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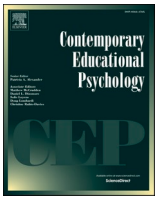

The Multidimensional Student Well-being (MSW) instrument: Conceptualisation, measurement, and differences between Indigenous and non-Indigenous primary and secondary students

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ABSTRACT

Enabling children's and youth's well-being is widely valued by families and communities worldwide. However, there is no general agreement about the structure and measurement of well-being in schooling contexts, nor in particular for Indigenous students who comprise some of the most educationally disadvantaged populations in the world. We theorised a multidimensional student well-being model and the Multidimensional Student Well-being (MSW) instrument, grounded on recent research. We investigated its structure, measurement, and relation to correlates of well-being for a matched sample of 1,405 Australian students (Indigenous, N = 764; non-Indigenous, N = 641) at three time-points, 10–12 months apart. Analyses supported an a priori multidimensional model of 6 higher-order domains of well-being, represented by 15 first-order factors. This structure was invariant across Indigenous and non-Indigenous, male and female, and primary and secondary schooling levels. Correlates provided support for convergent and discriminant validity. There was a downward trend in well-being over time, which calls for attention to multidimensional domains of students' well-being to promote healthy development throughout school life and beyond. The results support a multidimensional model of student well-being appropriate for primary and secondary schooling and both Indigenous and non-Indigenous students.

1. Introduction

Individual well-being is increasingly gaining attention worldwide (Marsh et al., 2020; Martela et al., 2022). However, international well-being assessments have mostly tended to focus on adult populations, while comprehensive large-scale studies on adolescent well-being are relatively few (Programme for International Student Assessment—PISA (2018) (Organisation for Economic Co-operation & Development, 2019). This absence of a discussion of children's subjective well-being has been notable according to The Children Society (Pople, Rees, Main, & Bradshaw, 2015). Critically there is a particular need for improved instruments for assessing well-being in educational settings (Govorova et al., 2020; Ryan and Deci, 2017) for all students, but particularly for Indigenous students who comprise some of the most educationally disadvantaged populations in the world. Student well-being is defined by the Organisation for Economic Co-operation and Development (Organisation for Economic Co-operation & Development, 2017) as "the psychological, cognitive, social and physical qualities that students need to live a happy and fulfilling life" (p. 19), and is increasingly being incorporated globally as a priority into education policy. In acknowledging the critical importance of student well-being, the Organisation for Economic Co-operation & Development, 2017 has advocated that policy makers should focus on students' well-being now, as student well-being predicates adult well-being and that schools, along with other social institutions, play an important role in addressing children's fundamental psychological and social needs,

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better preparing them to deal with unfavourable situations when they arise. However, despite a growing body of well-being research, there are a plethora of challenges and controversies in the field, including no agreement on how well-being in general, and well-being in educational contexts in particular, should be defined, conceptualised, and measured (Govorova et al., 2020).

To address some of these issues, the 2015 edition of PISA included an instrument to assess five well-being domains: cognitive, psychological, social, physical, and material (Govorova et al., 2020). However, missing in the instrument is the cultural aspect of well-being that reinforces Indigenous students' identity and the important role 'connection to Country' plays in promoting Indigenous well-being (Durmush et al., 2021). Mooney et al. (2016) have emphasised the salience of the cultural dimension, which may also be an indispensable aspect of well-being for other minority student populations but has been neglected in most well-being measurements. Previous research suggests that Indigenous conceptualisations of well-being are holistic and culturally informed and therefore culturally distinct. For example, Dudgeon et al. (2016) suggested that Indigenous Australians' wellbeing is connected to family and community wellbeing and connection to community and culture. That is, Indigenous peoples' lived experiences are distinct as members of Indigenous minoritized groups, and as such, cultural identity is inherently distinct for Indigenous and non-Indigenous peoples.

Western models do not tend to account for cultural well-being as an important component of wellbeing. For example, Jones et al. (2018) identified that there is a dearth of large-scale research which examines cultural wellbeing. To contribute to accounting for the importance and distinctiveness of cultural wellbeing for Indigenous children and youth and the multicultural nature of non-Indigenous Australian society, our MSW model includes a measure of cultural wellbeing which measures understanding of, and feeling positive about one's culture. In addition, given the importance of Indigenous peoples' connectedness to family and community, these are measured as specific factors. Given these measures have been proposed by researchers to be salient for Indigenous peoples, we expect that Indigenous students will report high scores on these dimensions.

Given the diversity of cultures in the Australian population, as reflected in an estimate of over 160 other languages spoken in the home apart from English and Indigenous languages (Australian Bureau of Statistics, 2023), a well-being instrument for Australians cannot be complete without the cultural dimension. Also missing is the "self-belief" dimension (self-worth; competence beliefs), salient for any individual, but particularly salient for Indigenous students, which is highlighted in the Durmush et al. (2021) interviews with Indigenous Australian students, who emphasised the need for agency over their lives. To fill the gap in the literature and existing models of well-being for school-age Indigenous and non-Indigenous children and youth, we theorise that the well-being of school students is multidimensional, as illustrated by Dillon et al. (2020), Durmush et al. (2021), Govorova et al. (2020), and Organisation for Economic Co-operation & Development, 2017. Consistent with the PISA theoretical framework of well-being (Govorova et al., 2020), we first propose four distinguishable domains: Academic (cognitive), Psychological, Social, and Physical. Second, we propose the domains of Cultural and Self-belief well-being, given their potentially potent importance for Indigenous well-being (Durmush et al., 2021), to give a total of six domains. These six domains are expected to display a hierarchical structure with measurable facets pertaining to each domain so that the conceptualised model can guide educational intervention to promote students' well-being, measure intervention effects, and identify any domain that needs improvement at the individual or class and school levels. Definitions of the constructs are given in Appendix A. Fig. 1 shows our theoretical measurement structure and key covariates used to assess convergent and discriminant validity of responses to our MSW instrument.

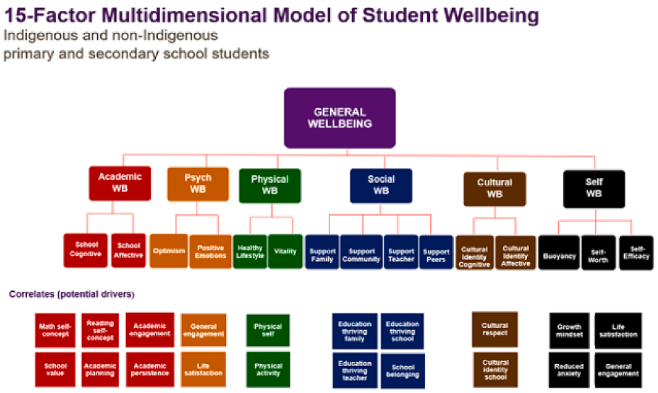

Fig. 1. Structure of Student Wellbeing.

1.1. *Addressing a significant gap in the well-being literature*

Issues with the extant well-being literature include: (1) a lack of conceptualisation that suits both Indigenous and non-Indigenous Australian school students, and students from other cultural backgrounds, (2) lack of a measure of multidimensional well-being that enables schools to assess students' well-being, (3) inadequate understanding of the correlates of well-being for schools to identify essential factors to facilitate specific aspects of students' well-being, (4) lack of a psychometrically sound instrument to assess the similarities and differences of well-being for students from different cultures, and (5) missing Indigenous worldviews leading to missing domains of well-being that are essential for Indigenous Australian students.

In terms of theoretical underpinnings, the extant well-being literature is based on Western conceptualisations, fundamentally disregarding important domains from an Indigenous perspective. In terms of measurement and comparison between Indigenous and non-Indigenous samples, an ongoing issue is a failure to recognise and appreciate Indigenous perspectives on well-being and learning. This failure results in a deficit view of Indigenous students who do not achieve as high as non-Indigenous students on Eurocentric metrics (Dillon et al., 2020). To address this issue, instead of comparing average achievers in school settings, which is likely to replicate and reinforce previous misleading findings that result in deficit views of Indigenous peoples, we recruited a matched sample of Indigenous and non-Indigenous students who were above-average in academic achievement. This sample has the advantage of providing us with data that inform a true picture of the well-being of these students of similar academic ability. It also responds to the burgeoning calls for attention to Indigenous worldviews and taking a positive psychology and strengths-based perspective in research with Indigenous populations with a focus on what enables Indigenous peoples to flourish and thrive (e.g., Craven et al., 2016; Durmush et al., 2021).

Globally knowledge and research about Indigenous peoples has been focused on deficit discourse that highlights Indigenous disadvantage (Fogarty et al., 2018). Fforde et al. (2013,p. 162) "use the term 'deficit discourse' to describe a mode of thinking, identifiable in language use, that frames Aboriginal identity in a narrative of negativity, deficiency, and disempowerment". Fogarty et al. (2018) note that: "Discourse is powerful in determining what can and cannot be considered 'truth' and influencing group and individual relationships accordingly" (p. 2). The discourse around Indigenous peoples has been associated with the narrative of failure and negativity (Fogarty et al., 2018). This has resulted in some Indigenous children and youth being disempowered and for some teachers to stereotype Indigenous students based on deficit discourses rather than embracing and building upon their strengths by employing strengths-based approaches such as culture-affirming pedagogy and curriculum (Craven et al., 2016).

1.2. Capitalising on Indigenous worldviews and evidence from Indigenous students

> "*I want to highlight the importance of data and evidence to this agenda… we do not know very much about what works. …There are too many anecdotes in public policy making for Indigenous people and not enough data*" (Anderson, 2017).

To understand the nature of well-being and to enhance the well-being of Indigenous students, it is essential to collect data to address the "lack of large-scale quantitative research" (Craven et al., 2016). Failure by successive governments to adopt a strengths-based approach when addressing the needs of Indigenous Australians has resulted in inappropriate policy and harmful practice that has seen them remain the most underprivileged Australians on all socio-economic well-being indicators, including education (Commonwealth of Australia, 2020). Considerable inequalities are also known internationally for Indigenous peoples' well-being and educational attainment (United Nations, 2020). However, there is a lack of understanding about the structure and nature of well-being for Indigenous students, the correlates of well-being, and what successful intervention strategies may look like. Understanding all the factors that contribute to Indigenous students' well-being has the potential to be game-changing. Internationally, we need a stronger evidence base of the nature of and potential enablers of Indigenous well-being to deliver research-derived recommendations that are salient for Indigenous students to inform effective education policy, practice, and interventions. This research provides that opportunity.

Our research draws on a strengths-based methodological framework pioneered by Craven et al. (2016). They theorised a new positive psychology of Indigenous thriving model "to broaden research paradigms available for Indigenous people, researchers, service providers, and other stakeholders who desire to see Indigenous Australians attain their full potential" (p. 33). Craven et al. emphasise that their model "seeks, in fact, to integrate Western and Indigenous methodologies, particularly those emphasizing the importance of embracing Indigenous knowledge, values, self-concepts, and autonomy, in new synergistic ways to yield translational research of salience to Indigenous children, youth, and communities" (p. 33). Craven et al. propose four key research pillars "fundamental to enable Indigenous children and youth to get the most out of life" (p. 6): educational, psychological, physical, and family and community thriving. All four pillars are hypothesised to be critical to Indigenous well-being and therefore included in our model (see Fig. 1 and supplemental materials). Craven et al. also emphasised the importance of intercultural knowledge. Thus, consideration of both Western and Indigenous knowledges, methodologies, and theories can stimulate new substantive-methodological synergies, and holistic Indigenous worldviews "can highlight new variables and emphases within interdisciplinary research and the value of its interconnectedness" (p. 6). Craven et al. utilise "a research framework (EMU) founded upon both positive psychology principles and holistic Indigenous Australian worldviews" (p. 33), foregrounds the primacy of Indigenous peoples' voices and agency, and builds on Indigenous peoples' strengths. Craven et al. argue that the EMU Framework is "a unifying framework for the conduct of research programs aiming to enable Indigenous children, youth, and communities to thrive" (p. 36). The three unique pathways within the EMU framework are (1) exemplars, (2) measurement, and (3) utilisation. The framework focuses on a strengths-based approach whereby exemplars of Indigenous success are identified. In this research, our exemplar is high-ability Indigenous students. Measurement allows for the complementation of Indigenous and quantitative measures that are holistic in nature, reflecting Indigenous worldviews. Craven et al. emphasised "Research with Indigenous Australian community members has emphasised that they would value the opportunity to have access to the advances generated by Western research methods" (Craven et al., 2016, p. 33). This research capitalises on Western scientific research methodology to elucidate salient domains of well-being for Indigenous children and youth.

In our research, we also capitalise on the qualitative research findings of Durmush et al. (2021) on Indigenous young people's conceptualisations of the nature and facilitators of their well-being. This informed the development of our MSW and selection of Indigenous-identified potentially potent correlates of well-being that account for Indigenous young people's holistic worldviews and identified areas of need. Durmush et al. found that family and kinship support, connection to Country, spirituality, cultural identity, and a sense of self were crucial for the wellbeing of Indigenous youth. These aspects of Indigenous well-being are incorporated into our hypothesised model of student well-being as Cultural Identity Well-being, Self-belief Well-being (represented by the first-order constructs of buoyancy, self-worth, self-efficacy), and Social Well-being (represented by the first-order facets of family, community, teacher, and peer support—see Fig. 1). Hence this research conceptualises a well-being model and instrument explicitly developed with Indigenous young people, and cross-validated with Indigenous students to test the structure and measurement of Indigenous well-being in schooling contexts. The final element of the research framework is utilisation which involves "applying the derived models and drivers to augment thriving in other Indigenous socio-cultural contexts". In this research, we build on the findings of Durmush et al. (2021) to evaluate a new multidimensional model of thriving and test its salience for Indigenous young people.

1.3. Capitalising on recent research with youth for developing models and measures of students' well-being

The general field of well-being research, particularly student well-being research, is plagued with challenges. Student well-being research suffers from a dearth in theoretical conceptualisations of the multidimensional nature and structure of student well-being despite that "it is critical that measurement tools take into consideration its multidimensional nature" (Organisation for Economic Co-operation & Development, 2017). Further, although there is currently no agreement about what exactly should be measured and how it should be measured for children and youth, research investigating well-being should capture a broad range of well-being indicators (Burns et al., 2022; Fabian & Pykett, 2022).

Recently, a small number of large-scale studies have examined young people's well-being, health behaviours, and social contexts. PISA developed a theoretical framework and measures of well-being for 15 year olds (Govorova et al., 2020) that included Academic (cognitive), Psychological, Social, and Physical well-being domains. We included these domains in our theorised model (Fig. 1), as four of the six domains in MSW. Similarly, the National Longitudinal Study of Adolescent to Adult Health (Harris et al., 2019) measures Grade 7–12 students' Psychological, Physical, and Social Wellbeing.

The Youth Risk Behavior Surveillance System (YRBSS) (Underwood et al., 2020) is the largest United States health surveillance system that measures high school students' health-risk behaviours. Measures include: sexual behaviours (Szucs et al., 2020), alcohol and other drug use (Jones et al., 2020), tobacco use (Creamer et al., 2020), dietary and physical activity behaviours (Merlo et al., 2020), and behaviours that contribute to unintentional injuries or violence (Basile et al., 2020). These aspects are reflected in our theorised model as Physical Well-being (see supplemental materials, Section 2, Table S2), which is represented by first-order factors of healthy lifestyle and physical activity to reflect constructs with positive affect.

The California Healthy Kids Survey (Austin et al., 2020) for Californian secondary students in Grades 7, 9, and 11 examines key indicators of "school climate and safety and student engagement, positive development, mental health, and risk behavior, particularly substance use" (foreword). Measures employed include academic motivation, school connectedness, school safety/bullying, substance use, and violence and weapons use. In our hypothesised model, academic

motivation, school connectedness, and school safety are reflected in the domain of Academic Well-being. Substance use and violence is reflected in the positive affect domain of Physical Well-being (see supplemental materials, Section 2, Table S2).

1.4. Towards a multidimensional model and measure of student well-being

We adopt a functional perspective of subjective well-being to embrace Indigenous worldviews, preferences, and Indigenous young people's perspectives of the importance of practical significance (Durmush et al., 2021). As such, in conceptualising and testing a model of well-being, we emphasise effective functioning in students' lives. That is, we conceptualise well-being beyond happiness (i.e., a purely hedonic perspective) and ill-being, which concurs with some other researchers (e.g., (Fredrickson & Kurtz, 2011)). We focus on domains that enable an individual to function effectively as a student and employ the positive psychology of Indigenous thriving (Craven et al., 2016).

In conceptualising students' effective functioning in school, we propose a multidimensional model in which each well-being first-order factor represents some potential facets of six higher-order well-being domains. Multiple factors measure each domain whereas each factor is measured by multiple survey items. The multiple well-being domains are clearly distinguishable from each other. The MSW instrument is also designed and hypothesised to be applicable to Indigenous and non-Indigenous, male and female, primary and secondary school students.

We propose a model with six higher order well-being domains relevant to school life: Academic, Psychological, Physical, Social, Cultural, and Self-belief (Fig. 1). Each of these higher order domains that are considered salient to Indigenous young people (see supplemental materials, Section 2, Table S1 for the literature that formed the basis of our conceptualisation) is represented by first-order constructs (see supplemental materials, Section 1 where each variable is defined).

1.5. The present investigation

The present investigation is a collaboration between our university research team and the New South Wales Department of Education (DoE). The focus of this study (including the selection of target students) came from government policymakers in the DoE. Given the lack of empirical research on well-being of high-achieving Indigenous students that they noted, DoE established a collaborative research program with our research team to identify drivers and barriers of student well-being for high-achieving Indigenous students in Years 4–9 (the last three years of primary school and the first three years of secondary school).

It is our thesis that a critical key to advancing student well-being research is addressing within-construct measurement issues, whereby the structure of hypothetical multidimensional student well-being constructs and their relation to potential correlates of student well-being are theorised and then tested. Testing involves instrumentation with demonstrated psychometrically sound properties, and then revising theory based on empirical research findings to ensure the appropriate scientific interplay between theory and research. In this article, we hypothesised a potential theoretical model of the multidimensional structure of student well-being for Indigenous and non-Indigenous students, and theorised its relation to potential correlates. The domains proposed are based on advances in theory, research, and practice stemming from: the PISA theoretical framework of well-being (Govorova et al., 2020); recent developments in measures of youth well-being; new insights into the nature of Indigenous well-being (e.g., Durmush et al., 2021); and research evidence underpinning a positive psychology strengths-based approach to Indigenous thriving (Craven et al., 2016; see supplemental materials and later discussion). We developed the MSW instrument to test the model of student well-being proposed and potential measures of correlates identified and tested with a sample of high-ability Indigenous and non-Indigenous Australian Year 4 to Year 10 students. Consistent with the wishes of our industry partner (DoE), high-ability students were chosen to serve as an exemplar of success to utilise the EMU research framework developed by Craven et al. (2016; see later discussion).

This research aimed to: (1) conceptualise Indigenous and non-Indigenous Australian school students' well-being as multidimensional in an Australian school education context, (2) design and test the psychometric properties of a measurement instrument for students' multidimensional well-being, (3) examine correlates of well-being domains so as to identify potential factors to facilitate specific aspects of students' well-being, and (4) identify the similarities and differences of well-being for Indigenous and non-Indigenous students.

2. Method

2.1. Participants

The present investigation is a synergistic collaboration between our university research team and the NSW Department of Education (DoE) with the aim of identifying drivers of academic success for Indigenous students. A total of 1,139 students from 245 schools in NSW (Indigenous, $N = 612$ and non-Indigenous, $N = 527$) participated at the first time-point (T1), 52 % females, aged between 9 and 16 years ($M = 12.31$, $SD = 1.65$). Details of the sampled students are given in supplemental materials (see Section 2, Table S3). Over three annual waves, we conducted surveys on psychosocial drivers of success for all participants at three time-points, 10–12 months apart (T1 in terms 3 and 4 in Year 1, T2 in terms 2 and 3 in Year 2, and T3 in term 3 of Year 3).

2.2. Procedure

DoE first identified a large sample of Indigenous students in 245 schools, using the National Assessment Program—Literacy and Numeracy (NAPLAN) test scores. NAPLAN is a nation-wide test designed to assess all Australian students in Years 3, 5, 7, and 9 in reading, writing, language conventions (spelling, grammar, and punctuation), and numeracy, which has been conducted annually since 2008. Indigenous students who scored within the top three of six bands in at least three of the NAPLAN tests were invited to participate in the study. DoE then selected a matched sample of non-Indigenous students based on their NAPLAN scores and matched by year-in-school, gender, and geographic location (typically the same school). Following university (Ref: 2014 340 N) and DoE ethics procedures (Ref: 2015358), consents were obtained from the schools and parents before each wave of data collection. In three successive years, with the participants' assent, we tested the achievement of all participants using a set of achievement tests developed by DoE for students in different stages of education, and used a set of survey instruments developed by the university research team to test the psychosocial drivers of success in school. Survey data were collected mostly online which was preferred by schools in remote locations except for some schools where printed survey forms were used.

2.3. Background information

Participants were asked to indicate their age, gender, Indigenous status, whether they currently resided in Australia, the state and post-code of their current residence, and the highest level of education they and their parents had attained.

2.4. Self-perceptions

In addition to background/demographic items, the survey comprised 48 items that formed 15 constructs under six well-being domains (see supplemental materials for all items, Section 2, Table S2). Responses for the 48 well-being items ranged from 1 (*strongly disagree*) to 6 (*strongly agree*). Full details of each well-being measure tested are provided in

Section 1 of the online supplemental materials.

2.5. Correlates of well-being

In addition to the well-being measures, at each of the three measurement points, students also responded to a set of psychological measures intended to test the convergent and discriminant validity of this study's 15 first-order student well-being factors. These included: maths self-concept, reading self-concept, and physical abilities self-concept measured with Self Description Questionnaire I (SDQ-I Brief version: (Marsh, 1992)); academic engagement measured using an adapted version of the Engagement and Aspirations scale (Yeung et al., 2011); school value, academic planning, academic persistence and anxiety measured using subscales from the Student Motivation and Engagement Scale (Martin, 2001); general engagement, measured with an adapted version of the PERMA Engagement subscale (Butler & Kern, 2016); life satisfaction, measured via the Student Life Satisfaction Scale (Huebner, 1991); school belonging, measured using a 4-item adapted version of the Relatedness Support subscale from the Basic Psychological Needs in General scale (Chen et al., 2015); physical activity, measured with a 4-item scale developed by the research team to assess one's level and enjoyment of physical activity; education thriving-family and education thriving-teacher, using 4-item scales that assess the extent to which one's family and teachers encourage and believe in the importance of their education; cultural respect measured with a 4-item scale developed by the research team; and growth mindset, measured using Theories of Intelligence Scale for Children—Self Form (ITISC – SF; Dweck, 1999). Responses for the correlates of student well-being also ranged from 1 (strongly disagree) to 6 (strongly agree). Please see supplemental materials, Section 1, for a full description of each correlate measured in this manuscript.

2.6. Statistical analyses

2.6.1. Structural validity

We verified the selected psychometric properties of each instrument via factor analysis and reliability indicators. Confirmatory factor analysis (CFA) was employed to test the factor structure of the data (Clarke, 2008). We employed Full Information Maximum Likelihood (FIML) procedures to handle item-level missing data present at each measurement point. FIML also enabled us to estimate longitudinal models using the responses from all participants that completed at least one wave of data. We first tested a 15-factor model to examine the factor structure of the hypothesised 15 well-being constructs (Model 1), and whether these 15 factors can be represented by the hypothesised six higher order factors (Model 2). These models were independently estimated at each of the three measurement points. Model fit was assessed by the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the Tucker-Lewis index (TLI). The chi-square test statistics are also reported. In general, values of CFI and TLI equal to or larger than .90 are considered an acceptable fit (Byrne, 2013). The value of RMSEA ranging between .05 and .08 is generally accepted as a close fit to a fair fit (Bowen & Guo, 2012). Factor loadings show the relations of each underlying construct (i.e., each well-being construct here) with each of the observed variables (i.e., the survey items). In order for an item to be kept in its corresponding factor without being altered or excluded, we considered .30 as a minimum for standardised loadings as suggested by Hair et al. (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014).

2.6.2. Measurement invariance

We tested for factor structure invariance (Model 3) separately across ethnicity (Indigenous and non-Indigenous students), gender (boys and girls), and level of schooling (primary and secondary) by employing the multigroup CFA procedures described by Byrne et al (1989). The baseline multigroup model involved no parameter constraints (configural invariance), the second model constrained factor loadings to be equal between groups (metric invariance), the third model constrained factor loadings and intercepts (scalar invariance) to be equal across groups, and the fourth model constrained factor loadings, intercepts, and uniqueness terms (strong invariance). We assessed measurement invariance by comparing the fit statistics of the models to the baseline model, and changes in CFI greater than .01 from one model to the next suggests that the more constrained model is not invariant (Cheung & Rensvold, 2002). These models were also estimated independently at each of the three waves of measurement.

2.6.3. Longitudinal measurement invariance

We tested measurement invariance across time through a series of three hierarchical models that imposed increasingly stringent restrictions: (a) configural invariance with no parameter constraints; (b) metric invariance, in which we constrained the factor loadings to be equal across time; and (c) scalar, invariance, where factor loadings and intercepts are set to be equal across time. As suggested by Cheung and Rensvold (2002), we assessed measurement invariance by comparing changes in CFI between each of the nested models to its immediate less restrictive model. Changes in CFI greater than .01 from one model to the next suggest that the more constrained model is not invariant.

2.6.4. Internal consistency

Internal consistency of the scores derived from each scale at each time-point was estimated by the omega coefficient (Flora, 2020; McDonald, 1999; Trizano-Hermosilla & Alvarado, 2016).

2.6.5. Convergent and discriminant validity: Multitrait-multimethod (MTMM) analysis over time (T1, T2, and T3 Data)

The MTMM paradigm (Campbell & Fiske, 1959) is a standard approach for testing convergent and discriminant validity. In this initial MTMM analysis, we assessed convergent and discriminant validity of the 15 well-being factors examined in relation to temporal stability over time, as emphasised by Campbell and O'Connell (Campbell & O'Connell, 1967) who specifically operationalised the multiple methods in their MTMM paradigm as multiple occasions (also see Marsh et al., 2005, 2010, (Marsh et al., 2019)). Tests of discriminant validity are based on comparing these stability coefficients (correlations of these same constructs over time, convergent validities in relation to this MTMM design) with correlations among the different traits. Although the design might be considered weak when providing support for convergence based on maximally different methods (e.g., multiple respondents—self, peer; multiple instruments designed to measure the same traits), it provides a "best case" test in relation to discriminant validity. Thus, if there is no support for discriminant validity in relation to convergent validities based on time as the method factor, support for discriminant validity is unlikely to be found with other, more demanding tests of convergent validity. Marsh et al. (2010) demonstrated new and evolving latent-variable approaches that allow convergent and discriminant validity to be assessed using the traditional Campbell and Fiske (1959) criteria (the original and most widely used basis of assessing MTMM data) while still overcoming subsequent criticisms of these criteria. However, we also extended these analyses with tests of convergent and discriminant validity in relation to external criteria.

2.6.6. Multilevel modelling using longitudinal data

We used longitudinal data to examine main and interaction effects involving Indigenous status, gender and age (linear and quadratic, as time indicators) using mixed effects models in R version 4.0.3 (R Core Team, 2021) using the lme4 package (Bates et al., 2015). We used T1-T3 factor scores from the scalar invariance model to employ multilevel models with student well-being as an outcome and examined whether that varies as a function of the individual and gender, adjusting for clustering as well as demographics. As fixed effects, we entered students'

demographic variables (i.e., Indigenous status, gender and age) in each model. Then, as random effects, we examined variations in the outcome variables as a function of within-subject variability (cluster). We defined effect sizes as: >0.1 (weak), >0.3 (moderate), and >0.5 (strong) (Cohen, 2013).

2.6.7. Convergent and discriminant validity: Relations with other constructs

Extending MTMM analyses based on temporal stability, we assessed convergent and discriminant validity of the 15 well-being factors proposed in this study by examining their relations with the 16 selected correlates described previously (see Fig. 1) based on Time 1 responses. In this step, we further explored convergent validity by contrasting the relations between the 15 well-being factors and the 16 correlates with a priori predictions from field experts. In order to do this, part of the authorship team rated each of the 240 correlations as "high positive (HP)", "low positive (L)", "zero (Z)" or "negative (N)". These a priori predictions are reported based on an overall agreement for each correlation examined (i.e., most voted rating and its percentage of agreement). For example, a correlation that was blind guessed to be high positive among all raters is presented as HP (1.0), whereas if the same prediction was made by three out of four raters, it would be reported as HP (0.75), and so forth.

Link to the data and R code, along with the code book, used in this paper https://osf.io/xkj6u/.

3. Results

3.1. Descriptive statistics and reliabilities

Table S4 (see online supplemental materials, Section 2) summarises the means, standard deviations, and reliabilities of the well-being constructs, as well as the correlate variables, examined. The omega values ranged from .72 to .94 among the 15 well-being factors, suggesting high internal consistency for each factor. The investigated correlates also showed high internal consistency values (Ω = 0.72 to 0.94). The means were all above the midpoint of the scale, showing that the participants had generally high levels of well-being. Family support had the highest mean across all three time-points (at T1 $M = 5.48$, $SD = 0.80$, at T2 $M = 5.39$, $SD = 0.85$, and at T3 $M = 5.30$, $SD = 0.87$), while cultural cognitive identity was the lowest at T1 ($M = 4.52$, $SD = 1.18$), at T2 ($M = 4.35$, $SD = 1.26$), and T3 ($M = 4.25$, $SD = 1.29$).

We also examined differences between Indigenous and non-Indigenous students, by comparing the latent means of all variables in the study using the T1 factor structure (see Table S4). In terms of well-being constructs, non-Indigenous students had statistically higher scores in school competence ($d = -0.12$, 95 % CI [−0.24, −0.01]) and self-efficacy ($d = -0.15$, 95 % CI [−0.27, −0.03]), whereas cultural cognitive identity was higher for Indigenous students ($d = 0.33$, 95 % CI [0.21, 0.44]). Among the correlates, differences were found in physical self-concept ($d = 0.12$, 95 % CI [0.00, 0.23]) and cultural respect ($d = 0.28$, 95 % CI [0.17, 0.40]) in favour of Indigenous students, while non-Indigenous students scored significantly higher in maths self-concept ($d = -0.12$, 95 % CI [−0.24, −0.00]), life satisfaction ($d = -0.15$, 95 % CI [−0.27, −0.04]), and growth mindset ($d = -0.19$, 95 % CI [−0.31, −0.07]).

3.2. Confirmatory factor analysis

A series of hierarchical CFA models were tested (see Section 2, Table S5 in online supplemental material). The data showed satisfactory fit to the hypothesised models at each of the three measurement points. Model 1 testing a 15-factor model showed an acceptable fit supporting the multiple domains of well-being (for example, Model 1 at T1: CFI = 0.963, TLI = 0.957, RMSEA = 0.037). Model 2 testing a higher order structure also showed an acceptable fit (e.g., Model 2 at T1: CFI = 0.951, TLI = 0.948, RMSEA = 0.041). The difference in fit indices between Models 1 and 2 was trivial, supporting the hypothesised structure of six well-being domains representing 15 specific well-being constructs (see supplemental material Section 2, Table S5, for a summary of the goodness-of-fit statistics of each model tested).

Standardised item-factor loadings and uniqueness associated with each of the 48 items in the questionnaire are presented in Table S6 in online supplemental material. Overall, items demonstrated acceptable loadings (>0.50), and the combination of fit and loadings suggest that the selected items were good indicators of the latent variables. The lowest item-factor loading was found for item 37 (Resilience – "I am good at dealing with setbacks").

3.3. Tests of factorial invariance

We conducted measurement invariance testing in two steps. Step 1 involved multi-group tests of invariance at T1, T2, and T3 separately, to determine whether the factor structure was invariant across two ethnic groups (Indigenous vs non-Indigenous), two gender groups (boys vs girls), and two grade groups (primary vs secondary). In Step 2, we examined whether the factor structure was invariant across time. Results of the analyses in Step 1 showed the 15-factor structure to be invariant regardless of the students' ethnicity, gender, or school grade, evidenced in the negligible difference between each level of the invariance tests (change in CFI < .01 and in RMSEA < 0.015), according to Cheung & Rensvold (2002). When considering factorial validity across time (Step 2), there was evidence of configural, metric, scalar, and strict invariance as all $\Delta\chi 2$ were non-significant ($p > .05$) and all ΔCFI were < 0.01, as can be seen at the bottom of Table S7 in supplemental material.

3.4. Convergent and discriminant validity in relation to time: MTMM analyses

Test-retest correlations showing evidence of convergent and discriminant validity among the 15 well-being factors at T1, T2 and T3 are reported at the top of Table 1. Convergent validity in relation to time is strongly supported as evidenced by the correlations between matching T1 and T2 factors (0.49 to 0.74, $M\,r = 0.64$), between matching T1 and T3 factors (0.42 to 0.68, $M\,r = 0.53$), as well as between matching T2 and T3 factors (0.50 to 0.69, $M\,r = 0.60$).

In order to establish discriminant validity, convergent validities (correlations shaded in grey in Table 1) are compared to other correlations in the MTMM matrix. This is, correlations among different constructs at T1 (0.21 to 0.82, $M\,r = 0.53$), at T2 (0.16 to 0.83, $M\,r = 0.51$), at T3 (0.22 to 0.84, $M\,r = 53$); and correlations between T1 and T2 non-matching factors (0.15 to 0.64, $M\,r = 0.40$), between T1 and T3 non-matching factors (0.11 to 0.60, $M\,r = 0.34$), as well as between T2 and T3 non-matching factors (0.06 to 0.58, $M\,r = 0.34$). Overall, the data largely supported discriminant validity of each measure based on the MTMM analysis.

3.5. Main and interaction effects involving Indigenous status, gender, and age

3.5.1. Indigenous status

Estimates of the Indigenous status effects on the well-being constructs are provided in Table 2. Indigenous status had a weak-to-moderate effect on school affect ($b = 0.16$ [0.03, 0.29]), school cognitive ($b = 0.20$ [0.08, 0.31]), as well as self-efficacy ($b = 0.13$ [0.03, 0.23]), and an expected moderate effect on cultural identity cognitive ($b = -0.35$ [−0.48, −0.23])0.322.

3.5.2. Gender

Gender had an effect on students' school affect ($b = 0.16$ [0.03, 0.29]), healthy lifestyle ($b = 0.11$ [0.01, 0.21]), perceived teacher support ($b = 0.14$ [0.01, 0.27]), perceived peer support ($b = 0.22$ [0.09, 0.35]), and cultural identity cognitive ($b = 0.14$ [0.02, 0.26]), as shown

Table 1
Test–Retest Correlations among 15 Well-being Factors: A Multitrait-Multimethod (MTMM) Matrix Using T1, T2 and T3 Data.

Latent factors	SA	SC	OP	PE	HL	VI	FS	CS	TS	PS	CA	CC	SW	SE	RE
Correlations between Time 1 and 2 wellbeing constructs: Convergent validity in diagonal (shaded), heterotrait-heteromethod correlation in off-diagonals															
School affective (SA)	.62	.54	.45	.45	.38	.40	.33	.35	.41	.23	.34	.33	.42	.49	.43
School cognitive (SC)	.54	.64	.45	.42	.36	.37	.31	.30	.32	.18	.37	.30	.42	.55	.46
Optimism (OP)	.48	.47	.63	.54	.45	.48	.49	.50	.45	.30	.30	.35	.60	.57	.46
Positive emotions (PE)	.45	.45	.55	.60	.43	.54	.49	.47	.43	.25	.21	.35	.59	.51	.45
Healthy lifestyle (HL)	.44	.44	.50	.51	.71	.64	.46	.49	.43	.29	.27	.37	.49	.50	.40
Vitality (VI)	.42	.41	.54	.58	.59	.73	.50	.49	.44	.26	.19	.34	.57	.47	.43
Family support (FS)	.37	.34	.47	.46	.39	.46	.64	.45	.41	.23	.28	.33	.46	.39	.30
Community support (CS)	.42	.39	.49	.49	.44	.50	.46	.58	.50	.31	.31	.41	.47	.46	.36
Teacher support (TS)	.49	.40	.43	.44	.35	.42	.39	.46	.60	.37	.23	.32	.45	.42	.40
Peer support (PS)	.31	.23	.37	.36	.25	.33	.30	.33	.36	.49	.15	.34	.30	.27	.25
Cultural identity affective (CA)	.38	.30	.28	.30	.20	.18	.22	.24	.23	.15	.68	.23	.27	.26	.28
Cultural identity cognitive (CC)	.35	.26	.35	.34	.32	.34	.34	.42	.33	.24	.29	.72	.37	.31	.31
Self-worth (SW)	.42	.42	.56	.54	.45	.50	.51	.47	.40	.25	.23	.36	.67	.53	.47
Self-efficacy (SE)	.52	.58	.51	.49	.45	.47	.43	.40	.37	.25	.33	.34	.57	.64	.48
Resilience (RE)	.46	.48	.53	.52	.44	.51	.40	.39	.43	.30	.22	.38	.56	.52	.63
Correlations between Time 1 and 3 wellbeing constructs: Convergent validity in diagonal (shaded), heterotrait-heteromethod correlation in off-diagonals															
School affective (SA)	.53	.41	.37	.38	.37	.31	.27	.26	.38	.22	.35	.26	.39	.42	.32
School cognitive (SC)	.55	.56	.40	.36	.38	.35	.32	.23	.37	.13	.33	.27	.43	.50	.35
Optimism (OP)	.41	.36	.52	.43	.44	.40	.43	.30	.38	.22	.28	.30	.54	.46	.32
Positive emotions (PE)	.40	.35	.46	.49	.40	.45	.42	.33	.39	.19	.29	.30	.54	.43	.39
Healthy lifestyle (HL)	.37	.34	.49	.45	.68	.60	.45	.36	.39	.27	.21	.29	.49	.46	.36
Vitality (VI)	.39	.38	.54	.47	.51	.62	.41	.35	.41	.24	.23	.33	.58	.48	.38
Family support (FS)	.33	.27	.45	.43	.37	.40	.54	.37	.42	.29	.27	.34	.47	.34	.32
Community support (CS)	.35	.28	.49	.44	.36	.43	.40	.44	.41	.27	.24	.32	.44	.34	.31
Teacher support (TS)	.32	.26	.29	.25	.26	.28	.27	.33	.42	.21	.24	.21	.30	.26	.21

(*continued on next page*)

Table 1 (*continued*)

Peer support (PS)	.29	.15	.30	.30	.32	.34	.31	.26	.37	.44	.15	.20	.27	.24	.31
Cultural identity affective (CA)	.36	.23	.26	.23	.23	.16	.22	.18	.30	.11	.57	.23	.20	.23	.18
Cultural identity cognitive (CC)	.22	.17	.30	.26	.29	.29	.30	.26	.36	.24	.27	.59	.28	.19	.25
Self-worth (SW)	.39	.34	.46	.42	.42	.42	.45	.33	.41	.24	.23	.31	.57	.46	.36
Self-efficacy (SE)	.45	.43	.43	.37	.42	.37	.36	.28	.37	.15	.31	.32	.47	.49	.35
Resilience (RE)	.39	.33	.44	.40	.39	.44	.38	.33	.42	.24	.20	.29	.49	.39	.42
Correlations between Time 2 and 3 wellbeing constructs: Convergent validity in diagonal (shaded), heterotrait-heteromethod correlation in off-diagonals															
School affective (SA)	.62	.44	.38	.37	.31	.38	.27	.29	.40	.22	.31	.26	.36	.42	.40
School cognitive (SC)	.58	.60	.49	.44	.31	.39	.35	.33	.36	.13	.31	.27	.48	.58	.43
Optimism (OP)	.45	.37	.56	.49	.42	.45	.47	.39	.44	.23	.20	.25	.56	.50	.43
Positive emotions (PE)	.40	.32	.49	.55	.41	.49	.43	.43	.38	.31	.17	.30	.53	.45	.44
Healthy lifestyle (HL)	.38	.32	.44	.41	.68	.57	.39	.40	.34	.27	.14	.30	.46	.41	.39
Vitality (VI)	.43	.32	.47	.49	.52	.62	.38	.42	.37	.25	.15	.37	.52	.43	.45
Family support (FS)	.31	.27	.48	.39	.34	.40	.57	.41	.40	.27	.20	.30	.43	.32	.30
Community support (CS)	.37	.24	.41	.42	.34	.40	.37	.57	.42	.35	.19	.39	.39	.35	.31
Teacher support (TS)	.37	.23	.33	.29	.28	.32	.27	.34	.52	.22	.14	.23	.32	.26	.28
Peer support (PS)	.25	.19	.23	.25	.26	.26	.21	.25	.27	.49	.13	.20	.22	.14	.24
Cultural identity affective (CA)	.32	.28	.18	.14	.16	.09	.15	.12	.18	.10	.63	.16	.14	.16	.06
Cultural identity cognitive (CC)	.24	.12	.28	.28	.28	.28	.31	.34	.29	.29	.20	.66	.28	.23	.20
Self-worth (SW)	.42	.35	.52	.51	.45	.49	.45	.42	.41	.24	.16	.36	.61	.49	.46
Self-efficacy (SE)	.46	.49	.50	.47	.40	.43	.39	.39	.39	.20	.24	.32	.56	.60	.39
Resilience (RE)	.44	.39	.53	.49	.40	.50	.38	.45	.39	.27	.12	.29	.56	.44	.68

(*continued on next page*)

Table 1 (*continued*)

Latent factors	SA	SC	OP	PE	HL	VI	FS	CS	TS	PS	CA	CC	SW	SE	RE
Correlations among Time 1 (below diagonal) and Time 2 (above diagonal) factors: Heterotrait-monomethod correlations															
School affective (SA)	1	.82	.56	.58	.43	.50	.38	.44	.58	.36	.40	.38	.51	.63	.62
School cognitive (SC)	.80	1	.59	.55	.43	.46	.34	.37	.48	.28	.38	.31	.55	.77	.64
Optimism (OP)	.63	.60	1	.77	.63	.71	.64	.60	.55	.44	.31	.45	.82	.74	.67
Positive emotions (PE)	.61	.56	.81	1	.56	.73	.64	.62	.56	.47	.26	.45	.83	.70	.74
Healthy lifestyle (HL)	.54	.54	.67	.63	1	.81	.48	.51	.42	.36	.24	.39	.57	.52	.54
Vitality (VI)	.54	.55	.77	.74	.82	1	.57	.56	.51	.40	.16	.43	.70	.58	.66
Family support (FS)	.42	.40	.64	.64	.54	.61	1	.63	.45	.37	.27	.40	.64	.51	.47
Community support (CS)	.47	.38	.59	.60	.54	.57	.63	1	.61	.51	.26	.48	.58	.54	.55
Teacher support (TS)	.60	.47	.62	.62	.53	.55	.54	.61	1	.49	.27	.44	.54	.52	.57
Peer support (PS)	.39	.28	.41	.43	.38	.36	.32	.43	.46	1	.17	.40	.41	.37	.45
Cultural identity affective (CA)	.45	.40	.39	.37	.34	.30	.34	.38	.34	.21	1	.37	.26	.35	.28
Cultural identity cognitive (CC)	.43	.36	.49	.44	.42	.43	.42	.51	.42	.36	.47	1	.44	.40	.47
Self-worth (SW)	.55	.54	.80	.80	.61	.71	.64	.57	.56	.37	.37	.45	1	.79	.72
Self-efficacy (SE)	.68	.77	.74	.71	.63	.64	.58	.53	.56	.42	.40	.43	.80	1	.68
Resilience (RE)	.55	.57	.62	.65	.55	.59	.45	.50	.51	.40	.34	.45	.65	.64	1
Correlations among Time 3 factors: Heterotrait-monomethod correlations															
School affective (SA)	1														
School cognitive (SC)	.80	1													
Optimism (OP)	.59	.67	1												
Positive emotions (PE)	.57	.58	.81	1											
Healthy lifestyle (HL)	.49	.51	.67	.66	1										
Vitality (VI)	.53	.55	.72	.74	.84	1									
Family support (FS)	.40	.41	.64	.63	.51	.56	1								
Community support (CS)	.48	.44	.61	.61	.51	.56	.62	1							
Teacher support (TS)	.57	.51	.57	.57	.46	.48	.53	.57	1						
Peer support (PS)	.29	.24	.34	.36	.37	.37	.38	.43	.35	1					
Cultural identity affective (CA)	.46	.44	.41	.33	.26	.25	.30	.31	.31	.22	1				
Cultural identity cognitive (CC)	.34	.31	.48	.47	.41	.46	.46	.56	.41	.30	.37	1			
Self-worth (SW)	.55	.56	.81	.84	.69	.78	.65	.60	.57	.31	.31	.46	1		
Self-efficacy (SE)	.65	.76	.78	.74	.62	.66	.53	.54	.56	.29	.48	.44	.84	1	
Resilience (RE)	.54	.63	.74	.75	.63	.71	.53	.57	.56	.37	.23	.42	.77	.71	1

Note. Correlations based on a CFA with 144 items and 45 factors. Model Fit Indices: CFI = 0.931, TLI = 0.923, RMSEA = 0.024, SRMR = 0.039. Shading represents higher-order factor.

Table 2
Main Effects Involving Indigenous Status, Gender, and Age.

Well-being constructs	Indigenous status		Gender		Age		Age–squared	
	b	95 % CI	*b*	95 % CI	*b*	95 % CI	*b*	95 % CI
School affect	**0.16***	0.03 to 0.29	**0.16***	0.03 to 0.29	**−0.27***	−0.34 to −0.20	−0.02	−0.06 to 0.01
School cognitive	**0.20***	0.08 to 0.31	0.07	−0.05 to 0.18	**−0.23***	−0.29 to −0.17	**−0.04***	−0.04 to −0.01
Optimism	0.07	−0.03 to 0.17	−0.03	−0.13 to 0.07	**−0.27***	−0.32 to −0.21	**−0.05***	−0.07 to −0.02
Positive emotions	0.04	−0.09 to 0.17	−0.08	−0.20 to 0.05	**−0.28***	−0.36 to −0.22	−0.05	−0.09 to −0.02
Healthy lifestyle	0.10	−0.01 to 0.20	**0.11***	0.01 to 0.21	**−0.21***	−0.26 to −0.16	**−0.03***	−0.06 to −0.01
Vitality	0.06	−0.06 to 0.18	−0.07	−0.19 to 0.05	**−0.28***	−0.34 to −0.21	**−0.05***	−0.09 to −0.02
Family support	0.07	−0.04 to 0.18	−0.03	−0.14 to 0.08	**−0.25***	−0.30 to −0.19	**−0.06***	−0.10 to −0.03
Community support	0.02	−0.11 to 0.16	0.07	−0.06 to 0.21	**−0.28***	−0.35 to 0.20	−0.03	−0.07 to 0.01
Teacher support	0.05	−0.08 to 0.18	**0.14***	0.01 to 0.27	**−0.29***	−0.36 to −0.21	0.03	−0.01 to 0.07
Peer support	0.02	−0.11 to 0.15	**0.22***	0.09 to 0.35	**−0.21***	−0.28 to −0.13	0.00	−0.04 to 0.04
Cultural identity affective	−0.02	−0.14 to 0.10	**0.14***	0.02 to 0.26	**−0.19***	−0.25 to −0.13	**−0.06***	−0.09 to −0.03
Cultural identity cognitive	**−0.35***	−0.48 to −0.23	0.05	−0.08 to 0.17	**−0.21***	−0.28 to −0.14	**−0.06***	−0.09 to −0.02
Self-worth	0.03	−0.08 to 0.13	−0.09	−0.08 to 0.13	**−0.23***	−0.29 to −0.18	**−0.05***	−0.08 to −0.02
Self-efficacy	**0.13***	0.03 to 0.23	0.05	−0.04 to 0.15	**−0.17***	−0.22 to −0.12	**−0.04***	−0.07 to −0.01
Resilience	0.05	−0.02 to 0.13	0.00	−0.08 to 0.07	**−0.16***	−0.20 to −0.12	**−0.03***	−0.06 to −0.01

Note. Standardised regression coefficients of the effects of Indigenous status, gender, and age on the 15 wellbeing factors; 95 % CI = 95 % Confidence interval. Significant effect ($p < .05$).

in Table 2.

3.5.3. Age (Linear and quadratic Effects)

As seen in Table 2, age had a negative effect on all 15 well-being constructs examined ($b = -0.29$ to $b = -0.16$). The quadratic effect of age was significant on 10 of the 15 well-being constructs: school cognitive ($b = -0.04$ [−0.04, −0.01]), optimism ($b = -0.05$ [−0.07, −0.02]), healthy lifestyle ($b = -0.03$ [−0.06, −0.01]), vitality ($b = -0.05$ [−0.09, −0.02]), family support ($b = -0.06$ [−0.10, −0.03]), cultural identity affective ($b = -0.06$ [−0.9, −0.03]), cultural identity cognitive ($b = -0.06$ [−0.09, −0.02]), self-worth ($b = -0.05$ [−0.08, −0.02]), self-efficacy ($b = -0.04$ [−0.07, −0.01]), and resilience ($b = -0.03$ [−0.06, −0.01]).

We found significant quadratic effects of age on students' school cognitive, optimism, healthy lifestyle, vitality, perceptions of support from their families, cultural identity affective, cultural identity cognitive, self-worth, self-efficacy, and resilience. The analysis consistently showed that as students grew older, these effects weakened. We also looked at other potentially interesting effects involving age (both linear and quadratic) and Indigenous status as a function of gender; however, no significant effects were found.

3.6. Convergent and discriminant validity in relation to other constructs: Correlates of student well-being

In order to examine convergent and discriminant validity in relation to other constructs, we explored the correlations involving the 15 well-being constructs and 16 correlates of student well-being. The results displayed in Table 3 are derived from a large CFA with 112 items and 31 factors based on the T1 factor structure. With a few exceptions, all the 240 correlations summarised in Table 3 were logical and in the expected direction. Overall, the results suggest that all six well-being domains are associated with general engagement opportunities ($r = 0.39$ to 0.88) and a sense of school belonging ($r = 0.44$ to 0.92). In line with a priori predictions, academic well-being is also associated with reading self-concept ($r = 0.71$). Physical activity has the greatest association with physical well-being (healthy lifestyle $r = 0.91$, and vitality $r = 0.80$, both of which were predicted by field experts). Social well-being is associated with a sense of school belonging (community support $r = 0.69$ (which was predicted to be lower), teacher support $r = 0.92$, and peer support $r = 0.52$) together with family thriving (family support $r = 0.78$), which was also predicted to be lower. As expected, cultural respect is associated with cultural well-being (cultural identity cognitive $r = 0.83$ and cultural identity affective $r = 0.49$). Finally, apart from general engagement and school belonging, self well-being is also associated with life satisfaction (self-worth $r = 0.75$, self-efficacy $r = 0.65$) as well as by reducing students' anxiety ($r = -0.50$), as predicted by the majority of our team.

4. Discussion

The present study attempted to answer three RQs. Hence our findings are presented around these RQs below.

4.1. RQ1. Measuring six domains of student well-being

The series of CFAs supported a 15-factor model (Model 1) with the respective hypothesised factors represented by six higher-order factors (Model 2), indicating the structure of six domains of well-being for this sample. The acceptable fit of the models and the logical correlations among the measured variables supported the six domains of well-being as distinct although correlated. This empirically established support for the multiple well-being domains is important for assessing the well-being of student samples, which is lacking in well-being research.

The series of invariance tests were also important for confirming the value of the model and the instrument for comparing different student samples. With established invariance of the instrument for different groups (e.g., ethnicity: Indigenous vs. non-Indigenous; gender: boys vs. girls; grade-level: primary vs. secondary), we can confidently compare the well-being perceptions of these groups. In addition to the usefulness for group comparisons, the established invariance between time-points also added a significantly important value of the instrument as a tool for assessing change of well-being over time and the degree to which educators are responsive to students' needs. This is of particular value to educators who can capitalise on the model and the instrument to ensure that the school experience is responsive to Indigenous students. Too often, the educational system has framed failures of Indigenous students to engage in schooling as a problem to be fixed. Abandoning the deficit perspective for Indigenous students, we advocate that the school system and its educators need to adapt to and accommodate Indigenous students (Krakouer, 2016) to meet their needs more appropriately. Well-being, conceptualised as hierarchical and multidimensional, is of particular value in a practical sense because it enables us to identify exactly which specific domain and which specific well-being facet of a student may need attention.

4.2. RQ2. Correlates of the student well-being domains

All six well-being domains are highly correlated with general engagement opportunities ($r = 0.39$ to 0.88) and a sense of school

Table 3
Correlates of Indigenous and non-Indigenous Student Well-being Using T1 Factor Structure.

	Wellbeing constructs														
	Academic Well-being		Psychological Well-being		Physical Well-being		Social Well-being				Cultural Well-being		Self-belief Well-being		
Wellbeing correlates	School affective	School cognitive	Optimism	Positive emotions	Healthy lifestyle	Vitality	Family support	Community support	Teacher support	Peer support	Cultural identity affective	Cultural identity cognitive	Self-worth	Self-efficacy	Resilience
Academic															
Maths self-concept	.54	**.69**	.44	.40	.37	.40	.34	.28	.31	.14	.28	.27	.43	.55	.43
Reading self-concept	.61	**.71**	.45	.40	.43	.39	.32	.30	.42	.22	.31	.35	.42	.55	.42
Academic engagement	**.70**	.64	.62	.62	.60	.59	.51	.51	.68	.38	.39	.45	.56	.62	.68
School value	**.67**	.57	.63	.59	.54	.59	.51	.51	.66	.34	.45	.43	.53	.60	.53
Academic planning	**.55**	.48	.48	.46	.52	.49	.40	.44	.53	.37	.37	.38	.44	.53	.53
Academic persistence	**.64**	.61	.55	.55	.58	.53	.44	.48	.58	.36	.46	.36	.50	.62	.60
Non-academic															
General engagement	.66	.62	.78	**.88**	.61	.67	.61	.58	.60	.39	.43	.41	.69	.73	.61
Life satisfaction	.51	.49	**.77**	.75	.63	.68	.69	.56	.53	.38	.33	.39	.75	.65	.55

(*continued on next page*)

Table 3 (*continued*)

Physical self-concept	.39	.41	.50	.47	.68	**.70**	.44	.46	.40	.30	.23	.43	.51	.46	.46
Physical activity	.48	.46	.60	.55	**.91**	.80	.47	.49	.47	.36	.32	.42	.55	.53	.50
Cultural respect	.44	.38	.52	.49	.47	.48	.49	.58	.53	.42	.49	**.83**	.53	.47	.50
School-related															
School belonging	.66	.54	.70	.71	.59	.61	.60	.69	**.92**	.52	.44	.50	.65	.63	.59
Education thriving family	.42	.43	.51	.48	.43	.43	**.78**	.51	.42	.27	.38	.35	.47	.54	.37
Education thriving teacher	.54	.45	.57	.56	.49	.50	.51	.52	**.85**	.41	.39	.37	.52	.52	.47
Growth mindset	-.06	-.06	-.06	-.05	-.04	-.10	-.05	-.08	**-.14**	-.09	.08	-.12	-.05	-.04	-.05
Anxiety	-.15	-.19	-.22	-.25	-.18	-.23	-.16	-.14	-.11	-.04	-.01	-.19	-.30	-.22	**-.50**

Note. Correlations based on a large CFA with 112 items and 31 factors based on the T1 factor structure. Model Fit Indices: CFI = 0.925, TLI = 0.917, RMSEA = 0.034, SRMR = 0.035. The three levels of shading highlight the a priori predictions made by the authors. Darker 35 % = 'High Positive', Darker 25 % = 'Low Positive', Darker 15 % = 'Zero', Blank = 'Negative'. The highest correlation for each row and column is highlighted in bold for ease of interpretation.

belonging ($r = 0.44$ to 0.92), suggesting that all the well-being domains are associated with providing students with general engagement opportunities and fostering a sense of school belonging. Academic well-being is also associated with enhancing reading self-concept, given the importance reading has to any academic work. Physical well-being is associated with physical activity. Social well-being is mostly associated with school belonging. Cultural respect is associated with cultural well-being. Self-belief well-being is associated with life satisfaction, students' general engagement, a sense of school belonging, and lower anxiety. These results suggest that no teacher is wasting their time in targeting correlates of specific domains of students' well-being.

4.3. RQ3. Similarities and differences of Indigenous and non-Indigenous students' well-being and correlates

The established invariance of the latent variables across Indigenous and non-Indigenous subsamples allows a direct comparison of the mean scores of these variables. Examining T1 data (supplemental materials, Section 2, Table S4), Indigenous students were relatively lower in School Competence and Self-efficacy but higher in Cultural Cognitive Identity. For the correlates of well-being, differences were also found, indicating Indigenous students were higher for Physical Self-concept and Cultural Respect, but had lower scores compared to non-Indigenous students in relation to Maths Self-concept, Life Satisfaction, and Growth Mindset. Overall, it seems that Indigenous students tend to enjoy higher well-being in Physical and Cultural domains, but not as much in Academic and Self domains as their non-Indigenous counterparts whereas

Indigenous and non-Indigenous students are mostly similar in Psychological and Social well-being domains. However, similar across Indigenous and non-Indigenous students is an apparent trend of declining well-being across time-points for all well-being constructs (e.g., T1-T3 Optimism = 5.05, 4.90, 4.76; T1-T3 Teacher Support = 4.74, 4.60, 4.48; T1-T3 Resilience = 4.78, 4.68, 4.54). This apparently downward trend is worrisome and calls for attention to students' well-being for a healthy development throughout school life and beyond. In fact, Indigenous and non-Indigenous students seemed to be very similar in most of the well-being constructs (see supplemental materials, Section 2, Table S4).

4.4. Contribution to the well-being literature

While there is an increasing attention to human well-being (Marsh, Huppert, Donald, Horwood, & Sahdra, 2020; Organisation for Economic Co-operation & Development, 2017), there is a lack of understanding of school students' well-being. In response to this concern, our study has contributed to the conceptualisation and measurement of well-being for students in general, and Indigenous Australian students in particular. The hierarchical, multidimensional model generated from this research provides a solid basis for schools to create a psychologically healthy and stimulating environment for students to thrive (Allen, Furlong, Vella-Brodrick, & Suldo, 2022; Furlong et al., 2013). The model provides a framework for educators to identify specific areas where students need support (Dillon et al., 2020), and directly attend to Indigenous students' needs in terms of well-being (Durmush et al., 2021).

4.5. Strengths, limitations, and future directions

4.5.1. Strengths and practical contributions

The consistency of patterns among the multiple well-being constructs, the logic of associations across the higher-order domains, and the logical associations of correlates with each dimension have evidenced the rigor of the model. The invariance tests not only added to the strength of the measurement across sub-samples and time-points, but also evidence the model's applicability, which can be generalised across student populations. The group comparisons have demonstrated that schools can use the model to identify student well-being issues and make informed decisions for improvement.

The research design for this research is robust. It used a large sample size (Indigenous, $N = 764$; Non-Indigenous, $N = 641$), and had three timewaves of data from 245 schools (both primary and secondary). The research also includes a rare study of school well-being for primary-aged students. The survey instrument used comprises 48 items, is psychometrically strong, and theoretically sound. With regard to psychometric properties, the findings of this research show that the factors of the survey instrument have satisfactory reliability and good test–retest correlation. Support for construct validity was attained by establishing structural validity as well as convergent and divergent validity. Further, invariance testing showed factor structure to be invariant across time for gender, Indigenous status, and school grade. These results mean that the survey instrument can be used confidently for males and females, Indigenous and non-Indigenous students, between the ages of 9 and 16 years. The strong psychometric properties of the survey MSW instrument assure that research questions posed in relation to student well-being can be answered reliably.

To educators, the finding showing the significance of providing general engagement opportunities and fostering a sense of belonging gives a direction for schools to promote all six domains of well-being in general. Apart from well-being in a general sense, the findings of the most relevant correlates to each well-being domain enable us to put appropriate focus on the best strategy to facilitate a specific domain. For example, to enhance academic well-being, teachers can consider reinforcing reading self-concept; to enhance physical well-being, we may strengthen physical activity opportunities; to enhance cultural well-being, we may consider ways to promote cultural respect and intercultural knowledge, especially within a multicultural school environment. In sum, the research has contributed to the theory of student well-being and the practice to improve it.

4.5.2. Limitations and future directions

The findings of this research are promising and can be strengthened by identifying areas for improvement. A limited number of higher order domains were hypothesised for student well-being informed by some of the available advances in theory and research (see Fig. 1 and supplemental materials). Future research may identify additional important well-being domains for schooling contexts.

A limited number of first-order constructs were identified to reflect at least some aspects of the higher order well-being domains. Hence the limited number of constructs cannot fully reflect the complexity of each higher order domain of well-being. Future research may consider more thoroughly attending to within-construct issues pertaining to each higher order latent domain of well-being.

Australian Indigenous people are a diverse group. Due to inadequate government responses and historical injustices, Indigenous students, on average, have poorer literacy skills. While this study used matched samples of students above-average in academic achievement, Indigenous students with poorer literacy may not be able to complete the survey in the written format. Therefore, future research should consider administering the test orally or with aural input, at least to some subsamples. Given the diversity among Indigenous students, it would be beneficial in terms of establishing external validity, to engage more Indigenous students from remote and other parts of Australia to test its generalisability to diverse Indigenous populations in Australia.

Our broad classification of Indigenous vs. non-Indigenous students is also a limitation. Mooney et al. (2016) recommend that education should be inclusive and respect Aboriginal students' identity and culture for them to move between Western and Indigenous cultures and gain skills necessary to live in a global world. However, for a multi-cultural society like Australia, this recommendation applies not only to Indigenous Australians, but also to other minority cultures, for whom we have broadly defined here as non-Indigenous, which may be overly simplistic.

Considering respect for minority cultures, contemporary views go beyond non-discrimination. As McDougall (2008) emphasizes, respect requires some affirmative action. Hence while schools need to be proactive in promoting harmony by embracing cultural identity and diversity to facilitate cultural well-being (also see Waldron, 1992), the affirmative actions need to be taken with careful consideration of the local context. Cultural identity is complex in the multicultural context of Australia where the majority are immigrants from all over the world. While first generation immigrants tend to maintain their home language, their offsprings, such as the school-aged children in our study, mostly prefer speaking English at home (Australian Bureau of Statistics, 2023). This implies that these children tend to identify themselves as Australian more than their original culture, unlike their parents who maintain a much stronger sense of their original culture. For Indigenous children, as they are likely to identify themselves as Indigenous Australians, they tend to have a strong sense of culture, especially for those who have close connection with their community. However, this speculation of cultural difference requires further research, probably with rich qualitative data for a deeper understanding.

While the three annual data collections are a strength of this research, dropout rates across the measurement points might have introduced some bias and compromised the matching. This is a common issue in education research, and could be due to students changing schools, or not being present on the day the data was collected.

Also, this research was conducted with a sample of non-Indigenous and Indigenous Australian students. The external validity of the model and its measurement needs to be tested with other Indigenous and non-Indigenous populations in the world.

5. Conclusion

In this paper, we examined the concept of student well-being, designed, and tested a multidimensional measurement of student well-being to explore the similarities and differences between Indigenous and non-Indigenous students for the various wellbeing constructs. Specifically, we attempted to answer three RQs. The findings were: (RQ1) a hierarchical and multidimensional model with six higher-order domains derived from 15 wellbeing factors was supported (Academic, Psychological, Physical, Social, Cultural, and Self-belief). The measurement was psychometrically sound and was invariant across Indigenous and Non-Indigenous, male and female, and primary and secondary students. (RQ2) many correlates were found to be logically associated with respective wellbeing domains, providing support for their convergent and discriminant validity and useful directions to inform interventions targeting specific wellbeing constructs. (RQ3) Indigenous Australian students tended to be higher in Physical and Cultural wellbeing. However, non-Indigenous Australian students tended to be higher in Academic and Self-belief wellbeing, whereas Indigenous and non-Indigenous students were similar in Psychological and Social wellbeing domains. In general, there appeared to be a downward trend for all wellbeing constructs across three time-points. This seemingly declining pattern calls for intervention strategies to maintain students' wellbeing and promote their healthy development throughout school life and beyond.

We hope that our proposed model will serve as an edifying theoretical basis for measuring multidimensional student well-being and elucidating its relations to other constructs in schooling contexts. This should stimulate advances in within-construct student well-being research in schools in particular and identify similarities and differences in Indigenous and non-Indigenous students' wellbeing. More broadly, our research provides a theoretical basis for operationalising student well-being constructs and their correlates as complex, dynamic, and interrelated.

6. Educational impact and implications statement

This study's findings contribute to the body of literature, as this provides a sound and reliable model of student well-being appropriate for primary and secondary schooling and both Indigenous and non-Indigenous students.

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Materials and analysis code for this study are available by emailing the corresponding author.

CRediT authorship contribution statement

Rhonda G. Craven: Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Herbert W. Marsh:** . **Alexander S. Yeung:** Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Diego Vasconcellos:** Writing – original draft, Validation, Software, Methodology, Formal analysis, Data curation. **Anthony Dillon:** Writing – original draft, Validation, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Richard M. Ryan:** Writing – review & editing, Validation, Methodology, Investigation. **Janet Mooney:** Writing – review & editing, Project administration, Investigation, Funding acquisition, Conceptualization. **Alicia Franklin:** Writing – review & editing, Visualization, Resources, Project administration. **Lily Barclay:** Writing – review & editing, Visualization, Resources, Project administration, Investigation, Funding acquisition, Conceptualization. **Annalies van Westenbrugge:** Writing – review & editing, Visualization, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A

Definitions of 6 Well-being Domains Comprising 15 Factors

Domain	Factor	Definition
Academic	Competence	Perception of competence in academic work
	Affective	Enjoyment when engaging in academic work
Psychological	Optimism	Hopefulness about the achieving and sustaining goals
	Positive emotions	Feeling good about oneself
Physical	Healthy lifestyle	Living in a healthy way
	Vitality	The energy available to the self
Social	Family	Quality of support and interconnectedness with family
	Community	Quality of support and interconnectedness with community
	Teacher	Quality of support and interconnectedness with one's teacher
	Peers	Quality of support and interconnectedness with peers
Cultural	Identity cognitive	Understanding of one's culture
	Identity affective	Feeling positive about one's culture
Self	Buoyancy	The ability to overcome hardship in life
	Self-worth	A global perception of the self
	Self-efficacy	Perceived capability to perform well as an individual

Note: Fig. 1 shows the factor structure. Details are given in Supplemental Material, Section 1.

Appendix B. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cedpsych.2024.102274.

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