	3	352
	Social well-being	0.467	0.457	3	352

* = $p > 0.05$; ** = $p > 0.01$.

Table A6. ANOVA post-hoc test for multiple comparisons.

		Survey Round True-Mean Differences between Pairings					
Sample	**Factor**	**1 vs. 2**	**1 vs. 3**	**1 vs. 4**	**2 vs. 3**	**2 vs. 4**	**3 vs. 4**
Full Sample (n = 774)	Academic	0.11 *	0.27 ***	0.35 ***	0.15 ***	0.24 ***	0.09
	Emotional	0.06	0.11	0.23 ***	0.04	0.17 **	0.13 *
	Social	0.17 ***	0.19 ***	0.20 ***	0.01	0.03	0.01
Start grade 1 in 2019 (n = 66)	Academic	0.33 *	0.54 **	0.66 **	0.21	0.33 *	0.12
	Emotional [a]	0.11	0.18	0.28	0.08	0.17	0.10
	Social	0.01	0.02	0.06	0.01	0.05	0.03
Start grade 1 in 2018 (n = 198)	Academic	0.54 ***	0.63 ***	0.71 ***	0.09	0.17	0.08
	Emotional	0.33 **	0.27 *	0.42 ***	−0.06	0.09	0.15
	Social	0.31 ***	0.31 ***	0.33 ***	0.00	0.03	0.02
Start grade 1 in 2017 (n = 195)	Academic	−0.02	0.13	0.22 *	0.14	0.24 *	0.09
	Emotional	0.01	0.07	0.18	0.06	0.16	0.10
	Social	0.16	0.15	0.21 *	−0.01	0.05	0.06
Start grade 1 in 2016 (n = 163)	Academic	−0.04	0.16	0.22	0.19	0.25 *	0.06
	Emotional	−0.06	0.05	0.15	0.11	0.21	0.10
	Social	0.19	0.17	0.16	−0.02	−0.03	−0.01
Start grade 1 in 2015 (n = 59)	Academic	−0.35 *	−0.04	0.07	0.31	0.42 *	0.11
	Emotional	−0.23	−0.20	0.06	0.03	0.29	0.26
	Social	0.06	0.11	0.16	0.05	0.10	0.05
Start grade 1 in 2014 (n = 89)	Academic [a]	−0.14	−0.02	0.06	0.11	0.19	0.08
	Emotional	−0.02	0.07	0.15	0.08	0.17	0.09
	Social	0.04	0.16	0.06	0.13	0.03	−0.10

[a] = Based on Dunnett's T3; * = $p > 0.05$, ** = $p > 0.01$, *** = $p > 0.001$.

Table A7. Weighted composite scores/True-means.

	Survey Round	**1**		**2**		**3**		**4**	
Grade	**Well-Being**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Full sample (n = 774)	Academic	3.40	0.76	3.29	0.72	3.14	0.70	3.05	0.72
	Emotional	3.67	0.85	3.60	0.88	3.56	0.86	3.44	0.83
	Social	4.00	0.68	3.83	0.65	3.82	0.67	3.80	0.65
Start grade 1 in 2019 (n = 66)	Academic	3.82	0.62	3.50	0.64	3.29	0.62	3.17	0.67
	Emotional	3.94	0.63	3.83	0.72	3.75	0.81	3.66	0.72
	Social	4.03	0.54	4.02	0.58	4.01	0.59	3.97	0.62

Table A7. *Cont.*

	Survey Round	1		2		3		4	
Grade	**Well-Being**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Start grade 1 in 2018 (n = 198)	Academic	3.75	0.72	3.21	0.72	3.12	0.70	3.04	0.73
	Emotional	3.85	0.82	3.52	0.89	3.58	0.82	3.43	0.85
	Social	4.05	0.68	3.75	0.65	3.74	0.67	3.72	0.69
Start grade 1 in 2017 (n = 195)	Academic	3.28	0.78	3.30	0.77	3.15	0.69	3.06	0.67
	Emotional	3.61	0.91	3.60	0.88	3.54	0.92	3.44	0.79
	Social	3.96	0.68	3.80	0.67	3.81	0.70	3.75	0.63
Start grade 1 in 2016 (n = 163)	Academic	3.20	0.72	3.24	0.70	3.04	0.69	2.98	0.67
	Emotional	3.54	0.86	3.60	0.91	3.49	0.82	3.39	0.78
	Social	3.98	0.73	3.79	0.65	3.81	0.63	3.82	0.65
Start grade 1 in 2015 (n = 59)	Academic	3.05	0.64	3.40	0.67	3.09	0.66	2.98	0.74
	Emotional	3.42	0.81	3.64	0.96	3.61	0.92	3.35	0.89
	Social	4.00	0.71	3.95	0.63	3.90	0.70	3.84	0.71
Start grade 1 in 2014 (n = 89)	Academic	3.21	0.58	3.35	0.76	3.24	0.83	3.16	0.87
	Emotional	3.57	0.84	3.59	0.84	3.50	0.89	3.42	0.95
	Social	3.97	0.70	3.94	0.62	3.81	0.65	3.91	0.60

Appendix C

An illustration of LST analysis which included N-1 indicator specific factors to account for indicator-specific effects [76,77], including auto-regressive effects between temporally adjacent state-factors [61,65] is provided in Figure A2. The model was applied separately to the three well-being dimensions, with the Emotional Well-being dimension containing 1 fewer indicator per measurement occasion and thus 1 fewer indicator-specific factor.

Measurement invariance was tested by gradually applying constraints and using $\Delta CFI \geq 0.01$ [75] as the criteria for significance. Model fits are presented in Table A8. For both samples, model fit becomes significantly worse for Emotional and Social Well-being when applying constraints for strong measurement invariance. As such, further analysis was conducted with only weak invariance constraints applied. With these constraints, the STMS-IS-AR model for the full sample resulted in an excellent fit to the data for Academic and Emotional Well-being, and an acceptable fit for Social Well-being. For the Start Grade 1 (2017) sample, the model resulted in an excellent fit to the data for Emotional Well-being, a good fit for Academic Well-being, and an acceptable fit for Social Well-being.

Finally, LST analysis results and model fits are presented in Table A9.

Table A8. Latent State-Trait Model Fits, full sample and start grade 1 (2017)-sample.

Model		χ^2	**Df**	**CFI**	**RMSEA**	**SRMR**
Full sample						
Academic well-being	Configural	537.77	144	0.962	0.059	0.038
	Weak invariance	602.17	156	0.957	0.061	0.046
	Strong invariance	655.13	170	0.953	0.061	0.047
Emotional well-being	Configural	325.97	85	0.964	0.061	0.041
	Weak invariance	338.88	94	0.963	0.058	0.040
	Strong invariance	437.31	103	0.950	0.065	0.038
Social well-being	Configural	621.33	144	0.945	0.065	0.035
	Weak invariance	662.77	156	0.942	0.065	0.042
	Strong invariance	822.99	167	0.924	0.071	0.045

Table A8. *Cont.*

Model		χ^2	Df	CFI	RMSEA	SRMR
Start Grade 1 (2017)						
Academic well-being	Configural	290.14	144	0.945	0.072	0.051
	Weak invariance	305.09	156	0.944	0.070	0.055
	Strong invariance	329.11	168	0.940	0.070	0.056
Emotional well-being	Configural	156.00	85	0.960	0.066	0.055
	Weak invariance	172.34	94	0.956	0.066	0.060
	Strong invariance	200.45	103	0.945	0.070	0.059
Social well-being	Configural	306.42	144	0.927	0.076	0.056
	Weak invariance	335.813	156	0.919	0.077	0.064
	Strong invariance	375.94	167	0.906	0.080	0.063

Table A9. Latent State-Trait Model Fits, different survey rounds.

Assessment	Trait Consistency	Occasion-Specificity	Latent State Residual Variance Estimate	Reliability of Indicators				
Full longitudinal sample								
Academic well-being				Item 1	Item 2	Item 3	**Item 4**	Item 5
Survey Round 1	0.563	0	0.216	0.484	0.653	0.477	0.616	0.608
Survey Round 2	0.529	0.222	0.131	0.483	0.658	0.441	0.656	0.551
Survey Round 3	0.601	0.149	0.115	0.487	0.669	0.462	0.712	0.551
Survey Round 4	0.549	0.153	0.151	0.534	0.711	0.518	0.687	0.598
Emotional well-being				Item 7	-	Item 9	**Item 10**	Item 11
Survey Round 1	0.471	0	0.507	0.356	-	0.526	0.752	0.428
Survey Round 2	0.419	0.227	0.382	0.386	-	0.533	0.790	0.440
Survey Round 3	0.449	0.239	0.314	0.416	-	0.521	0.764	0.444
Survey Round 4	0.468	0.209	0.312	0.419	-	0.575	0.785	0.473
Social well-being				Item 12	**Item 13**	Item 14	Item 15	Item 16
Survey Round 1	0.370	0	0.376	0.452	0.711	0.486	0.224	0.471
Survey Round 2	0.375	0.256	0.217	0.453	0.717	0.468	0.314	0.413
Survey Round 3	0.358	0.332	0.191	0.531	0.785	0.476	0.295	0.462
Survey Round 4	0.350	0.330	0.201	0.520	0.830	0.551	0.346	0.486
Start grade 1 in 2017								
Academic well-being				Item 1	Item 2	Item 3	**Item 4**	Item 5
Survey Round 1	0.284	0.000	0.405	0.432	0.619	0.460	0.674	0.661
Survey Round 2	0.288	0.388	0.181	0.444	0.654	0.440	0.671	0.619
Survey Round 3	0.331	0.362	0.149	0.421	0.694	0.491	0.767	0.563
Survey Round 4	0.316	0.381	0.154	0.472	0.687	0.494	0.724	0.554
Emotional well-being				Item 7	-	Item 9	**Item 10**	Item 11
Survey Round 1	0.353	0.000	0.701	0.416	-	0.582	0.757	0.425
Survey Round 2	0.323	0.407	0.320	0.473	-	0.575	0.790	0.483
Survey Round 3	0.379	0.151	0.474	0.428	-	0.487	0.764	0.407
Survey Round 4	0.360	0.419	0.235	0.508	-	0.621	0.759	0.471
Social well-being				Item 12	**Item 13**	Item 14	Item 15	Item 16
Survey Round 1	0.408	0.000	0.380	0.498	0.709	0.518	0.236	0.436
Survey Round 2	0.442	0.173	0.228	0.445	0.696	0.480	0.345	0.373
Survey Round 3	0.408	0.252	0.218	0.560	0.787	0.539	0.342	0.397
Survey Round 4	0.338	0.398	0.205	0.587	0.870	0.627	0.394	0.464

Note: **Bold** = Reference indicator.

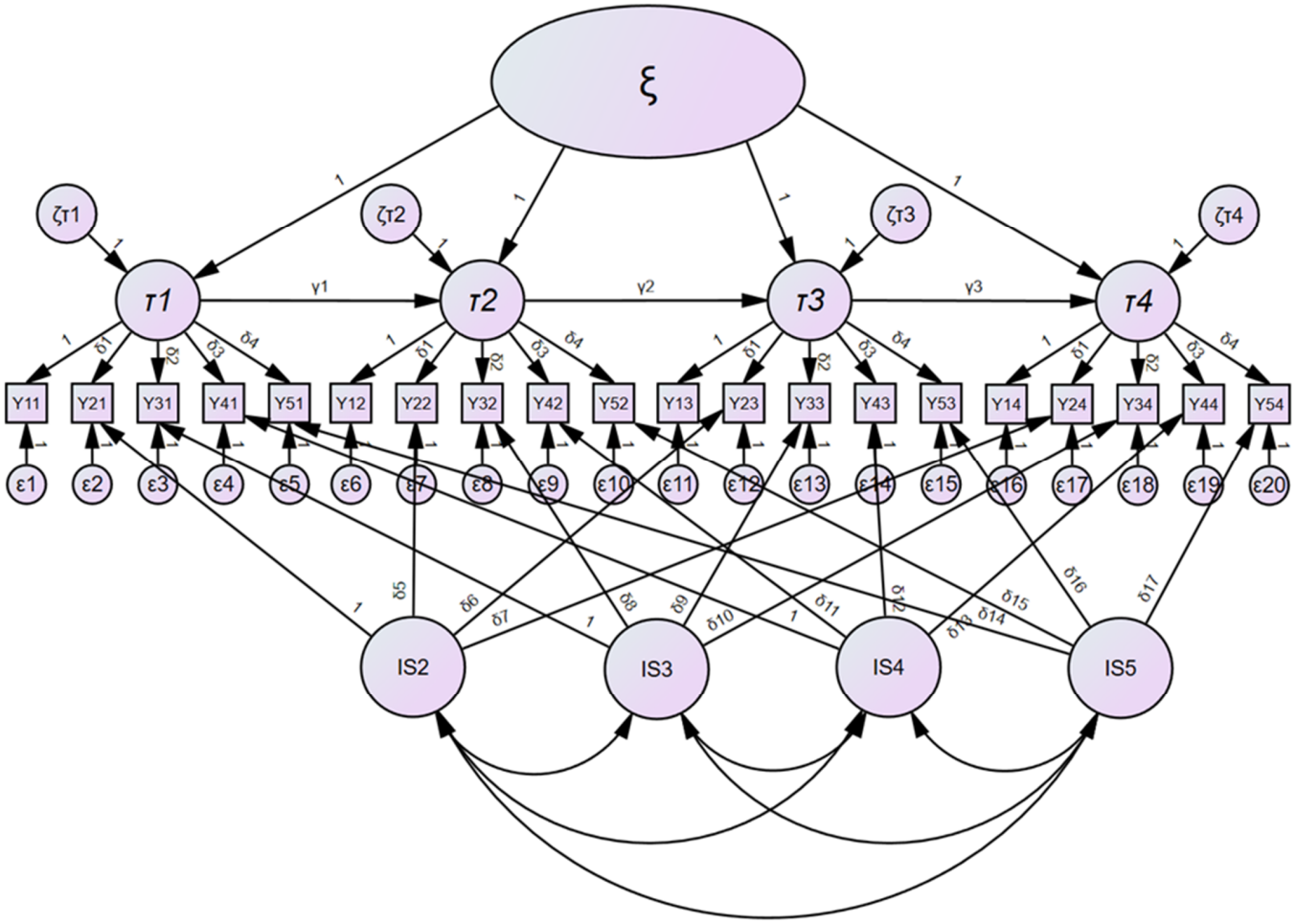

Figure A2. Single-Trait-Multiple-State Model with Indicator-Specific (IS) factors for indicators 2–5 and autoregressive effects between temporally adjacent state factors (STMS-IS-AR Model) with weak measurement invariance constraints placed on factor loadings for the latent state variables. ξ = Latent Trait Variable; τk = Latent State Variable at measurement occasion k; ζτk = Latent State Residual for the Latent State Variable at measurement occasion k; Yik = Observed variable i at measurement occasion k; γ = auto-regression coefficients; δ = factor loadings.

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