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Abstract

Student engagement is typically regarded as being a multidimensional construct, but there remains no clear consensus about its precise conceptualization. Several current measures of student engagement are limited by their omission of relevant dimensions and/or poor correspondence between dimension labels and item content. To address these limitations, we integrated dimensions from two validated student engagement instruments, each with different approaches to the dimensionality of student engagement, into a single measure and assessed its psychometric properties. We concluded from factor analyses that this scale captures seven distinct-yet-related engagement dimensions, including students' perceptions of contextual influences, which load on a global higher-order student engagement construct. SEM analyses indicated that poor academic performance was linked to lower student engagement and that lower student engagement was associated with worse emotional wellbeing, confirming the concurrent validity of the scale. The results validate the integrated measure of engagement as a comprehensive assessment of student engagement in Portuguese adolescents.

Keywords**:** Student engagement; dimensionality; integration; psychometrics; bifactor model; multilevel

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Student engagement has been implicated with a range of important outcomes including academic performance (Chase, Hilliard, Geldhof, Warren, & Lerner, 2014), a desire to continue into higher education (Wang & Holcombe, 2010), a reduced risk of dropout (Fall & Roberts, 2012) and overall better wellbeing (Wang, Chow, Hofkens, & Salmela-Aro, 2015). Given its importance for students, it is crucial that researchers develop a comprehensive understanding of this construct and the interactions between its dimensions. As part of this process, it is important to develop valid and reliable assessment instruments. The purpose of this study was to address limitations in current measures by integrating multiple dimensions of engagement from two validated student engagement instruments, each with different approaches to the dimensionality of student engagement, into a single measure and to test its psychometric properties.

Student Engagement: Dimensions and Labels

Although it is generally accepted that student engagement is multidimensional, there is an active debate in the engagement literature on a number of theoretical issues. One major issue pertains to 'conceptual haziness' (Reschly & Christenson, 2012) in the definition of student engagement. We refer to student engagement rather than school engagment to avoid emphasising the contextual influence from the school over influences from family or peers (Appleton et al., 2008). A tri-dimensional typology of student engagement including behavioral, cognitive and emotional indicators (Fredricks, Blumenfeld, & Paris, 2004; Jimerson, Campos, & Greif, 2003) is now prevalent and well-supported in the student engagement literature. However, there is no agreed consensus on the precise definition of these three dimensions, and this is evident in the variety definitions offered in the engagement literature. Finn (1989) and Appleton, Christenson, Kim and Reschly (2006), for example, defined emotional engagement as the sense of belonging, identification and connection with school. Skinner, Furrer, Marchand, and Kindermann (2008), alternatively, defined emotional engagement as the states that are relevant to student involvement, such as enthusiasm and interest. Different still, Connell and Wellborn (1991) referred to emotional reactions in class such as happiness or anxiety.

Definitions of cognitive engagement have incorporated investment (Fredricks et al., 2004; Yazzie-Mintz, 2007), perceptions and beliefs (Jimerson et al., 2003) and self-regulated learning (Appleton et al., 2006). Finally, behavioral engagement has been defined as responding to school expectations (Finn, 1989) but also in terms of students' effort, attention, and intensity during learning activities (Skinner et al., 2008).

A second issue relates to the role and relevance of context. Many student engagement frameworks (Fredricks et al., 2004; Skinner et al., 2008), which are themselves based on a motivational model grounded in self-determination theory (Connell & Wellborn, 1991; Deci & Ryan, 1985), consider student engagement as a mediator between context and outcomes such as achievement. Several authors have argued that contextual predictors (*facilitators*) of engagement are conceptually distinct from the student engagement construct (Lam et al., 2014; Skinner et al., 2008). Alternatively, Reschly and Christenson (2012), noted that engagement is an inherently subjective experience and that students' perceptions are the most accurate sources of information about objective reality. Moreover, psychological environments correspond more closely to individual experiences than objective environments. In line with this perspective, some conceptualizations of student engagement incorporate perceptions of contextual influences as a means to understanding the goodness of fit between the student and their learning environment (Sinclair, Christenson, Lehr, & Reschly, 2003). Multiple studies, including some by the authors of the present study with Portuguese samples, support this conceptualization (Moreira & Dias, 2018) and have shown it to be invariant across cultures (Virtanen et al., 2018).

Limitations of Current Student Engagement Measures

The above theoretical considerations highlight several issues relevant to the development of student engagement instruments. The first is that the conceptual haziness associated with student engagement means great attention and theoretical consideration should be taken when designing items to measure the different dimensions of student engagement. There are several examples of instruments where items do not match, in a theoretical sense, with their assigned dimensions. The Student School Engagement Survey (SSES; National Centre for School Engagement, 2006), for example, includes the item "I study at home even when I don't have a

test" as an indicator of cognitive engagement. This would be better described as an aspect of behavioral engagement because it refers to a concrete action. Similar challenges are present in the Multidimensional School Engagement Scale (MSES; Wang et al., 2017), which conceptualizes student engagement (and disengagement) as comprising four dimensions: cognitive, emotional, behavioral, and social. According to Fredricks et al. (2004), cognitive engagement refers to representations, standards, and beliefs about the school experience. However, the item "I look over my school work and make sure that it is done well", which was aligned with the cognitive engagement dimension, actually reflects a tangible behavior that demonstrates a will to overcome a challenge, and is, in other words, more consistent with behavioral engagement (Nguyen, Cannata, & Miller, 2016). Moreover, the item "I keep trying even when I get stuck on my school work" is a better reflection of an overt action, or behavioral engagement (Fredricks et al., 2004) rather than a cognition concerning school. Finally, the emotional engagement item "Doing well in school is important to my future", is a cognitive representation related to the relevance of schoolwork. In support of this proposal, similar items from the SEI (e.g. "School is important for achieving my future goals") have been shown in psychometric studies to load on a higher-order cognitive dimension (Betts, Appleton, Reschly, Christenson, & Huebner, 2010; Moreira, Vaz, Dias, & Petracchi, 2009).

Theory (Connell & Wellborn, 1991) and research (Skinner & Pitzer, 2012) highlight three significant contextual influences on student engagement (support from peers, teachers, and family). The SEI, which incorporates students' perceptions of these contextual factors, has been well validated (Appleton et al., 2006; Moreira & Dias, 2018; Moreira et al., 2009). The majority of available instruments, however, do not adequately capture students' perceptions of contextual factors. Although the MSES (Wang et al., 2017) incorporates items that measure students' perceptions of their relationships with peers as part of the social engagement dimension, it fails to capture the influence felt from teachers and family. The SSES (National Centre for School Engagement, 2006) includes items that measure students' perceptions of the support from teachers, but none that measure perceptions regarding support from peers or family. Other tri-dimensional instruments, such as the School Engagement Measure (SEM) – MacArthur

Network (Fredricks, Blumenfeld, Friedel, & Paris, 2005), do not include items that capture students' perceptions of their relationships with relevant others. Finally, although the SEI (Appleton et al., 2006) is the only validated instrument to measure students' perceptions of all three contextual influences, its shortcoming is that it does not include items to measure emotional or behavioral engagement.

In summary, there is converging evidence that measures of student engagement should integrate students' perceptions of contextual influences on engagement and indicators of engagement as a way to understand the inherently subjective experience of student engagement with school. Several available instruments assess an incomplete set of engagement dimensions, often failing to capture students' perceptions of contextual influences, and thus fail to capture key features of students' subjective experiences of school. Moreover, with some instruments, there is a mismatch between the labels of the dimensions and the content of their corresponding items. As such, it is difficult to integrate findings from studies using different measures, and this represents a serious obstacle to advances in the conceptualization and measurement of the student engagement construct.

The Current Study

Given that student engagement has increasingly been seen as relevant to addressing issues of student disengagement and school dropout (Fredricks et al., 2004) and promoting positive trajectories (Wang & Eccles, 2012; Wang & Fredricks, 2014), the principle objective of the current study was to develop and validate a measure of student engagement that addresses the limitations of currently available instruments. More specifically, the aim was to develop a new multidimensional measure by incorporating items from two validated measures of student engagement, the SEI and SSES, each with different approaches to the dimensionality of student engagement, to capture the three major indicators of student engagement and students' perceptions of contextual influences on engagement. This measure was designed for use with Portuguese adolescents, but can be easily adapted for use in other countries. Recent studies have shown that student engagement in Portugal has similar dimensionality (Moreira & Dias, 2018) and characteristics to student engagement in other cultures (e.g. decreases with age; decreases in

student from lower SES families; Moreira et al., 2018). Having an instrument that captures the full multidimensional nature of the student engagement construct will have important implications for research on student disengagement and dropout, school interventions and policy, and the monitoring/assessment of engagement in students, including those for who the consequences of disengagement are more severe (e.g. students from disadvantaged backgrounds).

The integration of multiple dimensions in the proposed measure of student engagement presented an opportunity to test whether indicators of engagement and students' perceptions of contextual influences should be conceptualized within the same construct. The bifactor model was ideal for this purpose because it allows researchers to assess the dimensionality of item responses. Bifactor models have already been championed for student engagement instruments (Wang et al., 2017). In bifactor models, a general factor accounts for relationships between items while additional specific factors account for shared variance among items beyond that accounted for by the general factor (Chen, West, & Sousa, 2006). If students' perceptions of contextual influences and indicators of engagement are related to each other at the global construct level, the bifactor model should reveal that items are largely unidimensional. This result would imply that it is appropriate to calculate and interpret a total student engagement score from the measure.

The current study also tested the validity of the new integrative scale. A measure is valid if it measures what it purports to measure (Borsboom, Mellenbergh, & Van Heerden, 2004). Indirect evidence of validity can be obtained by testing whether test scores are related to other measures of theoretically related constructs (Cronbach & Meehl, 1955). We therefore assessed the associations between the new integrative measure of student engagement and two constructs for which there was an anticipated theoretical overlap. The first variable considered was academic performance. The reciprocal relationships between student engagement and academic performance have been studied extensively and are well established. Engagement predicts academic performance (Carbonaro, 2005; Lee, 2014), and academic performance also predicts student engagement (Chase et al., 2014; Moreira et al., 2018; Wang & Eccles, 2012). It

was also expected that student engagement would be associated with emotional wellbeing because at least one theory (Fredrickson, 2001) suggests that positive emotions broaden cognitions and behaviors and help build adaptive physical, intellectual and social resources, such as engagement. In support of this, research showed that positive emotions are linked to student engagement (Reschly, Huebner, Appleton, & Antaramian, 2008), while disengagement is linked to higher levels of depression (Li & Lerner, 2011; Wang et al., 2015; Wang & Peck, 2013).

Method

Participants

The current study utilized data from the first wave of a six-year longitudinal investigation on student engagement in Portuguese adolescents. For this study, 104 schools were sampled from different regions of Portugal. This school sample included middle schools with the 7th to 9th grades (n = 26), secondary schools with the 10th to 12th grades (n = 12), and mixed schools (7th to 12th grades; n = 66). These types of schools do not present substantive differences with the exception of the grades they offer. Our school sample included 82 public schools, 18 private schools and 10 vocational schools.

The final student sample comprised 4,983 individuals. After excluding 13 students identified as statistical outliers in terms of recorded age and not considered adolescents (11 < *age* < 20), the final sample consisted of 4,969 students (53.9% female) attending the 7th grade (n = 2,553) or 10th grade (n = 2,379). Students in the 7th grade were on average 12.5 years old (SD = 0.7). Students in the 10th grade were on average 15.5 years old (SD = 0.9).

Instruments

Student engagement.

Measurement integration. The goal of the current study was to integrate multiple dimensions of student engagement into a single student-report measure for use in Portugal. We aimed to integrate the three indicators of the prevalent tri-dimensional framework (emotional, behavioral and cognitive) and students' perceptions of three contextual influences (teacher

support, family support and peer support). The approach to scale development was to extract and integrate items from two validated student engagement instruments that collectively capture these dimensions: the Student Engagement Instrument (SEI; Appleton et al., 2006; 36 items) and the Student School Engagement Survey (SSES; National Center for School Engagement, 2006; 49 items)[1]. Participants had completed these scales as part of the longitudinal study and item integration was, therefore, a post-hoc procedure. Both instruments have been translated into Portuguese and validated in Portuguese samples (e.g. Moreira & Dias, 2018; Moreira et al., 2009; Moreira et al., 2018). Items from the SEI capture cognitive engagement and indicators of the goodness of fit between the environment and the student. Items from the SSES capture emotional, cognitive and behavioral engagement. With the items of both instruments combined, the initial pool comprised 85 items.

Item selection. The authors sought to exclude items from the initial pool that did not have strong conceptual alignment with the six dimensions. Conceptual alignment was judged based on the following definitions from the engagement literature: emotional engagement (affective reactions to school and sense of belonging/identification); behavioral engagement (positive conduct and participation); and cognitive engagement (beliefs/perceptions about school). Students' perceptions of contextual influences was defined as the support felt from teachers, peers and family (Appleton et al., 2006). In total, 25 items were excluded from the initial pool because they had weak conceptual relevance or clarity.

Item scoring. Items were rated by students in the form intended by the original authors. All SEI items were scored on a four-point Likert scale from 1 (*strongly disagree*) to 4 (*strongly agree*). Items 1 to 3 of the SSES required students to give an indication of importance from 1 (*very important*) to 5 (*not at all important*). Items 4 to 28 of the SSES are statements to which

[1] These two scales were chosen for the longitudinal study because they have different approaches to student engagement dimensionality, and collectively capture the three prevalent indicators of engagement and students perceptions of contextual influences. At Wave 1 of the longitudinal study (2013), the SEI was the only available instrument that captured support from peers, teachers and family. The SSES was chosen because it was one of few available multidimensional measures (i.e. including cognitive, emotional and behavioral dimensions) widely used by a national institute for promoting student engagement in the US.

students indicated their agreement from 1 (*strongly agree*) to 4 (*strongly disagree*). Items 29 to 42 of the SSES required students to indicate "How often are the following statements true for you?" from 1 (*Always/ Almost Always)* to 5 (*Never/ Almost Never*). Across both instruments, items were recoded so that higher scores equal higher student engagement.

Academic performance. In Portugal, primary education is organized into three cycles: 1st (grades 1 to 4), 2nd (grade 5 and 6) and 3rd (grades 7 to 9). Secondary education, which is more specialized, includes grades 10 to 12. Students in the 4th, 6th and 9th grades (final years of each cycle) take national evaluation exams in Portuguese Language and Mathematics at the end of the year. These exams are graded according to a numerical scale that ranges from a minimum of 0 points to a maximum of 5 points. Students' final grades for these exams (6th grade exams for students in the 7th grade; 9th grade exams for students in the 10th grade) were obtained from school records. An average academic performance score was calculated using these two grades.

Emotional wellbeing. The Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) was used to measure student emotional wellbeing. The PANAS has 20 adjectives describing 10 positive and 10 negative emotions. Participants indicated the extent to which they had been feeling these emotions in the past few weeks from 1 (*very slightly or not at all*) to 5 (*extremely*). A single indicator of emotional wellbeing was calculated by subtracting the sum of the negative adjectives from the sum of the positive adjectives. Past studies reveal good internal consistency for the positive ($\alpha = .89$) and negative ($\alpha = .86$) subscales of the Portuguese PANAS (Galinha & Pais-Ribeiro, 2005).

Procedures

Data collection. Ethical approval was granted from the ethics committee of Lusíada University. In each school, a member of staff acted as a liaison between the school and the research team. Questionnaires were administered to classes of students, gathered in a single room, under the supervision of the school representative.

Data analysis.

Missing data. Missing response patterns were analyzed across the measures of engagement, academic performance and emotional wellbeing. Missing data were not missing

completely at random (MCAR), although this does not imply that missing data were not missing at random (MAR). The amount of missing data for student engagement and emotional wellbeing items was small (0.5% - 2.2%). Approximately 10% of data for academic performance was missing. Given these characteristics, and because our ability to obtain academic grades from records was school-dependent, we assumed missing data were MAR.

The sample was divided randomly into two subsamples: Sample A for principle components analysis (PCA; n = 2,443); and Sample B for confirmatory factor analysis (CFA; n = 2,526). These two samples did not differ in terms of their gender, $\chi^2(1) = 3.00$, $p = .083$, or distribution across the 7th and 10th grades, $\chi^2(1) = 1.11$, $p = .575$. The mean ages of the group were not significantly different, $t(4919) = 0.66$, $p = .512$. The full sample was used to test reliability and validity.

PCA. To determine the number of factors to extract we used parallel analysis (PA; Horn, 1965). In PA, eigenvalues from the real data correlation matrix are compared to those from a correlation matrix of random variables with an equal sample size and number of variables. Real factors are retained if their eigenvalue is greater than the parallel average random eigenvalues. A PCA with Promax rotation was then applied to test the factor solution proposed by PA. Missing values were imputed using the median. In pursuit of developing a practical and efficient measure, only the top four items with highest standardized factor loadings were retained per dimension.

CFA. We conducted a multilevel CFA to test a bifactor model. Following the proposals of Hox (2002), the multilevel CFA was conducted using the pooled within covariance matrix, rather than the total covariance matrix, to test a level-one CFA model with unbiased estimates due to clustering. Model fit was assessed using several indicators and heuristics for good fit: CFI ≥ .95 (Hu & Bentler, 1999); RMSEA ≤ .05 (Browne & Cudeck, 1992); and SRMR < .05 (Hu & Bentler, 1999). Missing values were handled using the full information maximum likelihood method.

Unidimensionality. We assessed scale unidimensionality based on the bifactor model by calculating omega hierarchical, ω_H, which determines the proportion of variance accounted

for by the general factor (Reise, Moore, & Haviland, 2010). A ω_H value > .75 is required to interpret the total MMSE score as a measure of a single student engagement construct (Reise, Scheines, Widaman, & Haviland, 2013). We also calculated the explained common variance (ECV) index. ECV estimates the proportion of common variance in scores due to the general factor. The higher the ECV, the more confidence in applying a unidimensional measurement model.

Reliability. McDonald's omega total coefficients were calculated to assess internal consistency. Omega is a better measure of internal consistency than Cronbach's alpha (Dunn, Baguley, & Brunsden, 2014). Values greater than .70 are an indication of good reliability (Nunnally, 1967).

Concurrent validity. We used structural equation modeling (SEM), also using the pooled within covariance matrix, to test the association between MMSE scores and (a) prior academic performance, and (b) emotional wellbeing. Missing values were handled using the full information maximum likelihood method.

Results

PCA

The PA supported retaining seven factors (Figure 1). Table 1 presents standardized component loadings for the 7-factor solution. Two factors were consistent with subtypes of behavioral engagement (behaviors related to student conduct and study behaviors). The remaining factors were consistent with emotional engagement, cognitive engagement, and students' perceptions of teacher support, peer support and family support.

FIGURE 1 ABOUT HERE

TABLE 1 ABOUT HERE

CFA

Table 1 gives the intraclass correlation coefficients (ICCs) for the items. These ICCs were low, suggesting that a small proportion of variance in the items was dependent on the school level. Fitting the bifactor model (Supplementary Figure 1) resulted in good model fit: CFI = .954, RMSEA = .035, and SRMR = .037. Factor loadings for this model are shown in

Table 2. These results champion a general student engagement factor and imply that the student engagement construct is unidimensional.

TABLE 2 ABOUT HERE

Scale Unidimensionality

We calculated ω_H to assess whether a total student engagement score from the MMSE can be interpreted as a measure of a single construct. For this, a value greater than .75 is preferred. Results indicated that ω_H was .78, which indicates approximately 80% of the variance in MMSE scores was due to the general student engagement factor.

We also calculated ECV. The calculations showed that ECV was .43, indicating that 43% of the common variance was attributable to the general student engagement factor. The implication of this finding is that the MMSE is not sufficiently unidimensional for SEM or IRT models that assume unidimensionality.

Reliability

Item statistics are available in Supplementary Table 1. Internal consistency was good for the MMSE subscales: student conduct (ω = .82), study behaviors (ω = .80), cognitive (ω = .73), emotional (ω = .77), family support (ω = .73), teacher support (ω = .73) and peer support (ω = .78). The internal consistency for total student engagement was excellent (ω = .93).

Concurrent Validity

Because the estimate for ECV was less than 50%, we used to SEM to test factor correlations between the general student engagement factor isolated from specific factor variance (Figure 2).

FIGURE 2 ABOUT HERE

The bifactor model revealed a significant positive relationship between student engagement and prior academic performance (see Table 3), although the size of the relationship was weak (r = .21). In contrast, the positive relationship revealed between student engagement and emotional wellbeing was strong (r = .56).

TABLE 3 ABOUT HERE

Discussion

Currently available student engagement instruments (e.g. the SSES; National Center for School Engagement, 2006) do not adequately capture cognitive, emotional and behavioral indicators of engagement. Additionally, they do not adequately capture students' perceptions of contextual influences from peers, family and teachers. The main objective of the current study was to address this shortcoming in the literature.

A principle component analysis revealed a 7-factor solution based on the 60 tested items. Consistent with the student engagement literature, five of these factors represent emotional engagement, cognitive engagement, and students' perceptions of support from teachers, family and peers. The remaining two factors represent different domains of behavioral engagement -- student conduct and study behaviors -- a finding that was unexpected but unsurprising given that these dimensions are multidimensional constructs in their own right. These domains are theoretically valid and have been acknowledged in research specific to behavioral engagement (Nguyen et al., 2016). The student conduct factor represents students' behaviors in relation to school/classroom rules and expectations, with adherence to these norms deemed an indicator of increased student engagement. Several studies have adopted this definition of behavioral engagement (Finn & Rock, 1997). The study behaviors factor, which has also been considered in research on behavioral engagement (Birch & Ladd, 1997), represents tangible actions performed by the student to overcome challenging material or tasks.

A major finding of the study was the support for a bifactor model. By championing a bifactor model, the study supports modelling student engagement as a general factor, partialling out shared common variance from specific factors. By calculating ω_H, the study highlighted that it is appropriate to calculate and interpret total student engagement scores because the majority of variance in these scores was explained by the general factor. These results imply that students' subjective perceptions of support from relevant others are not conceptually distinct from the cognitions, emotions or behaviors that make up student engagement: they belong inside the global engagement construct. As such, this finding aligns with Appleton et al.'s (2006) conceptualization of engagement, which is supported heavily by empirical evidence (Betts et al., 2010; Moreira & Dias, 2018).

The study also demonstrates that the MMSE is a valid measure of student engagement. Consistent with an extensive body of past research, academic performance and student engagement were found to be positively correlated. This association was weak, but consistent with the effect sizes identified in past studies (Moreira & Dias, 2018) and sufficiently large to be considered practically relevant (Ferguson, 2009). The study also revealed a large positive correlation between the general student engagement factor and emotional wellbeing. This finding aligns with research that has linked engagement with positive emotions and coping (e.g. Reschly et al., 2008), and thus serves as further evidence of concurrent validity.

Implications for Practice

The MMSE adds to the many available student engagement instruments by providing an insight into the multiple distinct-yet-related dimensions relevant to understanding students' subjective experiences of school. Psychometrically sound measures, founded on an accurate and complete conceptualization of the student engagement construct, are vital for addressing issues of student disengagement and school dropout. One application of this short, and therefore practical, instrument is that it can be used to evaluate and monitor engagement in groups of students deemed at risk of educational inequity. Students from socio-economically disadvantaged families, for example, are at risk of poorer academic performance (Ma, 2000) and thus at risk of disengagement with school and the knock-on negative effects on academic and developmental trajectories. The MMSE may also serve to highlight specific sources of disengagement for these at-risk groups of students (e.g. teacher support for learning), or indeed for individuals. Such information may prove useful for informing teacher practices and interventions, or policies at the school level. It is noteworthy, however, that a longer version of the MMSE might be necessary to make more valid individual-level decisions (Kruyen, Emons, & Sijtsma, 2012). This may be achievable using the expanded selection of items revealed by PCA in the results section.

Limitations and future research

The large sample size is a strength of the current study although students were only either 7th or 10th graders. Future studies are needed to determine whether the MMSE is valid in

different groups of students (e.g. primary school). In addition, these results are based on a Portuguese-language instrument applied to a Portuguese sample. This raises the concern of whether the MMSE is suitable for use in different cultures. More work is required to produce translations of this instrument and to establish cross-cultural measurement equivalence.

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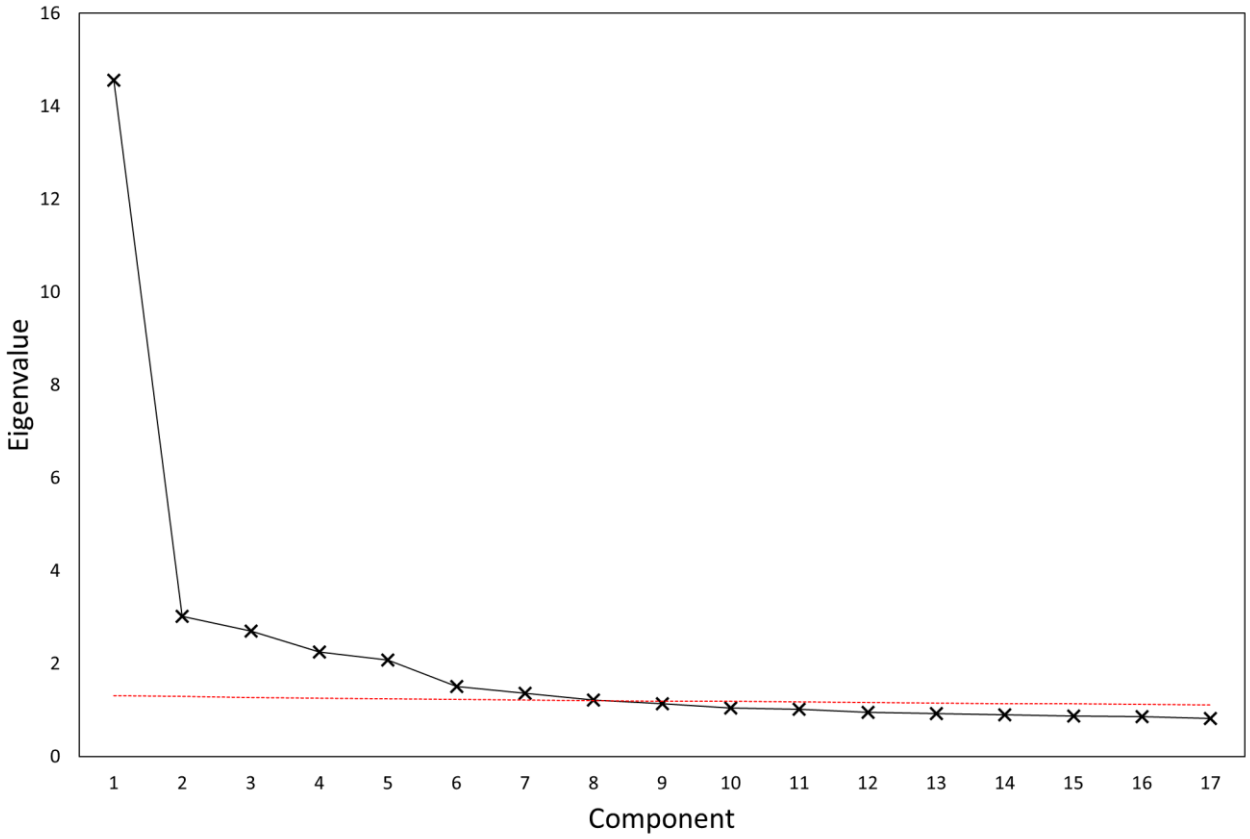


Figure 1. Scree plot of actual (solid line with markers) versus simulated eigenvalues (dotted line).

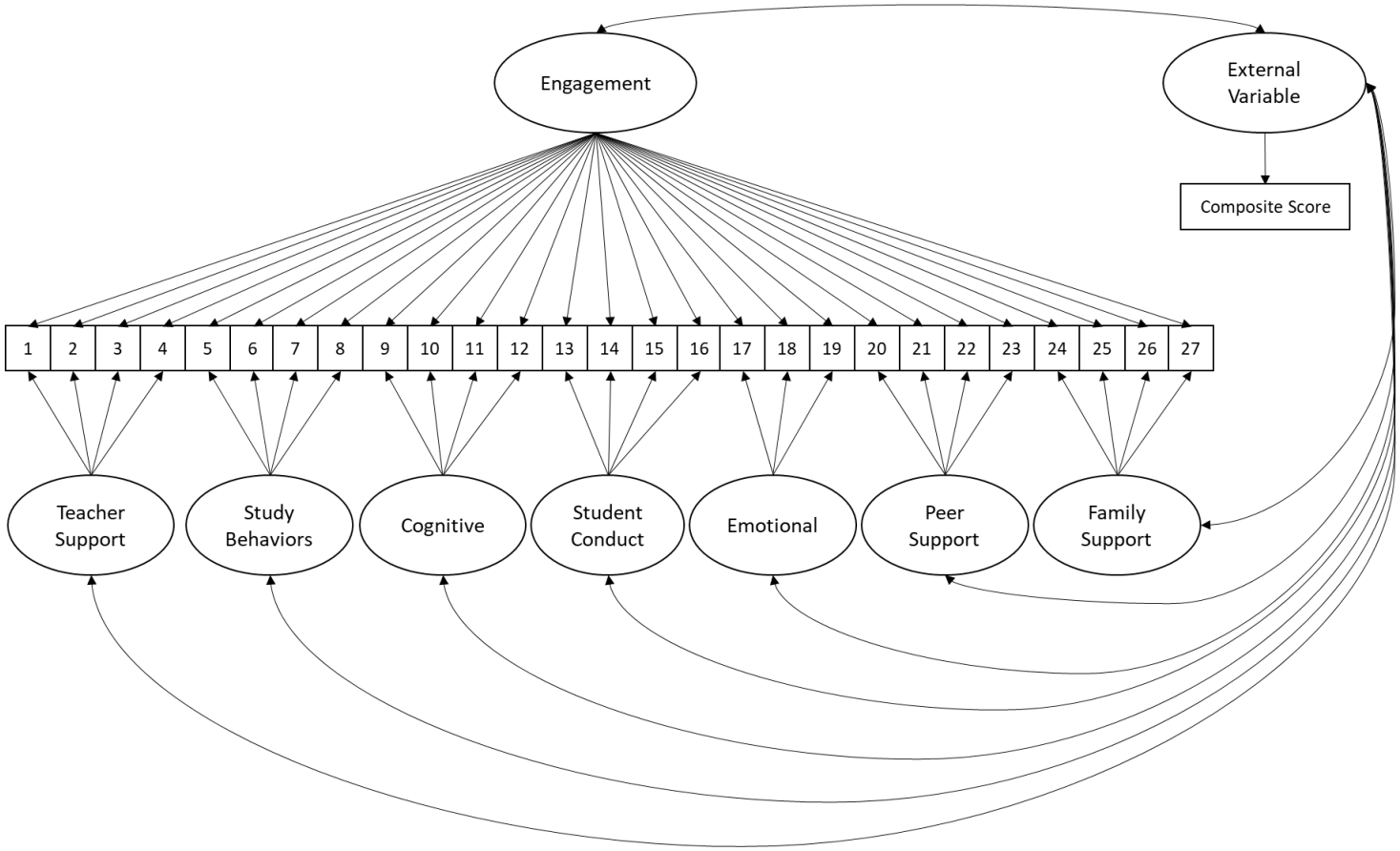


Figure 2. Full structural model used to test the association between the MMSE bifactor model and external variables; (1) prior academic performance; and (2) student emotional wellbeing.

Table 1.

Items comprising the seven-factor model and standardized loadings. Principle component analysis based on Sample A (n =2,443).

Original Scale and No.	Item No. in Study	Item Text (English original)	Component							ICC
			TSR	SB	COG	SC	EMO	PSL	FSL	
SEI 31	1	At my school, teachers care about students	**.69**							**.048**
SEI 3	2	My teachers are there for me when I need them	**.67**							**.054**
SEI 16	3	Overall, my teachers are open and honest with me	**.66**							**.033**
SES 14	4	Most of my teachers care about how I'm doing	**.66**							**.050**
SEI 21	-	Overall, adults at my school treat students fairly	.65							.026
SES 7	-	The teachers at my school treat students fairly	.62							.066
SEI 5	-	Adults at my school listen to the students	.61							.053
SEI 13	-	Most teachers at my school are interested in me as a person, not just as a student	.58							.032
SES 19	-	Most of my teachers understand me	.52							.037
SES 9	-	I like most of my teachers at school	.50							.056
SES 42	-	I feel I can go to my teacher(s) with the things that I need to talk about	.50							.040
SEI 36	-	The teaching is good at this school	.49							.098
SES 16	-	There is an adult at school that I can talk to about my problems	.38							.046
SES 10	-	I am getting a good education at my school	.38							.057
SES 36	5	I check my schoolwork for mistakes		**.87**						**.074**
SES 34	6	I study at home even when I don't have a test		**.83**						**.056**
SES 35	7	I talk with people outside of school about what I am learning in class		**.65**						**.018**
SES 41	8	I enjoy the work I do in class		**.62**						**.037**
SES 32	-	I am interested in the work I get to do in my classes		.60						.040
SES 39	-	I try my best at school		.59						.044
SES 31	-	I feel excited by the work in my school		.59						.037

SEI 2	-	After finishing my schoolwork I check it over to see if it's correct	.54					.046
SES 37	-	If I don't understand what I read, I go back and read it over again	.52					.040
SES 27	-	I try my best on homework	.51					.048
SES 33	-	My classroom is a fun place to be	.41					.036
SES 38	-	Most of my teachers praise me when I work hard	.40					.040
SEI 15	-	When I do schoolwork I check to see whether I understand what I'm doing	.31					.044
SEI 34	9	What I'm learning in my classes will be important in my future		**.77**				**.056**
SEI 35	10	The grades in my classes do a good job of measuring what I'm able to do		**.69**				**.031**
SES 2	11	[How important do you think…] the things you are learning in school are going to be to you in later life?		**.67**				**.032**
SEI 19	12	School is important for achieving my future goals		**.66**				**.038**
SEI 26	-	The tests in my classes do a good job of measuring what I'm able to do		.60				.036
SEI 9	-	Most of what is important to know you learn in school		.55				.029
SEI 11	-	Going to school after high school is important		.54				.116
SES 3	-	[How important do you think…] it is to get good grades?		.50				.024
SEI 17	-	I plan to continue my education following high school		.48				.110
SEI 8	-	My education will create many future opportunities for me		.47				.050
SEI 31	-	I am hopeful about my future		.47				.048
SEI 33	-	Learning is fun because I get better at something		.44				.027
SEI 25	-	When I do well at school it's because I work hard		.37				.037
SES 26	13	I treat my teachers with respect			**.85**			**.034**
SES 17	14	I respect most of my teachers			**.72**			**.035**
SES 24	15	I treat my classmates with respect			**.72**			**.024**
SES 28	16	I follow rules in school			**.66**			**.030**
SES 25	-	I complete work on time			.56			.041
SES 23	-	I come to class prepared			.51			.044
SES 15	-	I learn a lot from my classes			.26			.047
SES 5	17	I feel like I belong in my school				**.80**		**.040**
SES 4	18	I feel close to people at my school				**.78**		**.026**
SES 6	19	I am happy to be at my school				**.67**		**.050**
SEI 7	20	Students at my school are there for me when I need them					**.79**	**.020**
SEI 6	21	Other students at school care about me					**.78**	**.031**

SEI 14	22	Students here respect what I have to say						**.63**		**.034**
SEI 4	23	Other students here like me the way I am						**.55**		**.038**
SEI 24	-	I have some friends at school						.26		.021
SEI 28	-	I feel like I have a say about what happens to me at school						.26		.027
SEI 20	24	When I problems at school my family/guardian(s) are willing to help me							**.77**	**.046**
SEI 1	25	My family/guardian(s) are there for me when I need them							**.74**	**.016**
SEI 12	26	When something good happens at school, my family/guardian(s) want to know about it							**.59**	**.040**
SEI 29	27	My family/guardian(s) want me to keep trying when things are tough at school							**.49**	**.046**
SS loadings			5.65	5.40	5.19	3.86	2.71	2.43	2.23	
Proportion Var.			.09	.09	.09	.06	.05	.04	.04	

Note. SEI = Student Engagement Instrument (Appleton et al., 2006). SSES = Student School Engagement Survey (National Center for School Engagement, 2006). BEH = Behavioral Engagement; BEH: SC= Student Conduct; BEH= SB: Study Behaviors; EMO = Emotional Engagement; COG = Cognitive Engagement; COG:FAG = Future Academic Goals; COG:CRSW = Control and Relevance of School Work; TSR = Teacher-Student Relationship; FSL = Family Support for Learning; PSL = Peer Support for Learning. †Item excluded because of loadings > |.30| on more than one factor.

Table 2.

Standardized (and fully standardized) factor loadings and residual variances for the Multifactorial Measure of Student Engagement (MMSE) items based on the bifactor model.

Item No.	λ_{GEN}	λ_{TSR}	λ_{SB}	λ_{COG}	λ_{SC}	λ_{EMO}	λ_{PSL}	λ_{FSL}	Residual Variance
1	1.00 (.51)	1.00 (.48)							.18 (.51)
2	0.87 (.46)	0.80 (.40)							.19 (.62)
3	1.00 (.50)	0.89 (.42)							.20 (.58)
4	1.15 (.53)	0.63 (.27)							.27 (.65)
5	1.63 (.45)		1.00 (.61)						.48 (.42)
6	1.50 (.41)		0.93 (.56)						.60 (.51)
7	1.60 (.45)		0.70 (.44)						.68 (.61)
8	1.58 (.55)		0.49 (.38)						.40 (.55)
9	0.96 (.49)			1.00 (.67)					.11 (.31)
10	0.99 (.47)			0.48 (.30)					.28 (.69)
11	1.22 (.46)			0.83 (.41)					.39 (.62)
12	0.77 (.42)			0.56 (.41)					.20 (.66)
13	1.05 (.52)				1.00 (.70)				.09 (.24)
14	0.89 (.40)				0.74 (.46)				.28 (.63)
15	0.88 (.46)				0.76 (.56)				.16 (.48)
16	0.97 (.47)				0.67 (.46)				.22 (.57)
17	1.00 (.46)					1.00 (.82)			.05 (.12)
18	0.71 (.36)					0.47 (.42)			.24 (.70)
19	1.24 (.53)					0.50 (.38)			.27 (.57)
20	0.75 (.35)						1.00 (.68)		.17 (.42)
21	0.66 (.30)						1.08 (.73)		.16 (.38)
22	0.78 (.40)						0.49 (.37)		.24 (.70)

23	0.65 (.31)	0.56 (.40)		.28 (.75)
24	0.82 (.46)		1.00 (.61)	.12 (.42)
25	0.48 (.32)		0.68 (.48)	.13 (.67)
26	0.87 (.44)		0.92 (.50)	.19 (.56)
27	0.67 (.40)		0.53 (.34)	.18 (.73)

Table 3.

Factor correlations between the Multifactor Measure of Student Engagement (MMSE) factors from the bifactor model and external variables.

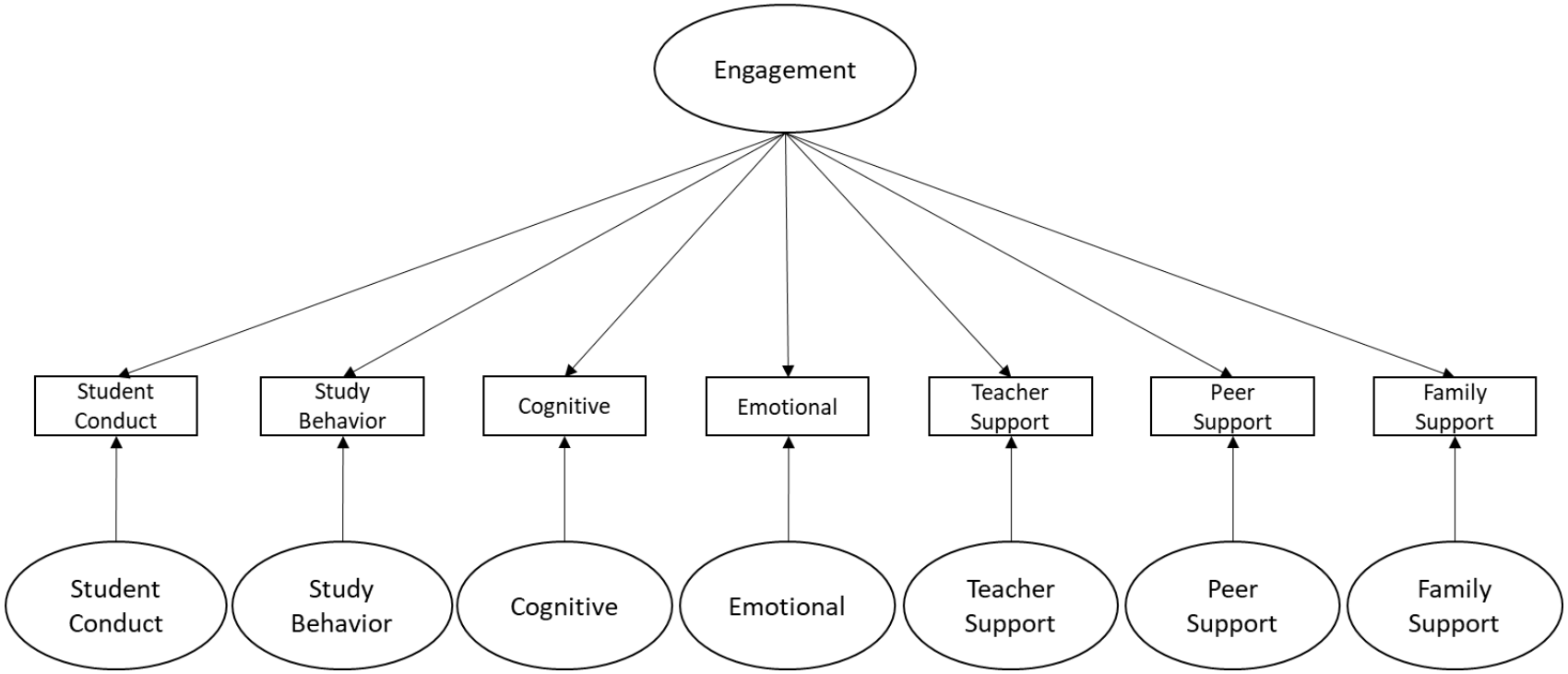
	Prior Academic Performance		Emotional Wellbeing	
	r	*p*	*r*	*p*
Student Engagement	.212	<.001	.557	<.001
Cognitive	-.046	.131	-.071	.011
Emotional	-.080	.002	.104	<.001
Student Conduct	-.010	.729	-.117	<.001
Study Behaviors	-.079	.008	-.099	<.001
Teacher Support	-.123	.002	-.239	<.001
Family Support	-.049	.093	-.016	.554
Peer Support	-.028	.250	.004	.843

Supplementary Table 1.

Item statistics based on full sample

Item		*M*	*SD*	Observed Range	Skew	Kurtosis	r_i
Teacher Support							
	1	3.23	0.64	1-4	-.62	1.02	.64
	2	3.29	0.58	1-4	-.38	0.57	.58
	3	3.21	0.63	1-4	-.47	0.63	.63
	4	2.92	0.66	1-4	-.42	0.57	.55
Study Behaviors							
	5	3.22	1.13	1-5	-.09	-0.70	.73
	6	3.02	1.11	1-5	.03	-0.63	.68
	7	3.34	1.07	1-5	-.24	-0.53	.63
	8	3.48	0.88	1-5	-.04	-0.05	.62
Cognitive							
	9	3.52	0.62	1-4	-1.16	1.33	.72
	10	3.29	0.66	1-4	-0.70	0.63	.54
	11	4.35	0.83	1-5	-1.27	1.44	.60
	12	3.64	0.57	1-4	-1.61	2.92	.55
Student Conduct							
	13	3.46	0.62	1-4	-1.00	1.43	.80
	14	3.41	0.71	1-4	-1.26	1.82	.60
	15	3.39	0.60	1-4	-0.76	1.18	.70
	16	3.30	0.64	1-4	-0.75	1.12	.66
Emotional							
	17	3.08	0.67	1-4	-0.59	0.96	0.77
	18	3.09	0.62	1-4	-0.55	1.44	0.61
	19	3.10	0.72	1-4	-0.66	0.69	0.64
Peer Support							
	20	3.03	0.66	1-4	-0.45	0.61	0.70
	21	2.94	0.68	1-4	-0.46	0.56	0.71
	22	2.99	0.60	1-4	-0.39	1.06	0.55
	23	3.28	0.62	1-4	-0.55	0.70	0.51
Family Support							
	24	3.68	0.54	1-4	-1.64	2.83	0.71
	25	3.79	0.46	1-4	-2.26	5.72	0.55
	26	3.57	0.61	1-4	-1.27	1.39	0.62
	27	3.66	0.53	1-4	-1.40	2.09	0.51

Note. r_i = Item whole correlation corrected for item overlap and scale reliability



Supplementary Figure 1. Bifactor models tested using multilevel confirmatory factor analysis (CFA). Rectangles represent subscale items. Elipses represent latent factors.