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Tests of factorial structure and measurement invariance for the Student Engagement Instrument: Evidence from middle and high school students in Portugal

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Abstract

While past research has shown the Student Engagement Instrument (SEI) to be an adequate measure of school engagement, this self-report questionnaire currently exists as a number of different versions, each comprising various subsets of the original 35 items (Appleton et al., 2006). The first objective of this study was to use confirmatory factor analysis to assess the fit of different factorial structures with data acquired from 1,229 Portuguese adolescents in the 7th to 12th grades. Our second objective was then to test measurement invariance across gender and school year and to examine the psychometric properties of the factorial structure of the SEI with the best fit to our data. Our analyses revealed that the 15-item Brief-SEI structure fit our data best, and continued to fit the data well with the addition of two-higher order factors representing Cognitive and Psychological Engagement. This higher-order model showed strict measurement invariance across gender and strong measurement invariance across school year. Internal consistency of the subscales was good and the subscales were correlated (albeit weakly) with academic performance. This study therefore provides a synthesis of current research on the SEI, and offers a validated instrument which is consistent with Appleton's theoretical conceptualization of student engagement.

Keywords: engagement; confirmatory factor analysis; Portuguese; validity; Student Engagement Instrument

Introduction

The Need for Research on Engagement Assessments

Preventing school failure and promoting positive academic trajectories has become a national imperative in knowledge-based societies. The importance of students' engagement with school as an effective means for the prevention of school failure, and for the promotion of positive academic trajectories, has been increasingly acknowledged by different theoretical approaches, including developmental (e.g. Li & Lerner, 2011), bio-ecological (Bronfennbrenner, 2005), and interactionist theories (Eccles et al., 1993), including self-determination theory (e.g. Deci & Ryan, 2010). Accordingly, substantial efforts to develop valid assessment instruments of students' engagement have been made. One such instrument, the Students Engagement Instrument (SEI; Appleton, Christenson, Kim, & Reschly, 2006), has gained substantial empirical support as a suitable measure of this phenomenon. That said, a number of different factorial structures of the SEI adopting different subsets of items have been proposed, and it is therefore unclear how to best operationalise this instrument for use in schools. The primary objective of this study was to address this shortcoming.

Student Engagement with School

Engagement with school refers to the subjective experiences and perceptions that students have concerning school (Appleton, et al., 2006). Such perceptions have been shown to be associated with the trajectories of psychological and behavioral adjustment (including school involvement) taken by students throughout their education (Baker, 2006; Cavendish, 2013; Wang, 2009; Wang & Eccles, 2013; Wang, & Holcombe, 2010; Way, Reddy, & Rhodes, 2007). This has been confirmed by longitudinal and multilevel studies, which have shown student engagement with school to be a predictor of a wide range of academic trajectories such as school dropout (Wang & Eccles, 2012; Wang, & Fredricks, 2014).

Student engagement is generally considered as a multidimensional construct including the various components of student experiences (cognitions, emotions, behaviours and interpersonal relationships) that interact under different levels of influence: individual, family, school and community (Appleton et al., 2006; Appleton, Christenson, & Furlong, 2008; Fredricks, Blumenfeld, & Paris, 2004; Moreira, Oliveira, Dias, Vaz, & Torres-Oliveira, 2014; Wang, Willett, & Eccles, 2011). The number and nature of these underlying dimensions, however, remains under debate.

As an illustration of this debate, many current perspectives derive from the proposals of Finn (1989), which emphasize that engagement has both behavioral and affective dimensions. Norris, Pignal, and Lipps (2003), for example, have proposed a two-dimensional construct made up of Academic Engagement (behavioral commitment and identification with academic aspects of school) and Social Engagement (interpersonal aspects and participation in extracurricular activities). Alternatively, Sciarra and Seirup (2008) have proposed that school engagement consists of three dimensions: Behavioral (concentration, persistence, and attention), Emotional (assurance, comfort, and pride in one's institution), and Cognitive Engagement (effective study and homework realization, and the importance attributed to investment in one's own academic progression).

The fact that the operationalization of student engagement remains far from well-established means that more research is needed since the overlap in terms, theories, and dimensions often make cross-study comparisons problematic. This is particularly an issue for researchers working in the field of education, for whom it is often interesting to make cross-cultural comparisons. Indeed, student engagement has been a topic of interest in the U.S. (Appleton et al., 2006), Portugal (Moreira Vaz, Dias & Petracchi, 2009), Finland and Denmark (Virtanen, Kiuru, Lerkkanen, Poikkeus and Kuorelahti, 2016), China (Lam, Wong, Yang & Liu, 2012), Romania (Robu, 2012, 2013) and Malaysia (Karim & Hamid, 2016). It is therefore relevant to conduct further investigations of the student engagement construct in order to understand whether a common dimensionality of this construct exists cross-culturally (see Virtanen et al., 2018).

The Student Engagement Instrument (SEI)

Because of its demonstrated association with academic trajectories (e.g. Klem & Connell, 2004; Wang & Eccles, 2012; Wang, & Fredricks, 2014) there has also been a need to develop instruments that accurately assess student engagement. Toward this goal, Appleton et al. (2006) developed a self-report questionnaire, the Student Engagement Instrument (SEI), which aims to evaluate school engagement from an integrative perspective. The underlying conceptualization of student engagement adopted for this instrument was based on theory, predominantly Finn's (1989) participation-identification model and Connell's self-systems processes model (Connell, 1990; Connell & Wellborn, 1991; also McPartland, 1994), but also empirical evidence obtained from an intervention model applied in schools. Both these theoretical and

empirical foundations lead Appleton et al. (2006) to propose a four-part taxonomy of student engagement that highlights the mutual and dynamic influences of individual and contextual factors (academic, behavioral, cognitive, and psychological) on modulating individuals' subjective experiences (Christenson & Anderson, 2002; Reschly & Christenson, 2006). According to Appleton et al., while academic and behavioral engagement receive considerable attention in schools, there is little emphasis the on cognitive and psychological aspects of engagement.

The original version of the SEI, which was specifically constructed to assess cognitive and psychological engagement, was validated with a sample of American 9th graders (Appleton et al., 2006). An exploratory factor analysis using a Promax rotation and subsequent confirmatory factor analysis resulted in a set of 35 items (2 reversed; see Table 1), each scored on a 4-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree). These items were found to be distributed best across six factors. *Control and Relevance of School Work* (CRSW; 9 items), *Future Aspirations and Goals* (FAG; 5 items), and *Extrinsic Motivation* (EM; 2 items) were considered as subcomponents of Cognitive Engagement, while *Teacher–Student Relationships* (TSR; 9 items), *Family Support for Learning* (FSL; 4 items), and *Peer Support for Learning* (PSL; 6 items) were considered as subcomponents of Psychological Engagement[1].

Since this original formulation of the SEI, a number of different authors have championed versions of the SEI using various subsets of the original 35 items and adopting different factorial structures.

Perhaps the most validated SEI adaptation is that offered by Betts, Appleton, Reschly, Chistenson and Huebner (2010). This 33-item version was identical to the original SEI with the exception that the two items pertaining to Extrinsic Motivation, which are both reverse-scored, were removed. In addition to championing a five-factor model consistent with Appleton et al. (2006), this study revealed that the SEI had measurement invariance across gender and school grades. Research has also shown that this version of the SEI has good score reliability (Reschly, Betts, & Appleton, 2014) and is a strong predictor of several academic indicators such as academic performance and positive functioning (Lovelace, Reschly, Appleton, & Lutz, 2014).

[1] Later versions of the SEI have used the term affective engagement rather than psychological engagement, although we shall use the later in order to remain consistent with the original conception of SEI.

One further observation made by Betts et al (2010) was that a series of item pairs had significantly correlated residuals (Items 1 and 5, 10 and 12, 11 and 13, 14 and 15, 22 and 24, and 25 and 26), which could be indicative of item redundancy. A brief version of the SEI (the SEI-B), based on the removal of one item from each of these item pairs, has recently been proposed (Pinzone, Appleton, & Reschly, 2017). The resulting 27-item SEI-B also revealed a five-factor structure and was shown to display longitudinal measurement invariance over three time points.

The first assessment of the SEI applied to a cultural context other than the United States was conducted by Moreira et al. (2009), who tested a Portuguese version (the *Escala de Avaliação do Envolvimento Escolar*) of the original 35-item SEI in a sample of Portuguese students. An exploratory factor analysis with a Promax rotation revealed a six-factor structure consistent with that offered by Appleton et al. (2006), although six of the 35 items were subsequently removed from the instrument due to poor factor loadings. Virtanen et al. (2016) have since tested a series of factorial structures of a Finnish version of the 33-item SEI (Betts et al., 2010) using confirmatory factor analysis. While their analysis revealed that the five-factor structure championed by Betts et al. fit well to the data (CFI = .92; TLI = .91), two alternative models - one with the CRSW dimension divided into three sub-factors, and a second model with two higher-order factors and the CRSW dimension divided into three sub-factors - fit better (CFI = .94, TLI = .94).

Finally, a recent study by Virtanen et al. (2018) aimed to develop a brief version of the SEI based on data collected from Portuguese, Finnish and Danish students. An iterative process, where items with the lowest factor loadings and with correlated residual covariances were eliminated, resulted in a 15-item version of the SEI. The FAG and CRSW factors were shown to be highly correlated (>.90) and were therefore set to load on a second-order factor (Cognitive Engagement). Confirmatory factor analysis indicated that this model fit well to the data in all three countries (CFIs > .95).

Most of the versions of SEI described above assumed that student engagement is a multidimensional construct, demonstrated by the fact that they tested models in factor analysis comprising orthogonal factors (although see Virtanen et al., 2017, who did include a cognitive engagement higher-order factor, and Virtanen et al., 2016, who found good fit for a model including two higher-order factors). This is theoretically intriguing since Appleton et al. (2006) designed the SEI to capture the multiple components of two aspects of engagement - cognitive and psychological –suggesting

that the factors included in these models should load onto two higher-order factors. One study that has directly assessed this prediction is that conducted by Betts (2012). In this study, Betts assessed an extended bifactor model incorporating two general factors and five specific factors, representing CRSW, FAG, TSR, FSL and PSL. The two general factors were allowed to correlate and specific factors were specified to correlated across, but not within, the general factors. Bifactor models like this assess the variation in scores accounted for by specific factors after extracting variation related to general factors. This model showed good fit to the data (CFI = .93, TLI = .92). Furthermore, the cognitive and psychological general factors had a significant but moderate correlation (*r* = .42), suggesting that while cognitive and psychological engagement shared some common features, they were also reasonably distinct.

There is, therefore, little clarity on which set of items, or which factor structure, are optimal for the SEI. Different versions of the SEI have tested models with subsets of 35, 33, 29, 27, and 15 items (see Table 1 for a summary of these different item structures). Most have revealed a structure based on five correlated factors, but models including higher-order factors (Betts, 2012; Virtanen et al., 2016), and models dividing CRSW into sub-factors (Virtanen et al., 2016; 2018), have also shown good model fit.

TABLE 1 ABOUT HERE

Study Objectives

In an attempt to offer some clarity to the current literature on the SEI, our primary aim was to use confirmatory factor analysis to assess and contrast the five different factorial structures championed by Moreira et al. (2009), Betts et al. (2010), Virtanen et al. (2016, 2018) and Pinzone et al. (2017). A further aim was then to assess measurement invariance of the superior model across gender and school level. Finally, we were also interested in tested the internal consistency and construct validity of the SEI.

Method

Participants

We first selected three local schools based on the average amount of government support they obtained for their students. Since the amount of support depends on the average income of students' families, this was taken as a proxy for student socio-economic status. We purposefully chose a school with a low, medium, and high average student socio-economic status to be representative of the overall student population. Having selected these three schools, we asked the school directors to identify further

schools with similar characteristics that might also be willing to participate in the study (Snowball technique). Within each school, teachers opting to participate in the research recruited students, without restriction, from their classes. Informed consent for participation in this study was obtained from a parent or guardian (for participants under 18 years old), and from the participants themselves when over 18.

In total 1,229 Portuguese adolescents and young adults aged between 12 and 21 years old (M = 15.30, SD = 1.77), from 10 schools took part in this study. The sample was nearly equally divided by gender (44.8% male; 55.2% female), and school year (16.7% in 7th Grade; 13.0% in 8th Grade; 13.6% in 9th Grade; 19.9% in 10th Grade; 18.0% in 11th grade; and 18.9% in 12th Grade). The majority of adolescents were enrolled in regular schools (n = 1119; 91.0%) while the remainder (n = 110; 9.0%) were enrolled in vocational schools. The educational level of the student's parents was low, as is representative of the Portuguese population (OECD, 2016): 76.2% of fathers and 74.4% of mothers had left school during or before middle school, and 91.3% of fathers and 88.6% of mothers had left school during or before high school. 67.8% of mothers, and 88.4% of fathers were reported to be in employment.

Measures

Student Engagement Instrument. The participants completed the full 35 items of the SEI (Appleton et al., 2006) translated into Portuguese (Moreira et al., 2009). This Portuguese version was translated following a pre-defined procedure for verifying semantic equivalence including back translation, review by independent experts, and a "think aloud" procedure with peer consultants (Mallinckrodt & Wang, 2004). Reliability of this Portuguese version of the SEI was shown by Moreira et al. to be good for the total scale (α = .84), and acceptable for the six subscales (α = .64 - .79).

Youth Self Report. The YSR (Achenbach, 1991) is a 112-item, self-report measure that assesses socially desired behaviors and behavior problems. Its items should therefore be theoretically distinct, and uncorrelated, from those measuring student engagement and were therefore used to assess divergent validity. The total problem scale, which assess behavioral and emotional functioning, comprises eight sub-scale symptoms rated on a three-point scale (0 = *not true*, 1 = *sometimes true*, 2 = *frequently true*). The YSR assesses internalizing behaviors; anxious/depressed (e.g. "*I'm afraid to go to school*"), somatic complaints (e.g. "*I have nightmares*") and withdrawn/depressed (e.g. "*I like being alone*"); and externalizing behaviors; social problems (e.g. "*I feel lonely*") and thought problems (e.g. *"I hear sounds or voices that*

do not exist"). Participants completed the Portuguese version of the YSR (Fonseca & Monteiro, 1999), which has an acceptable to good internal consistency of its factors (α = .70 to .80), high test-retest reliability, and good convergent and discriminant validity.

Academic Performance. We also obtained a measure of our participants' academic performance: the mean grade obtained across Portuguese and Maths. In Portugal, exam grades at middle school level are given between 0 and 5. At high school exams are graded between 0 and 20.

Procedure

Data Collection. The questionnaires (SEI and YSR) were completed during a class period. All teachers were sent a series of standardized guidelines to follow during the administration of questionnaires to students. This study was approved by the Centro de Investigação em Psicologia para o Desenvolvimento [Research Center on Positive Development], Portugal.

Statistical Analysis. Missing data for the SEI and YSR were replaced with the series mean. Multivariate normality, an assumption of confirmatory analysis, was assessed prior to analysis using the Henze-Zirkler (1990) test to determine the method of model estimation. For each of the predefined factor structures tested (Models 1 to 6, see below for full description) mean engagement scores and standard deviations were calculated for each of the subscales, including higher-order dimensions and total engagement. Internal consistency was then assessed using Cronbach's alpha (α).

Confirmatory Factor Analysis.

Model Specifications. The first series of models tested included those previously defined in past research. Model 1 tested the full 35-item, six-factor model proposed by Appleton et al., (2006). Model 2 tested the six-factor model described by Moreira et al. (2009). Model 3 tested the five-factor model described by Betts et al. (2010). For a more detailed comparison with the results obtained by Betts et al., we also examined the correlated residuals of items for this model. Since Betts considered a threshold of .10 as indicative of a significant relationship between items, we also adopted this cut-off.

Model 4, based on Virtanen et al., (2016), tested the five-factor model, with the CRSW factor specified as a higher-order factor measured by *Control of School Work* (Items 14, 15 and 17), *Relevance of School Work* (Items 11, 13 and 16) and *Validity of Student Assessment* (Items 10 and 12) sub-factors. Model 5 tested the SEI-B proposed by Pinzone et al. (2017), which has a five-factor structure. Model 6 tested the brief SEI

proposed by Virtanen et al. (2018), which has a four factor structure, with cognitive engagement specified as a higher-order factor measured by CRSW and FAG. Finally, Model 7 tested the extended bifactor model offered by Betts (2012) in which the psychological and cognitive factors act as general factors, and CRSW, FAG, TSR, FSL and PSL serve as specific factors. In this model, the general and specific factors for psychological engagement were allowed to correlate with the general and specific factors for cognitive engagement.

Some ancillary models were tested subsequent to this initial series of models. Model 8 tested the factor structure proposed by Moreira et al. (2009) excluding the EM dimension. Model 9 added cognitive and psychological engagement as higher-order factors to Model 7. Model 10 tested the addition of these higher-order factors to the SEI-B offered by Pinzone et al. (2017) and Model 11 tested this addition in the brief SEI offered by Virtanen et al. (2018).

For ease of interpretation standardized estimates are reported despite unstandardized parameters being used in the models. The metrics of each latent factor for both models were defined through setting the first item (see Table 1) as marker indicators (loading of 1 on the factor).

Model Estimation. Because our data violated multivariate normality, we conducted CFAs using the robust Maximum Likelihood (MLM) estimator. The incorrect application of non-robust ML when this assumption is violated includes inflated chi-square values and underestimation of goodness-of-fit indices. To be consistent with the models prescribed by past research, we did not specify any correlated item residuals.

Invariance. To evaluate measurement invariance across school years (middle vs. high school) and gender (males vs. females) we used a multi-group confirmatory factor analysis approach with a series of nested models, each increasing in the number of restrictions applied (Bollen, 1989). In the first stage, measuring configural invariance, unstandardized factor loadings, item residuals, and factor variances/ covariances were unconstrained. This provides a test of the extent to which the model fits across the global sample. Secondly, weak invariance was examined by additionally constraining the standardized factor loadings across groups (school year or gender) to be equal. The application of this set of constraints provides a test of whether items load on the factors similarly across groups. In the third model we examined strong invariance (constraining

factor loadings and intercepts to be equal across groups). Finally, we examined strict invariance by constraining factor loadings, intercepts and residual variances across groups. With large sample sizes χ^2 difference tests tend to be too strict (Quintana & Maxwell, 1999), and invariance was therefore determined based on the change in CFI between models (ΔCFI < .01; Cheung & Rensvold, 2002).

The adjustment of all models were assessed using the Chi-square test (χ^2) and several indices of fit: Tucker-Lewis Index (TLI; Tucker & Lewis, 1973); Comparative Fit Index (CFI; Bentler, 1990); and Root-Mean Square Error Approximation (RMSEA; Hu & Bentler, 1998). To adjust for sample size χ^2/df ratios were also computed. The values considered as a reference for acceptable model fit were: $\chi^2/df \leq 5$ (Schumacker & Lomax, 2010); CFI ≥ .90 (Hu & Bentler, 1999); TLI ≥ .90 (Bentler, 1990); and RMSEA < .08 (Browne & Cudek, 1993).

We also assessed the construct validity of the SEI for middle school and high school students by calculating Pearson's correlations. As an assessment of construct validity, we examined the correlation coefficients between the mean average scores for the items comprising each SEI subscale. Strong correlations between subscales is taken as evidence that they measure theoretically similar constructs (i.e. student engagement). To evaluate divergent validity, we examined the correlations between SEI and YSR subscales. Subscales measuring theoretically distinct constructs should not correlate strongly. Finally, as the subscales of the SEI have been shown to be correlated with academic performance indicators (Appleton et al., 2006), we included mean overall student grade in the correlation matrices. The attainment of meaningful positive correlations here will also be indicative of convergent validity.

The effect size of correlations will be interpreted according the heuristics described by Cohen (1988).

Results

Scale Characteristics and Internal Consistency

Descriptive statistics calculated for the versions of SEI described by Models 1 to 6 revealed that the means and standard deviations for each of the subscales were similar across the five item structures tested, although total engagement was assessed to be slightly higher in the briefer versions.

TABLE 2 ABOUT HERE

Internal consistency estimates for each of the models are also presented in Table 2. Considering first the values of alpha for the total SEI score, it is evident that the reliability of all versions of SEI was good, ranging from .82 to .90. Estimates for the cognitive and emotional dimensions of engagement were also good for all versions of the SEI, ranging between .73 and .88.

Confirmatory Factor Analyses

We assessed multivariate normality prior to CFA for the full set of 35 SEI items. The outcome of the Henze-Zirkler's tests indicated that our data did not display multivariate normality, HZ = 1.06, $p < .001$.

Model fit indices for the first six models tested are presented in Table 3. The Chi-square tests for all four models were found to be significant at $p < .001$, but this was expected with our large sample size. All models showed acceptable fit based on the RMSEA heuristic of <.08, although model 6 (RMSEA = .035) appeared to have the best model fit based on this index. Models 1, 2 and 3 failed to meet the criteria of <.90 required for CFI and TLI. Model 4 had an acceptable fit for CFI (.902) but not for TLI (.892). Models 5 and 6, representing the SEI-B and Brief-SEI structures championed by Pinzone et al. (2017) and Virtanen et al. (2018), had values of CFI and TLI indicative of a good model fit, although the values for Model 5 (CFI = .913, TLI = .902) were less good than for Model 6 (CFI = .973, TLI = .966).

TABLE 3 ABOUT HERE

An investigation of correlated residuals based on Model 3 revealed 12 item pairs. Five of these pairs, with correlated residuals ranging from .11 to .19, were items within the same factor (items 10 and 11, 14 and 15, 25 and 26, 1 and 2, and 19 and 20). Seven correlated item pairs, with correlated residuals ranging from .10 to .15, were evident across different factors (items 13 and 27, 13 and 29, 11 and 5, 7 and 22, 8 and 22, 8 and 23, and 9 and 23). These results reveal only a small similarity with those obtained by Betts et al. (2010) in that only two common correlated residual pairs were identified (items 14 and 15, and items 25 and 26).

Bifactor model. Model 7 (CFI = .914, TLI = .900) was a bifactor model including two general factors, representing the cognitive and emotional engagement higher-order dimension, and five specific factors. The unstandardized and standardized beta coefficients for this model, and unstandardized error variances, are presented in Table 4.

TABLE 4 ABOUT HERE

The majority of standardized beta coefficients (22 items) were higher for general factors than the specific factors, supporting the existence of these higher-order factors. Three items loading on the CRSW dimension (items 11, 12 and 13), and one item loading on the PSL dimension (item 24) did not have significant loadings on their specific factors, although their beta coefficients for the general factors were significant. All items had more than 50% of their variance accounted for by the model (error variance ranging between .16 and .45). The cognitive and emotional higher-order factors correlated strongly (r = .70) supporting the idea that both underlie an overarching concept of engagement, but also that these factors have some individual characteristics. Consistent with Betts (2012) we observed a moderate correlation between the CRSW specific factor and the general emotional engagement factor (r = .41) after the variation of the general factors had been extracted. The correlations between the other specific factors and their opposing general factor were weak (-.15 to .21).

Ancillary Models. Having tested the original structures offered by past research, our aim was to test some additional models. The first of these, model 8, was an adaptation of the Moreira et al. (2009) model, but with the EM factor removed. Although, the two reverse-coded items relating to this factor have been deemed by other researchers to be problematic for the SEI (Betts et al., 2010), this particular five-factor model did not present a combination of fit indices indicative of acceptable model fit (CFI = .904, TLI = .892).

Since the bifactor model supported the existence of two higher-order factors, we tested the subsets of items defined by Moreira et al (2009; model 9), Pinzone et al. (2017, model 10) and Virtanen et al. (2018; model 11) with models incorporating higher-order factors. Models 9 (CFI = .894, TLI = .883) and 10 (CFI = .901, TLI = .891) failed to reach the values for both CFI and TLI representative of an acceptable fit to the data. Model 11, however, indicated that the brief version of the SEI proposed by Virtanen et al. (2018) fit well to the data with the addition of two higher-order factors (CFI = .961, TLI = .951). The factor structure and standardized loadings of this model are shown in Figure 1.

FIGURE 1 ABOUT HERE

We therefore proceeded to examine measurement invariance with this model.

Measurement invariance. Multi-group confirmatory analyses were first conducted to test the factorial invariance in Model 11 across gender and school level (Table 5). Changes in CFI revealed that there were no significant changes in the model with the addition of constraints on factor loadings, intercepts and residuals, $\Delta CFI < .01$, providing evidence of strict invariance. The observed changes to RMSEA also confirmed that the addition of constraints did not drastically alter the fit of the model. When repeated to test invariance across school grade, multi-group confirmatory analyses suggested that the SEI achieved weak invariance, $\Delta CFI = .002$, and strong invariance, $\Delta CFI = .008$, but not strict invariance, $\Delta CFI = .036$.

TABLE 5 ABOUT HERE

Construct Validity

Table 6 presents Pearson correlations between the subscales of SEI (convergent validity), YSR (divergent validity), and student academic performance. Two common patterns emerge between the subsamples. Firstly, students had moderate to strong correlations between SEI subscales. The strongest correlations were between subscales loading on the same higher-order factor. Secondly, the SEI subscales showed weak negative correlations with Internalizing, Externalizing, and Total Problems.

Finally, the sub-components of cognitive and psychological engagement (excluding peer support for learning) correlated weakly, yet significantly, with academic performance. In particular, FAG ($r = .23$), CRSW ($r = .17$) and FSL ($r = .13$) had the largest correlations.

TABLE 6 ABOUT HERE

Discussion

The broad objective of this study was to test the factorial structure and validity of the Students Engagement Instrument (SEI), with the aim to determine which of several factorial structures and subsets of items best fits data obtained from a sample of Portuguese adolescents. A series of initial confirmatory factor analyses revealed that while two different brief-SEI factor structures fit our data acceptably, versions with more items did not. Consistent with the theoretical formulation of the SEI by Appleton et al. (2006), a bifactor model confirmed that it is appropriate to consider the SEI subscales as subcomponents of two higher-order dimensions in our sample. Further models incorporating these higher-order factors showed that one brief version of the SEI with 15 items fit our data well. This model showed strict measurement invariance

across gender, and strong measurement invariance across school year and good internal consistency.

The Brief-SEI

This study offers some clarity to researchers, clinicians and educators wishing to use the SEI by providing evidence in favor of one particular version over others presented in the SEI literature. While the 33-item version of SEI championed by Betts et al. (2010) has been validated on several occasions in American samples (e.g. Lovelace et al., 2014; Reschly, et al., 2011), our analyses showed that it had an unsatisfactory fit to our data. This casts doubt on its suitability beyond the United States. Conversely, the 15-item Brief-SEI has been validated, and indeed shown to be invariant, across two cultures other than Portugal – Finland and Denmark – suggesting that it may be a more suitable instrument to adopt when wishing to make cross-cultural comparisons. Our study further adds to the findings of Virtanen et al. (2018), which also indicated that the 15-item Brief SEI had measurement invariance across gender and different levels of academic achievement, by showing that it is invariant across different school years.

But why adopt this particular structure when the SEI-B, offered by Pinzone et al. (2017), also had acceptable fit? We argue that because Appleton et al. (2006) designed the SEI to assess two distinct components of engagement, models tested by factor analyses should incorporate two higher-order dimensions. Our results revealed that the SEI-B does not model these higher-order dimensions acceptably in our sample. In other words, if one choses to use the SEI-B to assess student engagement it may be inappropriate to interpret scores for cognitive and psychological engagement. Further, Pinzone et al. chose to develop the SEI-B by eliminating one item from each pair of items observed by Betts et al. (2010) to have correlated residuals. Our own assessment of correlated residuals in this model identified just two of the same item pairs. This is problematic for Pinzone et al. since it suggests that their choice of items to remove was guided by statistical artifacts, or sample specific factors. This therefore implies that the subset of items used by the SEI-B may not be the most appropriate for use with students from contexts beyond that tested. Alternatively, in combination with its confirmed validity, our study indicates that the structure offered by the Portuguese version of the Brief-SEI tested in the present study is more consistent with Appleton's original theoretical conceptualization of student engagement than other Brief versions (e.g. including 2 higher-order factors of cognitive and psychological engagement, rather than

only one higher-order factor of cognitive engagement), and thus ideal for measuring this construct in adolescents.

One consideration is that the models representing other versions of SEI might have shown better fit after a process of inspecting modification indices and gradually allowing for the free estimation of correlated residuals. However, without good theoretical reasons to do so, post hoc modifications like this, especially when model fit can be argued to have been achieved, can be construed as opportunistic and bad practice (Brown, 2006). Further, these confirmatory factor analyses were meant only to describe the structure of SEI and not to force modification of its content in order to conform to a simple structure.

As a final point on factorial structure, although our results clearly support the Brief-SEI, it is unclear whether all the items included in this version of the instrument are theoretically sound. For example, item 29 "*I am hopeful about my future*" is problematic considering that students can be hopeful about their futures without being engaged with school (Moreira et al., 2015), without aspiring to continue in education, or without believing that a school education will be useful for their futures (consider, for example, aspiring professional athletes). Nonetheless, we reran model 11, replacing this item with item 25 "*I plan to continue my education following high school",* and found comparably acceptable model fit. This issue might therefore be suitably remedied by the substitution of single items.

Our results demonstrated that the Brief-SEI subscales had strong correlations, indicating good construct validity, and that these subscales had low correlations with behavioral problems, indicating good divergent validity. However, the correlations with academic performance were weaker than we expected. Nonetheless, this finding is consistent with previous research which has emphasized the importance of student's engagement for academic performance (Appleton et al., 2006; Lovelace et al., 2014), including analysis using the same subset of items (Virtanen et al., 2018). For example, Appleton found a weak positive correlation between FAG and student grade point average (GPA; r = .25) and weak positive correlations with the other subscales. It has been shown that student engagement with school decreases from middle school to high school (Eccles & Wigfield, 1992; Marks, 2000; Stipek, 2002) and a range of factors other than engagement, such as academic goals, have also been shown to be predictive of a significant amount of variance in academic performance for high school students (Moreira, Dias, Vaz & Vaz, 2013). The high school environment typically encourages a

greater focus on performance goals (e.g. greater emphasis on exam performance) compared to middle school (Midgley, 2014). Considering that a large proportion of our sample were high school students, it is possible that the weak correlation between engagement and academic performance is a result of other factors, such as learning strategies, becoming important in determining academic performance than students' subjective experiences.

Curiously, past research has shown negative associations between the CRSW factor and measures of reading and mathematics (Appleton et al., 2006; Lovelace et al., 2014) whereas our results showed the opposite. Lovelace et al. argued that their findings might be attributable to psychometrics: CRSW had lower factor loadings than other factors, suggesting that there may be issues with construct validity. In support of this, other studies have found poor fit for five-factor models due to low factor loadings for CRWS and found better fit for a four-factor model excluding this subscale (Grier-Reed et al., 2012). The bifactor model also highlighted that CRSW had a moderate correlation with the psychological engagement factor, despite being defined as a subcomponent of cognitive engagement. This suggests that there may be issues with the overall conceptualization of SEI that should be addressed by future research. At the very least, researchers should consider whether alterations to the phrasing of some CRSW items, or removal of this dimension altogether, is appropriate.

Practical Implications

This study is useful for guiding school teachers and psychologists wishing to choose a version of the SEI to conduct school-level monitoring of psychological and cognitive engagement of students. It demonstrates that the Brief-SEI is a valid instrument with sound psychometric properties and with the additional benefit of being quick to complete and easy to administer. As such, this instrument may prove useful for identifying students with a low engagement with school, and thus enabling the enactment of targeted interventions.

Future Directions

While our study has highlighted various studies interested in assessing engagement with school in adolescents using the SEI, other researchers have focused on adapting this instrument for use with different age groups, included younger children (Carter, Reschly, Lovelace, Appleton & Thompson, 2012) and college/university students (Grier-Reed, Appleton, Rodriguez, Ganuza & Reschly, 2012; Karim & Hamid, 2016;

Waldrop, Reschly, Fraysier & Appleton, in press). These scales are typically adaptations of the full 35 items presented by Appleton et al. (2006) or the 33 items presented by Betts et al. (2010) and are altered by replacing words such as "*school*" with "*college/university*" and "*adults*" with "*faculty/professors*". Interestingly, at least two of these studies have championed 4-factor structures as opposed to the 5 or 6 most often revealed in past research using adolescents (Carter et al., 2012; Grier-Reed et al., 2012), indicating that there may be significant differences in the meaning of engagement between students at different points in their educations. With the exception of the study conducted by Karim and Hamid (2016), these altered versions of the SEI have been tested uniquely in the U.S., and it is important that such effects are examined cross-culturally. We propose that the model championed in this article, the 15-item Brief-SEI, may serve as an excellent tool for doing so due to its proven invariance across cultures, gender and school ability, good internal consistency, and theoretical superiority (ability to acceptably model higher-order dimensions) to other versions.

References

Achenbach, T. (1991). *Manual for the Youth Self-Report and 1991 Profile*. Burlington, VT: University of Vermont, Department of Psychiatry.

Appleton, J. J., Christenson, S. L., & Furlong, M. J. (2008). Student engagement with school: Critical conceptual and methodological issues of the construct. *Psychology in the Schools*, *45*(5), 369-386. http://dx.doi.org/10.1002/pits.20303

Appleton, J. J., Christenson, S. L., Kim, D., & Reschly, A. L. (2006). Measuring cognitive and psychological engagement: Validation of the Student Engagement Instrument. *Journal of School Psychology*, *44*(5), 427-445. http://dx.doi.org/10.1016/j.jsp.2006.04.002

Baker, J. A. (2006). Contributions of teacher–child relationships to positive school adjustment during elementary school. *Journal of School Psychology*, *44*(3), 211-229.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological bulletin, 107*(2), 238-246.

Betts, J. (2012). Issues and methods in the measurement of student engagement: Advancing the construct through statistical modeling. In S.L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 783-803). Boston: Springer US.

Betts, J. E., Appleton, J. J., Reschly, A. L., Christenson, S. L., & Huebner, E. S. (2010). A study of the factorial invariance of the student engagement instrument (SEI): Results from middle and high school students. *School Psychology Quarterly*, *25*(2), 84–93. http://dx.doi.org/10.1037/a0020259

Bollen, K. (1989). *Structural equations with latent variables.* New York: Wiley.

Bronfenbrenner, U. (Ed.). (2005). *Making human beings human: Bioecological perspectives on human development*. London: Sage.

Brown, T.A. (2006). *Confirmatory Factor Analysis for Applied Research.* New York: Guilford.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing Structural Equation Models* (pp. 136-162). Newbury Park, CA: Sage Publications.

Byrne, B. M. (1994). *Structural equation modeling with EQS and EQS/Windows: Basic concepts, applications, and programming.* Sage.

Carter, C. P., Reschly, A. L., Lovelace, M. D., Appleton, J. J., & Thompson, D. (2012). Measuring student engagement among elementary students: Pilot of the Student Engagement Instrument—Elementary Version. *School Psychology Quarterly*, *27*(2), 61-73.

Cavendish, W. (2013). Students perceptions of school efforts to facilitate student involvement, school commitment, self-determination, and high school graduation. *Social Psychology of Education, 16*(2), 257-275. http://dx.doi.org/10.1007/s11218-013-9212-z

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural equation modeling, 9*(2), 233-255.

Christenson, S. L., & Anderson, A. R. (2002). Commentary: The centrality of the learning context for students' academic enabler skills. *School Psychology Review, 31*(3), 378-393.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Earlbaum Associates.

Connell, J. P. (1990). Context, self, and action: A motivational analysis of the self-system processes across the life-span. In D. Cicchetti (Ed.), *The self in transition: Infancy to childhood* (pp. 61–97). Chicago: University of Chicago Press.

Connell, J. P., & Wellborn, J. G. (1991). Competence, autonomy, and relatedness: A motivational analysis of self-system processes. In M. Gunnar & L. A. Sroufe (Eds.), *Minnesota symposium on child psychology* (Vol. 23, pp. 167-216). Chicago: University of Chicago Press.

Deci, E. L., & Ryan, R. M. (2010). *Self-determination: Basic psychological needs in motivation, development and wellness*. London: John Wiley & Sons, Inc.

Eccles, J. S., Midgley, C., Wigfield, A., Buchanan, C. M., Reuman, D., Flanagan, C., & Mac Iver, D. (1993). Development during adolescence: the impact of stage-environment fit on young adolescents' experiences in schools and in families. *American psychologist*, *48*(2), 90-101.

Eccles, J.S., & Wigfield, A. (1992). The development of achievement-task values: A theoretical analysis. *Developmental Review, 12,* 265-310.

Finn, J. D. (1989). Withdrawing from school. *Review of Educational Research, 59*(2), 117–142.

Fonseca, A.C., & Monteiro, C.M. (1999). Um inventário de problemas do comportamento para crianças e adolescentes: O youth self-report de Achenbach. *Psychologica, 21,* 79-96.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of educational research*, *74*(1), 59-109.

Grier-Reed, T., Appleton, J., Rodriguez, M., Ganuza, Z., & Reschly, A. L. (2012). Exploring the Student Engagement Instrument and career perceptions with college students. *Journal of Educational and Developmental Psychology, 2*(2), 85-96.

Henze, N., & Zirkler, B. (1990). A class of invariant consistent tests for multivariate normality. *Communications in Statistics-Theory and Methods, 19*(10), 3595-3617.

Karim, M. I., Hamid, H.S.A. (2016). Factor structure of the student engagement instrument among Malaysian undergraduates. *Jurnal Psikologi Malaysia, 30*(2), 1 – 12.

Klem, A. M., & Connell, J. P. (2004). Relationships matter: Linking teacher support to student engagement and achievement. *Journal of School Health, 74*(7), 262-273.

Lam, S-f., Wong, B.P.H., Yang, H., & Liu, Y. (2012). Understanding student engagement with a contextual model. In S.L. Christenson, A.L. Reschly & C.

Wylie (Eds.), *Handbook of Research on Student Engagement* (pp. 403-420). New York; Springer.

Li, Y. & Lerner, R. M. (2011). Trajectories of school engagement during adolescence: Implications for grades, depression, delinquency, and substance use. *Developmental Psychology*, *47*(1), 233-247. http://dx.doi.:10.1037/a0021307

Lovelace, M. D., Reschly, A. L., Appleton, J. J., & Lutz, M. E. (2014). Concurrent and predictive validity of the student engagement instrument. *Journal of Psychoeducational Assessment, 32*(6), 509–520. http://dx.doi.org/10.1177/0734282914527548

Mallinckrodt, D., & Wang, C. (2004). Quantitative methods for verifying semantic equivalence of translated research instruments: A Chinese version of the experiences in close relationships scale. *Journal of Counseling Psychology, 51*, 368-379.

Marks, H.M. (2000). Student engagement in instructional activity: Patterns in the elementary, middle, and high school years. *American Educational Research Journal*, *37*(1), 153-184.

McPartland, J.M. (1994). Dropout prevention in theory and practice. In R. J. Rossi (Ed.), *Schools and students at risk: context and framework for positive change* (pp. 255 – 276). New York, NY: Teachers College.

Midgley, C. (Ed.). (2014). *Goals, goal structures, and patterns of adaptive learning*. Oxford: Routledge.

Moreira, P. A. S., Dias, P., Vaz, F. M., & Vaz, J. M. (2013). Predictors of academic performance and school engagement: Integrating persistence, motivation and study skills perspectives using person-centered and variable-centered

approaches. *Learning and Individual Differences, 24*(0), 117-125. http://dx.doi.org/10.1016/j.lindif.2012.10.016

Moreira, P. A. S., Cloninger, R. C., Dinis, L., Sá, L., Oliveira, J.T., Dias, A. & Oliveira, J. (2015). Personality and well-being in adolescents. *Frontiers in Psychology* 5: 1494. http://dx.doi.org/10.3389/fpsyg.2014.01494

Moreira, P. A. S., Oliveira, J. T., Cloninger, K. M., Azevedo, C., Sousa, A., Castro, J., & Cloninger, C. R. (2012). The psychometrics and validity of the Junior Temperament and Character Inventory in Portuguese adolescents. *Comprehensive Psychiatry, 53*(8), 1227-1236. http://dx.doi.org/10.1016/j.comppsych.2012.04.014

Moreira, P. A. S., Oliveira, J. T., Dias, P., Vaz, F. M., & Torres-Oliveira, I. (2014). The Students' Perceptions of School Success Promoting Strategies Inventory (SPSI): Development and validity evidence based studies. *The Spanish Journal of Psychology, 17*, E61. http://dx.doi.org/10.1017/sjp.2014.62

Moreira, P. A. S., Vaz, F. M., Dias, P. C., & Petracchi, P. (2009). Psychometric properties of the Portuguese version of the Student Engagement Instrument. *Canadian Journal of School Psychology*, *24*(4), 303-317. http://dx.doi.org/10.1177/0829573509346680

Norris, C., Pignal, J., & Lipps, G. (2003). Measuring school engagement. *Education Quarterly Review*, *9*(2), 25-34.

OECD (2016). *Education at a Glance: OECD Indicators.* OECD Publishing, Paris. *http://dx.doi.org/10.187/eag-2016-en*

Quintana, S. M., & Maxwell, S. E. (1999). Implications of recent developments in structural equation modeling for counseling psychology. *The Counseling Psychologist*, *27*(4), 485-527.

Reschly, A. L., Betts, J., & Appleton, J. J. (2014). An examination of the validity of two measures of student engagement. *International Journal of School & Educational Psychology, 2*(2), 106-114.

Reschly, A., & Christenson, S. L. (2006). School completion. In G. Bear, & K. Minke (Eds.), *Children's Needs III: Development, Prevention, and Intervention*. Washington DC: National Association of School Psychologists.

Robu, V. (2012). Antecedents of school engagement among Romanian adolescents. *Romanian Journal of School Psychology, 5,* 15-46.

Robu, V. (2013). Perceived social support, school engagement, and school adjustment among adolescents: Testing a structural model of relationships. *Romanian Journal of School Psychology, 6,* 7-29.

Schumacker, R. E., & Lomax, R. G. (2010). *A beginner's guide to structural equation modeling* (3rd ed.). New York: Routledge.

Sciarra, D. T., & Seirup, H. J. (2008). The multidimensionality of school engagement and math achievement among racial groups. *Professional School Counseling, 11*(4), 218-228.

Stipek, D. (2002). *Motivation to learn: Integrating theory and practice (4th ed.).* Boston: Allyn and Bacon.

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika*, *38*(1), 1-10.

Virtanen, T. E., Kiuru, N., Lerkkanen, M., Poikkeus, A., & Kuorelahti, M. (2016). Assessment of student engagement among junior high school students and associations with self-esteem, burnout and academic achievement. *Journal of Educational Research Online*, *8*(2), 136-157.

Virtanen, T., Moreira, P.A.S., Andersson, H. Ulvseth, H., Tetler, S., & Kuorelahti, M. (2018). Analyzing measurement invariance of the Students' Engagement Inventory brief version: The cases of Denmark, Finland and Portugal. *Canadian Journal of Psychology, 33*(4), 297-313.

Waldrop, D., Reschly, A. L., Fraysier, K., & Appleton, J. J. (2018). Measuring the engagement of college students: Administration format, structure, and validity of the Student Engagement Instrument-College. *Measurement and Evaluation in Counseling and Development*. Advance online publication. Retrieved from https://www.tandfonline.com/doi/full/10.1080/07481756.2018.1497429

Wang, M. T. (2009). School climate support for behavioral and psychological adjustment: Testing the mediating effect of social competence. *School Psychology Quarterly*, *24*(4), 240-251.

Wang, M. T., & Eccles, J. S. (2012). Social support matters: Longitudinal effects of social support on three dimensions of school engagement from middle to high school. *Child Development, 83*(3), 877-895.

Wang, M. T., & Eccles, J. S. (2013). School context, achievement motivation, and academic engagement: A longitudinal study of school engagement using a multidimensional perspective. *Learning and Instruction, 28*(0), 12-23.

Wang, M. T., & Holcombe, R. (2010). Adolescents' perceptions of school environment, engagement, and academic achievement in middle school. *American Educational Research Journal*, *47*(3), 633-662.

Wang, M. T., & Fredricks, J. A. (2014). The reciprocal links between school engagement, youth problem behaviors, and school dropout during adolescence. *Child Development, 85*(2), 722-737.

Wang, M. T., Willett, J. B., & Eccles, J. S. (2011). The assessment of school engagement: Examining dimensionality and measurement invariance by gender and race/ethnicity. *Journal of School Psychology, 49*(4), 465-480. http://dx.doi.org/10.1016/j.jsp.2011.04.001

Way, N., Reddy, R., & Rhodes, J. (2007). Students' perceptions of school climate during the middle school years: Associations with trajectories of psychological and behavioral adjustment. *American Journal of Community Psychology, 40*, 194 –213. http://dx.doi.org/10.1007/s10464-007-9143-y

Table 1.

Item subsets of different versions of the Student Engagement Instrument.

Version	Number of Items	Control and Relevance of School work	Future Aspirations and Goals	Extrinsic Motivation	Teacher-Student Relationship	Family Support for Learning	Peer Support for Learning
Appleton et al. (2006)	35	10, 11, 12, 13, 14, 15, 16, 17, 18	25, 26, 27, 28, 29	34, 35	1, 2, 3, 4, 5, 6, 7, 8, 9	30, 31, 32, 33	19, 20, 21, 22, 23, 24
Moreira et al. (2009)	29	10, 11, 12, 13, 16, 17	25, 26, 27	34, 35	1, 2, 3, 4, 5, 6, 7, 9	30, 31, 32, 33	19, 20, 21, 22, 23, 24
Betts et al. (2010)	33	10, 11, 12, 13, 14, 15, 16, 17, 18	25, 26, 27, 28, 29	-	1, 2, 3, 4, 5, 6, 7, 8, 9	30, 31, 32, 33	19, 20, 21, 22, 23, 24
Virtanen et al. (2016)	31	10, 11, 12, 13, 14, 15, 16, 17	25, 26, 27, 28, 29	-	1, 2, 3, 4, 5, 6, 7, 9	30, 31, 32, 33	19, 20, 21, 22, 23, 24
Pinzone et al. (2017)	27	12, 13, 15, 16, 17, 18	25, 27, 28, 29	-	1, 2, 3, 4, 6, 7, 8, 9	30, 31, 32, 33	19, 20, 21, 23, 24
Virtanen et al. (2018)	15	12, 13, 16	27, 28, 29	-	1,3,6	31, 32, 33	20, 21, 23

1. Overall, adults at my school treat students fairly
2. Adults at my school listen to the students.
3. At my school, teachers care about students.
4. My teachers are there for me when I need them.
5. The school rules are fair
6. Overall, my teachers are open and honest with me.
7. I enjoy talking to the teachers here.
8. I feel safe at school.
9. Most teachers at my school are interested in me as a person, not just as a student
10. The tests in my classes do a good job of measuring what I'm able to do.
11. Most of what is important to know you learn in school.
12. The grades in my classes do a good job of measuring what I'm able to do.
13. What I'm learning in my classes will be important in my future
14. After finishing my schoolwork I check it over to see if it's correct
15. When I do schoolwork I check to see whether I understand what I'm doing.
16. Learning is fun because I get better at something
17. When I do well in school it's because I work hard.
18. I feel like I have a say about what happens to me at school.
19. Other students at school care about me.
20. Students at my school are there for me when I need them
21. Other students here like me the way I am
22. I enjoy talking to the students here
23. Students here respect what I have to say
24. I have some friends at school.
25. I plan to continue my education following high school
26. Going to school after high school is important
27. School is important for achieving my future goals
28. My education will create many future opportunities for me.
29. I am hopeful about my future
30. My family/guardian(s) are there for me when I need them
31. When I have problems at school my family/guardian(s) are willing to help me.
32. When something good happens at school, my family/guardian(s) want to know about it.
33. My family/guardian(s) want me to keep trying when things are tough at school.
34. I'll learn, but only if my family/guardian(s) give me a reward. (Reversed)
35. I'll learn, but only if the teacher gives me a reward. (Reversed)

Table 2.

Descriptive statistics and scale reliability for six versions of the SEI, each including different subsets of items.

		Appleton et al. (2006)		Moreira et al. (2009)		Betts et al. (2010)		Virtanen et al. (2016)		Pinzone et al. (2017)		Virtanen et al. (2018)	
		M (SD)	α	M (SD)	α	M (SD)	α	M (SD)	α	M (SD)	α	M (SD)	α
COG		3.03 (.34)	.80	2.97 (.36)	.73	3.21 (.40)	.86	3.23 (.41)	.87	3.26 (.40)	.84	3.33 (.46)	.85
	CRSW	3.09 (.41)	.82	3.16 (.46)	.83	3.09 (.41)	.82	3.10 (.43)	.83	3.16 (.42)	.79	3.24 (.52)	.83
	FAG	3.42 (.50)	.85	3.43 (.58)	.86	3.42 (.50)	.85	3.42 (.50)	.85	3.42 (.50)	.83	3.43 (.51)	.85
	EM	1.74 (.76)	.90	1.74 (.76)	.90	-	-	-	-	-	-	-	-
PSYCH		3.12 (.36)	.88	3.14 (.35)	.87	3.12 (.36)	.88	3.12 (.36)	.87	3.13 (.36)	.87	3.16 (.38)	.81
	TSR	2.95 (.43)	.85	2.98 (.43)	.85	2.95 (.43)	.85	2.93 (.44)	.84	2.95 (.45)	.84	3.02 (.50)	.82
	FSL	3.48 (.46)	.84	3.48 (.46)	.84	3.48 (.46)	.84	3.48 (.46)	.84	3.48 (.46)	.84	3.43 (.49	.84
	PSL	3.13 (.45)	.85	3.13 (.45)	.85	3.13 (.45)	.85	3.13 (.45)	.85	3.10 (.46)	.84	3.03 (.51)	.84
TOTAL		3.08 (.32)	.90	3.08 (.32)	.88	3.16 (.34)	.92	3.16 (.35)	.91	3.18 (.34)	.90	3.23 (.36)	.86

Note. COG = Cognitive Engagement; *CRSW* = Control and Relevance of School Work; *FAG* = Future Aspirations and Goals; *PSYCH* = Psychological Engagement; *TSR* = Teacher-Student Relationships; *FSL* = Family Support for Learning; *PSL* = Peer Support for Learning

Table 3.

Fit indices of a series of models tested from in past literature.

Model	χ^2	*df*	χ^2/df	CFI	TLI	RMSEA	95% CI
1. Appleton et al., (2006)	2,082	545	3.82	.878	.866	.048	[.046, .050]
2. Moreira et al., (2009)	1,423	362	3.93	.897	.884	.049	[.046, .052]
3. Betts et al., (2010)	1,875	485	3.87	.882	.872	.048	[.046, .051]
4. Virtanen et al., (2016)	1,533	421	3.64	.902	.892	.046	[.044, .049]
5. Pinzone et al., (2017)	1,111	314	3.54	.913	.902	.045	[.043, .048]
6. Virtanen et al., (2018)	204	82	2.49	.973	.966	.035	[.029, .041]
			Bifactor Model				
7. Betts (2012)	1,477	456	3.24	.914	.900	.043	[.040, .045]
			Ancillary Models				
8. Moreira et al., (2009)	1,236	314	3.94	.904	.892	.049	[.046, .052]
9. Moreira et al., (2009)	1,332	318	4.19	.894	.883	.051	[.048, .054]
10. Pinzone et al., (2017)	1,218	318	3.83	.901	.891	.048	[.045, .051]
11. Vertanen et al., (2018)	262	84	3.12	.961	.951	.042	[.036, .047]

Table 4

Unstandardized factor coefficients (standardized coefficients) and unstandardized error variances.

Item	COG	PSYCH	CRSW	FAG	TSR	FSL	PSL	Error Variance
10	1.00 (.57)		1.00 (.16)					.29
11	0.99 (.49)		0.59 (.08)					.44
12	1.14 (.67)		0.24 (.04)					.23
13	1.26 (.74)		-0.67 (-.11)					.18
14	0.69 (.34)		2.40 (.33)					.45
15	0.73 (.46)		2.62 (.45)					.21
16	0.93 (.50)		0.74 (.11)					.36
17	0.88 (.49)		1.65 (.25)					.32
18	0.44 (.24)		1.98 (.30)					.41
25	0.83 (.41)			1.00 (.60)				.28
26	0.88 (.45)			0.92 (.56)				.27
27	1.07 (.61)			0.46 (.31)				.24
28	0.92 (.59)			0.34 (.26)				.21
29	0.96 (.55)			0.23 (.16)				.30
1		1.00 (.36)			1.00 (.49)			.27
2		1.17 (.41)			1.03 (.49)			.27
3		1.37 (.48)			0.80 (.38)			.28
4		1.36 (.51)			0.73 (.37)			.24
5		1.07 (.33)			1.06 (.44)			.40
6		1.28 (.47)			0.84 (.42)			.25
7		1.19 (.41)			0.93 (.43)			.31
8		1.37 (.49)			0.25 (.12)			.32
9		1.38 (.41)			0.57 (.23)			.47
30		1.01 (.39)				1.00 (.48)		.23
31		1.14 (.42)				1.44 (.65)		.16
32		1.42 (.51)				0.91 (.40)		.25
33		1.37 (.53)				0.52 (.25)		.24
19		1.24 (.43)					1.00 (.60)	.20
20		1.29 (.45)					0.93 (.56)	.22
21		1.30 (.47)					0.59 (.37)	.26
22		1.36 (.51)					0.40 (.26)	.26
23		1.39 (.51)					0.69 (.44)	.22
24		1.31 (.49)					0.12 (.08)	.30

Note. COG = Cognitive Engagement; *PSYCH* = Psychological Engagement; *CRSW* = Control and Relevance of School Work; *FAG* = Future Aspirations and Goals; *TSR* = Teacher-Student Relationships; *FSL* = Family Support for Learning; *PSL* = Peer Support for Learning

Table 5.

Gender and school level invariance for the 5 first-order, two second-order factors (Model 11).

	Δχ2	*Δdf*	*p*	CFI	ΔCFI	RMSEA	ΔRMSEA
Gender Invariance:							
Configural Invariance	373.78			.955		.045	
Weak Invariance	17.63	13	.172	.954	.001*	.043	.001
Strong Invariance	24.18	8	.002	.951	.004*	.044	.001
Strict Invariance	37.99	15	<.001	.946	.005*	.045	.000
School Grade Invariance:							
Configural Invariance	893.68			.915		.061	
Weak Invariance	75.20	65	.182	.913	.002*	.059	.003
Strong Invariance	78.76	40	<.001	.905	.008*	.059	.001
Strict Invariance	241.52	75	<.001	.868	.036	.066	.006

Note. * indicates determination of invariance.

Table 6.

Pearson's correlation coefficient matrix demonstrating convergent validity (intercorrelations between SEI subscales, and correlations between SEI subscales and mean academic performance) and divergent validity (correlations between SEI and YSR subscales).

	SEI								YSR			
	CRSW	FAG	TSR	FSL	PSL	COG	EMO	ENGAGE	INT.	EXT.	TOTAL	GRADE
CRSW	1											
FAG	**.57****	1										
TSR	**.40****	**.33****	1									
FSL	**.43****	**.50****	**.35****	1								
PSL	**.25****	**.29****	**.38****	**.32****	1							
COG	**.89****	**.88****	**.41****	**.52****	**.30****	1						
PSYCH	**.48****	**.49****	**.77****	**.74****	**.76****	**.55****	1					
ENGAGE	**.80****	**.80****	**.66****	**.71****	**.58****	**.90****	**.86****	1				
INT.	-.05	-.06*	-.06*	-.11**	-.21**	-.06*	-.17**	-.13**	1			
EXT.	-.09**	-.10**	-.12**	-.14**	-.09**	-.11**	-.15**	-.14**	**.60****	1		
TOTAL	-.09**	-.10**	-.10**	-.14**	-.17**	-.10**	-.19**	-.16**	**.87****	**.88****	1	
GRADE	.17**	.23**	.06*	.13**	-.02	.23**	.08**	.18**	.02	-.10**	-.06	1

Note. Values in bold represent Pearson correlations with medium to large effect sizes; $r > .30$. *CRSW* = Control and Relevance of School Work; *FAG* = Future Aspirations and Goals; *TSR* = Teacher-Student Relationships; *FSL* = Family Support for Learning; *PSL* = Peer Support for Learning; *COG* = Cognitive Engagement; *PSYCH* = Psychological Engagement; *ENGAGE* = Student Engagement; *INT*. = Internalizing; *EXT*. = Externalizing; *TOTAL* = Total Problems; *GRADE* = Academic Performance

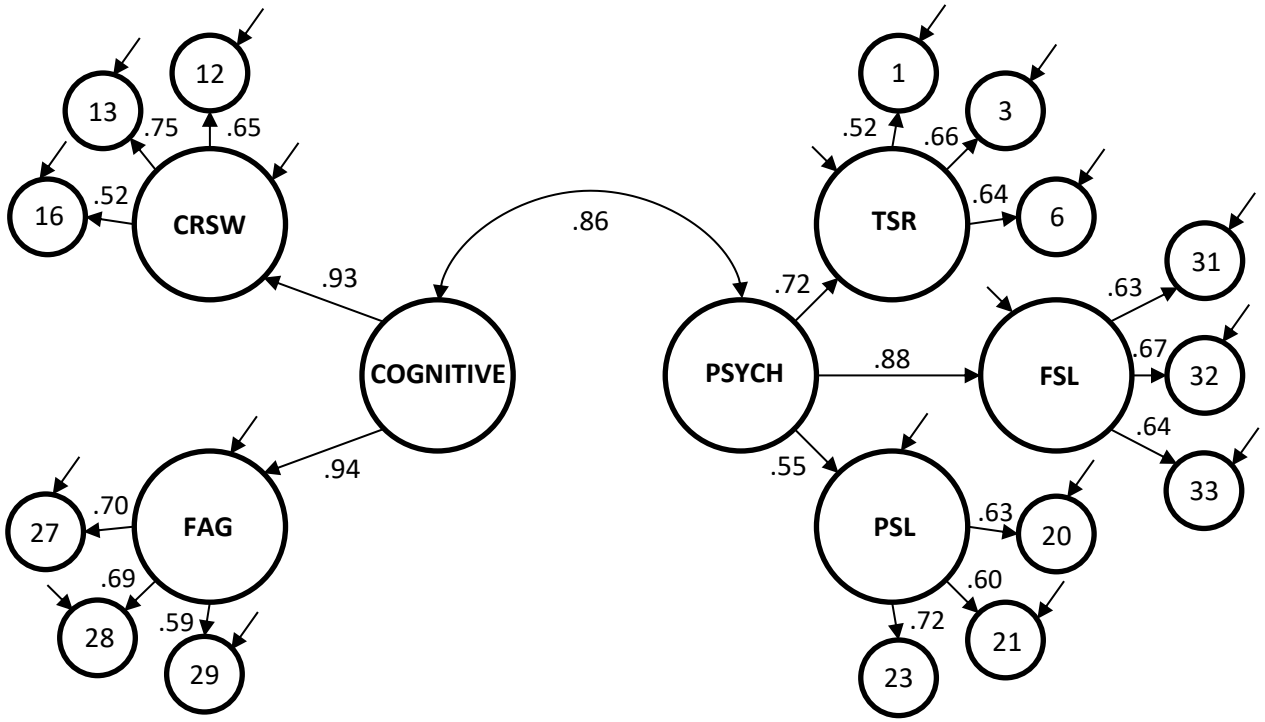

Figure 1. Factor structure and fully standardized loadings for Model 11 (item subset proposed by Virtanen et al., 2018, with the addition of two higher-order factors). Arrows without values represent the influence of error variance. *COGNITIVE*=Cognitive Engagement; *PSYCH*=Psychological Engagement; C*RSW*=Control and Relevance of School Work; *FAG*=Future Aspirations and Goals; *TSR*=Teacher-Student Relationships; *FSL*=Family Support for Learning; *PSL*=Peer Support for Learning.