Measuring Engagement in 4th to 12th Grade Classrooms:
The Classroom Engagement Inventory

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Abstract

Research on factors that may promote engagement is hampered by the absence of a measure of classroom-level engagement. Literature suggests that engagement may have three dimensions – affective, behavioral, and cognitive. No existing engagement scales measure all three dimensions at the classroom level. The Classroom Engagement Inventory (CEI) was developed to fill this gap. In Study 1, exploratory and confirmatory factor analyses were conducted on data of 3,481 students from 4th to 12th grade. The results suggested a four-factor model of the CEI. Using these results, in Study 2 several items were revised and data were collected one year later from 4th to 12th grade students in the same school district as Study 1. Analyses were conducted on data from 3,560 students after data cleaning. A series of potential models was tested. The final results suggest a five-factor 24-item CEI: (1) Affective Engagement, (2) Behavioral Engagement-Compliance, (3) Behavioral Engagement-Effortful Class Participation, (4) Cognitive Engagement, and (5) Disengagement. Results advance understanding of the construct of classroom engagement. The CEI fills a significant gap in measurement of engagement. The CEI is classroom-level, measures multiple dimensions of engagement, uses self-report, is relatively short, and can be readily administered in classrooms from 4th to 12th grade.

Keywords: engagement, factor analysis, measurement invariance, scale development

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Many school reform efforts seek to increase student engagement because educators presume it is a key variable that drives the outcomes prioritized by the Federal Department of Education: increased achievement, enrollment in challenging courses, and reduced dropout rates. School reform efforts also seek to increase engagement because it is amenable to intervention (Finn & Zimmer, 2012).

Despite its role in predicting important outcomes and its potential malleability, there is a dearth of well-articulated, comprehensive measures of *classroom*-level engagement (Fredricks & McColskey, 2012; Fredricks et al., 2011). The purpose of this article is to fill this gap by discussing the development of the Classroom Engagement Inventory (CEI) in two sequential studies. The aim is to provide schools with a relatively short but valid instrument that they can use to inexpensively measure classroom engagement. We begin by defining engagement and then discuss issues related to its measurement.

Classroom Engagement

Classroom engagement refers to *a student's active involvement in classroom learning activities* (Reeve, Jang, Carrell, Jeon, & Barch, 2004; Skinner, Kindermann, & Furrer, 2009). This includes "attention, interest, investment, and effort students expend in the work of learning" (Marks, 2000, p. 155) within the classroom. Fredricks, Blumenfeld and Paris (2004) describe three dimensions of engagement – affective (emotional), cognitive, and behavioral. Research by Archambault and colleagues (Archambault, Janosz, Fallu, & Pagani, 2009) supports these dimensions. At the classroom level, *affective* engagement refers to positive emotions during class, such as interest, enjoyment, and enthusiasm (Fredricks et al., 2004; Skinner et al., 2009). *Behavioral* engagement refers to observable behavior such as time-on-task, overt attention, classroom participation, question asking, and choice of challenging tasks. *Cognitive* engagement refers to mental effort, such as meaningful processing, strategy use, concentration, and metacognition. There is a need for research that explores the multiple dimensions of classroom engagement simultaneously. As Fredricks et al. (2004) state, "the vast majority of studies test the impact of a single type of engagement" (p. 83).

An important consideration in the measurement of engagement is the level at which the construct is measured. A seemingly identical construct can bear different meanings at different levels of generality. Engagement at the *school* level, for instance, is typically measured as bonding to school, participation in extracurricular activities, attendance, and number of referrals and suspensions. However, school engagement does not directly reflect classroom engagement. The same student may be highly engaged in one class, but not in others, and classrooms vary in average student engagement (Darr, 2012). Yet, many measures conflate classroom-level and school-level engagement (Fredricks et al., 2004). For example, Archambault et al. (2009) asked students about liking school, having fun at school, being interested in French class, and putting effort into French class. The first two are about school-level engagement and the latter two are about classroom-level engagement. Lawson and Lawson (2013) recommend that classroom engagement be distinguished from school engagement.

A commonly used measure of engagement is the Student Engagement Instrument (SEI), which has good evidence of reliability and validity (Appleton, Christenson, Kim, & Reschly, 2006; Betts, Appleton, Reschly, Christenson, & Huebner, 2010; Carter, Reschly, Lovelace, Appleton, & Thompson, 2012). However, the SEI is designed to measure school-level engagement. Sample items include, "Overall, adults at my school treat students fairly" and

"What I'm learning in my classes will be important in my future." The SEI does not claim to measure behavioral engagement, and includes scales that go beyond engagement such as Future Aspirations and Goals and Family Support for Learning (Betts et al., 2010). In contrast, the Classroom Engagement Inventory measures psychological, behavioral, and affective engagement at the classroom level.

School-level versus classroom-level measures of engagement may serve different functions and be appropriate in different contexts. Engagement should be measured at the same specificity level as the intervention and as other key variables. The measure should be classroom-level if the purpose is to (1) evaluate the effectiveness of an intervention enacted at the classroom level, (2) provide feedback to teachers regarding student perceptions of their classroom, (3) investigate what teachers can do in the classroom to improve engagement, or (4) investigate the link between engagement and learning in specific classes. For example, if increasing engagement in classrooms is the desired outcome of an intervention aimed at helping teachers use positive discipline or develop warm teacher-student relationships, then a classroom-level measure would be most appropriate. Measuring engagement at an inappropriate level can obscure results and make an intervention appear less successful than it really is.

A measure of classroom engagement will be most useful if it is invariant across groups such as lower and higher income, male and female, and younger and older students. If measures lack invariance, it may not be appropriate to compare results across groups. In contrast, invariance across age allows comparison of engagement at different ages cross-sectionally and longitudinally. Invariance across subject matter allows comparison of engagement in different subjects. Other measures of engagement have proven invariant across gender and age (Archambault et al., 2009; Betts et al., 2010; Martin, 2009). In the present studies we replicate these results with classroom-level engagement, and also examine invariance across income groups and subject matter.

Preliminary Instrument Development

To develop the CEI, we reviewed articles purporting to measure engagement in school settings. The articles were found in computerized databases (Education Full Text, ERIC, and PsycINFO) and reference lists from other articles. Next, we extracted non-overlapping items that closely aligned with the definition of engagement given above. Items that purported to measure engagement, but in fact measured other constructs, such as peer or teacher relationships or perceived relevance of school, were not extracted. This resulted in 35 items. Items were adapted to be classroom-level by including "In THIS class" at the beginning.

We searched for items that seemed to measure each of the three major dimensions. Behavioral engagement items were taken from the behavioral engagement and disengagement scales of Skinner et al. (2009) which were adapted from Wellborn (1991), such as, *In this class, I listen very carefully*. Cognitive engagement items were adapted from Linnenbrink (2005) and Stipek and Gralinski (1996), which was adapted from Meece, Blumenfeld, and Hoyle (1988), such as, *I do my work without thinking too hard*. Items were also adapted from a scale developed by the Motivation Research Group (Maehr & Pintrich, 2001; Pintrich & Maehr, 2002), such as, *In this class, when I do work, I ask myself questions to help me understand what to do*. Finally, some items were taken from Archambault et al. (2009), such as, *I do not want to stop working at the end of class*.

Few existing measures included items addressing affective engagement in classrooms. Research has shown that the Positive and Negative Affect Schedule Extended form or PANAS – X (Watson & Clark, 1994) is a valid and reliable measure; it is widely used in emotions research.

Therefore, we took five affective items (angry, happy, excited, interested, proud) from the PANAS—X. We generated five additional items, selecting only emotions that previous work has found youth experience in classrooms (embarrassed, smile or laugh, bored, fun, amused; Bergin & Bergin, 2009; Pekrun, Elliot, & Maier, 2009). This resulted in seven positive and three negative affect items. Other researchers have measured affective engagement with similar short scales, but relatively restricted sets of emotions, such as: *Class is fun, I enjoy learning, I feel good, I feel interested* (Skinner et al., 2009).

On the CEI, respondents indicated their level of agreement with each item using a 5-point Likert scale of frequency (25 items; 1= *never, 2=hardly ever, 3=monthly, 4=weekly,* and 5=*each day of class*) or a 7-point Likert scale (10 items; 1=*not at all true* to 7=*very true*). These different scales did not pose a problem for analysis because a latent response variable formulation was used to obtain polychoric correlations which were then analyzed (Muthén, 1984). More details are in the Results section of Study 1. All items were coded so that higher scores indicate higher levels of engagement. Six reverse-coded items were placed throughout the scale to reduce response bias.

After compiling the items, some were rewritten to remove difficult language and to shorten item length. We then asked eight students, primarily in 4th grade, to "think aloud" as they completed the survey, telling us how they understood the individual items. We also asked them to circle words they did not understand. If they did not circle a word that we were concerned they might not understand, we asked them to define it for us in their own words. This feedback resulted in minor modifications. In addition, in Study 1 we provided students with an *I don't know what this means* option on every item. Items with more than 1% of the students selecting this option were revised for Study 2. This process resulted in rewording or clarifying just a few items. For example, the word "amused" was not understood by some students in Study 1, so we changed the item from *I feel amused* to *I feel amused (smile, laugh, have fun)* for Study 2. A list of the resulting 35 items and their original sources is available from the authors. Additional constructs were measured and analyzed in Study 2 as validity variables.

Study 1

Method

Participants. Participants were 3,925 students from 4th to 12th grade in a school district in a medium-sized city in Missouri (estimated Metropolitan Statistical Area of 175,000 people) in the United States. Of the 3,222 students whose demographic data were available from the school district: 84.5% were White, 2.0% were Asian/Pacific Islander, 5.9% were Black, 5.5% were Hispanic, and 2.2% were American Indian/Alaska Native; 49.0% qualified for free or reduced lunch; and 51.6% were female. The survey included special education, remedial, and advanced students who were attending classes that varied in subject from gym, to remedial math, to AP literature.

Procedure. Data were gathered in April 2010. Teachers in all regular classrooms in 18 buildings (13 elementary, 3 middle schools, 1 high school, 1 career center) across the district administered the survey. Surveys were administered at the same time across an entire building to ensure that no student would be asked to take the CEI more than once and to ensure that a wide variety of subject areas was covered. Students were instructed to respond for the specific class (academic subject area) they were in at that moment. Students who were in study halls were asked to respond for the class they would attend next. The class identity was verified from a teacher survey. Students were told that the survey was voluntary; they could refuse to complete it. To improve quality of data, teachers read standardized instructions to students informing them

of the importance of their honesty and assuring them that the results would be confidential. Demographic data were taken from school records. The project met institutional review board requirements at the university.

Surveys were completed on scannable sheets. Before scanning, all completed surveys were visually inspected for suspect patterns (e.g., making a perfect "X" shape across all the items on the page), vulgar statements, and nonresponse. Suspicious surveys were coded as missing and not analyzed. There were 444 (11%) surveys coded as missing due to suspect patterns or incompletion resulting in 3,481 completed surveys.

Results

Factor structure of the Classroom Engagement Inventory. Histograms were used to examine the distribution of item responses. The factor structure of the CEI was then explored using Mplus version 6.1. Polychoric correlations (Olsson, 1979) were used to examine associations between ordered categorical items. A full information maximum likelihood estimation (FIML) method is used in the calculations of polychoric correlations in Mplus. This method assumes missing at random and makes use of all available data. The lowest covariance coverage was 0.818, meaning that all variables and pairs of variables had data for at least 81.8% of the sample; the missing information is small. Factor analyses were based on those polychoric matrices. A range of factor models was determined based on multiple criteria (i.e., model fit indices, modification indices, residual correlations, factor loadings, number of indicators per factor). Some researchers suggest conducting EFA and then CFA with the *same* data to tease out methodological explanations for a lack of fit in CFA before substantive explanations are used (van Prooijen & van Der Kloot, 2001). However, more researchers recommend conducting EFA at the initial stage of scale development and then conducting CFA with a new sample for validity and generalization (e.g., Worthington & Whittaker, 2006). We did both. In Study 1, we performed EFA and CFA with the same sample. In Study 2, we tested the final CFA model (which was consistent with the EFA model) from Study 1 with new data. We also cross-validated the final CFA model from Study 2 with the data in Study 1. Details are in the Study 2 section.

Separate EFAs were conducted with different numbers of factors. Geomin rotation, an oblique rotation method, was used for EFA. Following EFA, we conducted CFAs. During this process, items with a pattern coefficient less than .50 or cross-loaded on multiple factors were removed, which resulted in removing 14 items. For CFA, we used the recommended robust mean- and variance-adjusted weighted least squares (WLSMV) estimator (Beauducel & Herzberg, 2006; Finney & DiStefano, 2006). Multiple indices were examined to assess model fit.

Whole sample EFA and CFA suggested that the CEI consisted of four factors. Examination of the items revealed that the four factors measured three different dimensions of engagement—affective, behavioral, and cognitive. In addition, a Disengagement factor emerged, which included both behavioral and cognitive components. The standardized factor loadings (i.e., pattern coefficients) from CFA as well as the reliability coefficient (i.e., internal consistency) calculated as McDonald's omega (McDonald, 1999) are provided in Table 1. This four-factor model fit the data well (RMSEA=.059 with 90% CI [.057, .061], CFI=.965, TLI=.960; see Table 2). However, correlations between the four factors ranged from .48 (between Behavioral Engagement and Disengagement) to .74 (between Behavioral Engagement and Cognitive Engagement). The moderate to high correlations suggest a possible second-order general construct of classroom engagement. When the four factors were allowed to load on a general "classroom engagement" factor, a 2nd-order CFA model (i.e., the four factors load on a 2nd-order latent factor) had good model fit (RMSEA=.066 with 90% CI [.064, .068], CFI=.956,

TLI=.950). However, the robust chi-square difference test (Asparouhov & Muthén, 2006) was statistically significant ($\Delta\chi^2$=207.3, Δdf=2, p<.001), suggesting that for the classroom engagement construct, a hierarchical factor model was not as good as a first-order multidimensional model. (Note that the robust chi-square difference test is susceptible to sample size, just as the absolute chi-square tests are).

Measurement invariance and engagement across groups. To test whether the measure could validly be used with varied groups, we investigated measurement invariance across age level (three levels: elementary was 4th to 5th grade, middle was 6th to 8th grade, and high school was 9th to 12th grade), class subject (math, language arts, science, and social studies), gender, and free/reduced lunch status (as a proxy for income) using multiple group CFAs. Again, polychoric correlations were used to describe associations between ordered categorical items. The existence of measurement invariance for factors measured by *ordinal* (i.e., ordered categorical) indicators involves equality constraints on factor loadings and item thresholds simultaneously across groups because constraints on thresholds and factor loadings are "in tandem because the item probability curve is influenced by both parameters" (L. K. Muthén & Muthén, 2012, p. 485). The constrained model (i.e., measurement invariance model) was compared with the unconstrained model when thresholds and factor loadings were free across groups (i.e., configural invariance model). We used the default delta parameterization in Mplus.

The four-factor CFA model fit the data well in the whole sample and within each group we examined. Table 2 shows model fit statistics for the whole sample, and for the configural invariance and measurement invariance models for each of the four grouping variables (age level, class subject, gender, and free/reduced lunch status). All models had good model fit. Measurement invariance could be assumed across the groups based on the results. It should be noted that recommendations of *changes* in model fit indices have been proposed for testing measurement invariance (Chen, 2007; Cheung & Rensvold, 2002). These recommendations include a decrease in CFI by at least .01, supplemented by an increase in RMSEA by at least .015 for testing factor loading invariance or for testing intercept or residual invariance. By these standards, measurement invariance still existed in this study and in Study 2 described later. However, these recommendations are based on simulation studies that used the *maximum likelihood* estimation. We used the WLSMV estimator instead in the current research. For the WLSMV estimator, Mplus provides a robust chi-square difference test between nested models (Asparouhov & Muthén, 2006), and these test results are in Table 2. However, this robust chi-square difference is susceptible to sample size, just as the absolute chi-square tests are. For more information on and an example of how different estimation methods affect measurement invariance testing and substantive research hypothesis testing, see Wang et al. (in press).

In summary, factor analysis in Study 1 supported the hypothesis that engagement has three distinctly measurable dimensions – affective, behavioral, and cognitive – and that this dimensionality was the same across age level, gender, free/reduced lunch status, and class subject. Results also suggest a Disengagement factor and a possible second-order unidimensional construct. From the original 35 items, 21 were identified as making significant, distinct contributions to the four factors. In Study 2, we made improvements to and modified the CEI.

Study 2

Method

Participants. After similar data cleaning steps as in Study 1, participants were 3,560 4th to 12th grade students in the same school district and same 18 buildings as Study 1. Study 2 took place in Spring 2011, the year following Study 1, with students responding regarding a different

class. We were able to obtain demographic information of 2,524 students from the school district: 82.3% were White, 2.0% were Asian/Pacific Islander, 6.4% were Black, 6.1% were Hispanic, 2.4% were American Indian/Alaska Native, and 0.8% reported multiple races; 57.5% qualified for free or reduced lunch; and 51.7% were female. The project met institutional review board requirements at the university.

Procedure. We modified the CEI before administering it again. Three items from the 2010 survey were combined into one item due to high polychoric correlations and overlapping meaning. The three old items were: 1) In this class, I feel amused; 2) In this class, I smile or laugh; and 3) In this class, I have fun. The new item was: *In this class, I feel amused (smile, laugh, have fun)*. The deletions left two open affect items, which we filled with the following: 1) In this class, I feel anxious; and 2) In this class, I feel frustrated. This resulted in a balanced set of affect items, five positive and five negative. Another major change in the 2011 survey was that the order of the items was scrambled. In the 2010 survey, the affective, behavioral, and cognitive engagement items were placed together in the survey. Thus, the factor structure found in Study 1 may have been influenced by item position within the survey. The revised 2011 survey consisted of 35 items (25 items on a 5-point scale and 10 items on a 7-point scale). We included items that were eliminated in Study 1 in order to provide a second test of factor structure with scrambled items. Additional constructs were measured and analyzed as validity variables for the CEI.

Results

In all analyses, item responses were treated as ordered-categorical (ordinal) variables under which were continuous latent response variables (Muthén, 1984), as in Study 1. The lowest covariance coverage was 0.927, suggesting there was not much missing information in the dataset.

Step 1: Test the four-factor CFA model derived from Study 1. Data analysis started with the four-factor CFA model with 21 items, derived in Study 1. The initial four-factor CFA model from Study 1 fit the 2011 data satisfactorily (see Model 1 in Table 3). However, one item, *In this class, I compare things I am learning with things I already knew*, had large residual correlations (a residual correlation is the difference between an observed correlation and the corresponding model implied correlation between two variables) with three other items and had a relatively low loading (.44) on its factor (Behavioral Engagement). With this item removed, the new model (Model 2) still had good fit with the data. These results were consistent with those in Study 1, supporting the hypothesis that classroom engagement has affective, behavioral and cognitive dimensions.

Step 2: Justify deletion of items and consider adding items and/or factors. Because we suspected that items that were not included in the four-factor CFA might form new factors and/or contribute to the four factors, we conducted additional analyses. Those additional analyses included EFA for the 14 items that were left out of the four-factor CFA model; CFA with more potential contributing items; EFA with the 21 items in the four-factor CFA model and potential contributing items. The purpose was two-fold: 1) to justify the deletion of items from the final model and shorten the CEI so that it would be more economical for school districts to administer, and 2) to test the stability of the factor structure of the CEI that was found in Study 1. As in Study 1, multiple criteria were used in our decision making (i.e., model fit indices, modification indices, residual correlations, factor loadings, number of indicators per factor).

EFAs were conducted with the 14 items that were not included in the initial four-factor CFA model, to find out if there were factors that went undetected. Different numbers of factors

were extracted in those EFAs. Examining those EFA results suggested two potential additional factors. One was a Negative Feelings factor with four items and the other was a Compliance factor with five items. To accommodate the potential Negative Feelings factor, we tested two models (Models 3 and 4 in Table 3) and, based on multiple criteria (model fit, residual correlations, and factor loadings) decided not to add this factor or to allow additional indicators of Affective Engagement. To accommodate the potential Compliance factor, we tested Models 5 and 6 (see Table 3). Model 6 has satisfactory model fit.

An additional EFA was conducted on the 15 items comprising three factors (out of five factors in Model 6): Disengagement, Behavioral Engagement - Effortful Class Participation, and Behavioral Engagement - Compliance. This was done because in Study 1 these items were presented in a block, which may have affected the factor structure. In the revised survey they were interwoven with other items. The EFA results suggested adding an additional item to the "Effortful Class Participation" factor. We then used CFA to test a final five-factor model (Model 7) that has satisfactory model fit with 24 items (RMSEA=.059 with 90% CI [.057, .061], CFI=.961, TLI=.956). See Table 4 for factor loadings for this model. More details on model revisions are available from the authors.

Comparing Model 7 with Model 1 from Study 1, we found that three factors were exactly the same with the same sets of items. Those factors were Affective Engagement, Disengagement, and Cognitive Engagement. Another factor, Behavioral Engagement - Effortful Class Participation, was similar, with four of the five items overlapping. One item, *In this class, I compare things I am learning with things I already knew*, was in Model 1 but not in Model 7. Another item, *In this class, I do not want to stop working at the end of class*, was in Model 7 but not in Model 1. Model 7 also had an additional factor that was not in Model 1, which we have labeled Behavioral Engagement - Compliance.

The correlations among the five factors from Model 7 ranged from .56 (between Affective Engagement and Disengagement) to .90 (between Affective Engagement and Behavioral Engagement - Effortful Class Participation). We suspected that there may be a second-order factor. The second-order CFA model (Model 7a) came close to fitting satisfactorily RMSEA=.070 with 90% CI [.068, .072], CFI=.944, TLI=.938), but did not quite meet the criteria. The robust chi-square difference test between Models 7 and 7a was statistically significant ($\Delta\chi^2$=583.0, Δdf=5, p<.001).

We also tried to fit Model 7 with data in Study 1. Interestingly, the model fit was satisfactory (Model 7b; RMSEA=.056 with 90% CI [.054, .057], CFI=.965, TLI=.950), suggesting that while four factors were relatively easy to detect for the construct of classroom engagement, a five-factor model was also a plausible one. The final model (Model 7) was a five-factor CFA. Its standardized factor loadings (i.e., pattern coefficients) as well as the reliability coefficient calculated as McDonald's omega (McDonald, 1999) and factor correlations are in Table 4.

Step 3: Test measurement invariance and compare latent means of groups. Measurement invariance across groups was then investigated using multiple group CFAs as in Study 1. Results suggested that measurement invariance existed between age level (elementary, middle, and high school), free/reduced lunch status, gender, and core class subject (math, science, language arts, and social studies). See Table 5. Results of likelihood ratio (LR) chi-square different tests for each of the 24 items by each grouping variable, following recommendations by Kim and Yoon (2011) and Oort (1998), are available as supplemental material online.

Because measurement invariance existed across groups, structured means modeling was conducted to compare groups on their latent factor means. Effect sizes of group differences were calculated as Cohen's *d* (Cohen, 1988). The confidence intervals of effect sizes were calculated using the asymptotic estimates of standard errors as described in Nakagawa and Cuthill (2007). Effect sizes and their confidence intervals are in Table 6. Students in middle and high schools had lower classroom engagement and higher disengagement than students in elementary schools. Free/reduced lunch recipients, compared to non-recipients, had lower Cognitive Engagement (Cohen's *d* = -0.09), and lower Behavioral Engagement, including both Compliance (Cohen's *d* = -0.22) and Effortful Class Participation (Cohen's *d* = -0.12). Male students, compared to female students, had lower Affective Engagement (Cohen's *d* = 0.13) and lower Behavioral Engagement, including both Compliance (Cohen's *d* = 0.32) and Effortful Class Participation (Cohen's *d* = 0.17), and higher Disengagement (Cohen's *d* = -0.22). In terms of class subjects, using math classes for comparison, students in language arts classes had lower Compliance (Cohen's *d* = -0.15); students in science classes had higher Affective Engagement (Cohen's *d* = 0.20) and Effortful Class Participation (Cohen's *d* = 0.18) and lower Compliance (Cohen's *d* = -0.16); there were no statistically significant differences between students in social studies classes and students in math classes in classroom engagement.

Step 4: Test validity of the Classroom Engagement Inventory. Validity of the CEI was examined by correlating factor scores from the five-factor CFA model with variables that research and theory predict would be linked to classroom engagement. Items measuring *engagement-fostering teacher behaviors* were taken from the Instructional Practices Inventory (Painter & Valentine, 1996) and adapted for student report. The items measure teacher behaviors that elicit student engagement, such as asking for deeper thinking (Marks, 2000). Four items assessed whole-class activities (e.g., *In this class, we have class discussions that make me think deeply)* and three items assessed teachers' questioning practice (e.g., *My teacher asks me questions that have more than one right answer*). Items measuring *academic self-efficacy*, or belief in one's ability to accomplish school work (e.g., *In this class, I'm very sure I can master the skills taught*), were taken from the Patterns of Adaptive Learning Survey (PALS, Midgley, et al., 2000). Academic self-efficacy predicts interest and achievement and should be related to engagement (Bandura, 1997). Items measuring student *achievement goals* were also taken from the PALS. Three items measuring each of three types of goals – mastery, performance-avoidance, and performance-approach – were modified to be classroom-level (e.g, for mastery *In this class, one of my goals is to master a lot of new ideas and skills,* for performance-avoidance *In this class, it's important to me that I not do worse than others* and for performance-approach *In this class one of my goals is to show others that I'm good at my work*). Previous research suggests that mastery goals should be most strongly correlated with engagement, followed by performance approach goals, and performance avoidance goals (Linnenbrink, 2005; Wolters, 2004). *School-prompted interest* measures students' propensity to learn more about school topics, but not as school assignments, and was measured with 10 items (e.g., *Because of this class, I get so interested in this subject that I try to find out more about it on my own by looking the subject up on the internet)* patterned after Bergin and colleagues' work (e.g., Bergin, 1992; Ciani, Ferguson, Bergin, & Hilpert, 2010). School-prompted interest should be positively related to engagement because the more students are engaged in their classroom activities, the more likely they would be to want to learn more about the topics outside of school. Finally, self-reported *grades* in the targeted class were obtained; while self-reported grades should be used

with caution, they "generally predict outcomes to a similar extent as actual grades" (Kuncel, Credé, & Thomas, 2005, p. 76).

Factor scores for Disengagement were reversed around its grand mean such that a higher value indicated more disengagement and less engagement. Table 7 shows the relationship between each of the validity constructs and the five engagement factors. Separate correlations by age level were computed. Results were similar for elementary, middle, and high school students, so only the aggregated total across age level is reported in Table 7. All correlations were in the expected direction, supporting validity of the CEI. Correlations between the Disengagement factor and the validity variables were negative and those between the other CEI factors and the validity variables were positive. Regarding the magnitude of the correlations, academic self-efficacy ($r = .49$ to .67) and engagement-fostering teacher behaviors predicted CEI scores, with student reports of whole class activities more strongly predicting engagement ($r = .34$ to .57) than student reports of teacher questioning behavior ($r = .17$ to .44). Students' mastery goals correlated more strongly with engagement ($r = .59$ to .77) than performance-approach goals ($r = .31$ to .49), which, in turn, correlated more strongly than performance-avoidance goals ($r = .22$ to .39). Furthermore, engagement predicted school-prompted interest ($r = .39$ to .61) and self-reported grades ($r = .30$ to .39).

Discussion

This article discusses the development of the CEI and investigates its factor structure and validity in two studies. Methods appropriate for ordered categorical indicators were used. There has been an increasing emphasis on considering the ordered categorical nature of response options in factor analysis and structural equation modeling (e.g., Flora & Curran, 2004; Wang & Su, 2013). This article is an application of these advanced methods.

A significant contribution of these two studies is a newly available and much-needed self-report tool for measuring classroom engagement across a wide age range. Observational measures can be useful, but are too time consuming and expensive for schools to use regularly. Four key findings promote understanding of the construct of classroom engagement. First, results of both Study 1 and Study 2 indicate that engagement has three distinct dimensions – affective, behavioral, and cognitive – as well as a distinct disengagement dimension, as measured by the CEI. However, in Study 2, the behavioral dimension consisted of two factors. We called one "Compliance" because it reflects obedience to classroom norms. We called the second "Effortful Class Participation." This distinction is important. Fredricks et al. (2004) point out that "some studies separate cooperative participation, or adhering to classroom rules, from autonomy participation, or self-directed academic behaviors" (p. 62). They argue that researchers should "differentiate students who become invested in learning from those who do what they are supposed to do … but do not become invested in learning" (p. 85). Study 2 contributes to the literature by empirically confirming that, in this large, multi-age sample, compliance is distinct from other dimensions of engagement.

These results expand previous research on the multidimensionality of engagement by focusing on multiple dimensions at the classroom level (Glanville & Wildhagen, 2007; Reschly, Huebner, Appleton, & Antaramian, 2008; Skinner et al., 2009). One can imagine a child who tries hard and pays attention (i.e., is behaviorally engaged), because of external pressure, but is not affectively engaged (experiencing enjoyment or interest) in the learning activities. Indeed, Skinner et al. (2009) found that affective and behavioral dimensions of engagement were distinct but correlated ($r = .53$ fall and .60 spring) using self-report with items similar to the CEI. They did not measure cognitive engagement. Reeve and Tseng (2011) also found that affective and

behavioral engagement were distinct but correlated ($r = .30$) in a sample of Taiwanese high school students. They did not use a classroom-level measure, but focused on the school-level instead. By comparison, in Study 1 Affective Engagement correlated .73 with Behavioral Engagement and in Study 2 Affective Engagement correlated .90 with Effortful Class Participation and .68 with Compliance. The larger correlations found in the present studies may be partly because items in the CEI were treated as ordinal, and polychoric correlations were used for factor analysis. When observed variables do not have similar distribution shapes, traditional factor analysis based on Pearson correlations would likely underestimate their relationship (Goodwin & Leech, 2006).

Fredricks et al. (2004) expressed concern that cognitive and behavioral engagement may not be distinct factors. However, the present results indicate that the CEI distinctly measures these two dimensions of engagement. That is, a student could be behaviorally engaged without being cognitively engaged. For example, a student may be "paying attention" during an algebra lesson on an algorithm for solving a particular type of problem, but not deeply processing what it means. Alternatively, a student might be deeply processing math in class, but not paying attention to the lesson.

The CEI provides a tool to raise psychologists, teachers, and administrators' awareness of the varied types of engagement, and a tool for measuring all types efficiently. However, we do not want to overemphasize the dimensionality of engagement. We also found that the engagement construct was possibly hierarchical in Study 1, and the first-order factors in Study 2 correlated moderately to moderately high. Thus, one might consider classroom-level engagement a single global construct. These results confirm those of Archambault et al. (2009) who used a CFA in a study of high school students and found that affective and behavioral components were separate, but that a case for a global construct of engagement could also be made. Note that their items were at the classroom and school levels.

The second key finding was that factor structure was invariant across groups. Other researchers have stated that "one question that has yet to be fully evaluated is the extent to which the structure of student engagement differs across maturational levels and with respect to gender" (Betts et al., 2010, p. 85). The present studies directly address this issue. In both studies we found invariant factor structure by age level, gender, free/reduced lunch status, and class subject. Other researchers have found that engagement dimensionality was invariant when measured at the school-level, rather than classroom-level. Glanville and Wildhagen (2007), using the NELS88 data, found invariance across ethnicity. Betts et al. (2010) found invariant factor structure on the SEI from 6th to 12th grade. Their results are not directly comparable because the SEI measures a variety of motivational constructs that go beyond the definition of engagement presented in this article, including social support, extrinsic motivation, autonomy support, and utility. The finding that the CEI factor structure is invariant across demographic groups and core class subjects is important because it suggests that the CEI could be used with a variety of students and contexts. It can be used for longitudinal research, as well as evaluation of interventions, from late elementary school through high school.

The third key finding pertained to group differences in engagement. Marks (2000) found that high SES students were more engaged than low SES students, although the effect was small. In contrast, Reschly et al. (2008) found no significant correlations between the free/reduced lunch status and any of their affect, engagement, or coping scales. The present results fit more closely with Marks' sample; we found that non-recipients of free/reduced lunch had higher cognitive and behavioral engagement. In the present study we found that girls had greater

affective and behavioral engagement than boys, and lower disengagement. Marks (2000) also found that girls were moderately more engaged than boys. Similarly, Skinner et al. (2009) report that girls tended to be motivationally "better off" than boys, showing consistently higher levels of behavioral and affective engagement, as well as lower levels of behavioral and emotional disaffection.

The fourth, and final, key finding is that the CEI has internal consistency and evidence of validity. Internal consistency, calculated as McDonald's omega (McDonald, 1999), of each of the five engagement factors ranged from .82 to .90. Evidence for the CEI's validity is provided by the pattern of results, which is consistent with theory and published research. Teacher behaviors that elicit engagement – both whole class activities and questioning practices– predicted the CEI factors, as suggested by previous research (Painter & Valentine, 1996). Two student motivational variables – self-efficacy and achievement goal orientation – predicted CEI factors. Lau and Roeser (2002) observed a correlation of .47 between self-efficacy and what they called classroom engagement (doing homework, use of self-regulated learning strategies, paying attention, doing class activities). We found that all dimensions of the CEI were correlated with academic self-efficacy ($r = .49$ to .67), with Cognitive Engagement showing the strongest correlation. We also found that mastery goal orientation more strongly correlated with engagement than performance-approach goals, which is congruent with the literature on achievement goal orientation (DeBacker & Crowson 2006; Linnenbrink; 2005). For example, mastery goals have been demonstrated to correlate positively with indicators of engagement such as deep processing strategies, metacognitive strategies, self-regulation, preference for challenging tasks, effort, interest, and persistence (e.g., Harackiewicz, Durik, Barron, Linnenbrink-Garcia, & Tauer, 2008).

Furthermore, we found that CEI scores predicted outcomes that should be linked to engagement – school prompted interest and self-reported grades. School-prompted interest is a stringent test of engagement. It is a low-frequency behavior in which students pursue out-of-school learning because of interest sparked in school, and is a potential outcome of strong engagement (Bergin, 1992; Ciani, Ferguson, Bergin, & Hilpert, 2010). Effortful Class Participation was correlated more strongly with school-prompted interest ($r = .61$) than Compliance ($r = .49$). Both school-prompted interest and Effortful Class Participation reflect active student learning. In contrast, the other behavioral engagement factor – Compliance – may reflect obedience in the classroom, rather than engagement with the content, and mere obedience to classroom rules should be somewhat less likely to lead to effortful out-of-school learning.

Engagement is considered an important variable because it is supposed to lead to greater learning. Indeed, the CEI factors were correlated with self-reported grades ($r = .30$-.39). The dimension most strongly correlated with classroom grades was Compliance. This result is logical given that grades are often based on homework completion and obedience to the teachers' agenda. Similarly, Voelkl (1997) observed correlations of .42 and .49 between standardized test scores and behavioral engagement (paying attention, doing more than just the assigned work) among fourth and seventh graders in Chicago. Fredricks and colleagues (2011) report that "ten of the student self-report measures of engagement reported positive correlations with some measure of student achievement" (p. 20), even though several of these measures addressed school-level bonding.

The study has several limitations. First, the data are cross-sectional and do not demonstrate longitudinal change across time. Second, studies one and two were carried out in the same school district with predominantly white, rural, lower income students; it would be useful

to administer the CEI in other settings, including urban, multi-ethnic and higher income schools. Third, the correlations among variables could be inflated because all variables are measured by self-report simultaneously. In addition, the CEI measures frequency, but not intensity or degree of engagement in the class. We chose frequency because we felt this was the most useful to educators, but for some purposes a measure of intensity may be more appropriate.

The studies in this article provide a foundation for future research on the construct of classroom engagement. In both studies, we asked students to report their engagement for the specific class that they were currently attending. Variation attributable to class was therefore confounded with variation attributable to students. One way to address this issue would be to ask students to report their engagement in multiple classes and apply generalizability theory studies (Brennan, 2001; Shavelson & Webb, 1991) in order to separate variation due to students, due to classes, and due to their interaction. Using data for the final CEI model in Study 2, we calculated the intra-class correlations (ICCs) of the five factors using a two-level analysis in Mplus. The within level was the student level and the between level was classrooms. The ICCs ranged from .10 to .20 (Table 4), a range that is slightly lower than but in close proximity to that for mathematics achievement based on nationally representative data with schools being the between level units (Hedges & Hedberg, 2007, Table 2 on p. 68). Future research could also use both the CEI and the SEI in the same population to investigate the relationship between classroom-level and school-level engagement. Furthermore, researchers could test the links between the scores on the CEI and teacher practices, bullying, or course subject. Finally, future research should focus on acquiring a large, normative database to aid in interpreting the results of specific uses of the CEI.

In summary, the CEI is a relatively brief, self-report measure of classroom-level engagement that has demonstrated good psychometric properties and validity. It is a practical tool for measuring all dimensions of engagement – cognitive, affective, and behavioral – in classrooms from 4th to 12th grade. Its structure is invariant for elementary, middle, and high school students, for boys and girls, for low-income and higher-income students, and for various class subjects, which suggests it can be used in a variety of contexts. A next step will be to apply this measure in other samples and to collect additional validity evidence with relevant external measures.

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Table 1

Standardized Factor Loadings (Pattern Coefficients) in the Four-Factor CFA Model for the Classroom Engagement Inventory in Study 1

Item	Affective Engagement (ω=.91)[a]	Behavioral Engagement (ω=.84)[a]	Cognitive Engagement (ω=.89)[a]	Dis-engagement (ω=.86)[a]
1. I feel excited[1]	.85			
2. I feel interested[1]	.85			
3. I feel happy[1]	.80[b]			
4. I have fun[1]	.80			
5. I feel proud[1]	.79			
6. I get really involved in class activities[3]		.82		
7. I actively participate in class discussions[2,3]		.78		
8. I form new questions in my mind as I join in class activities[2]		.71		
9. I compare things I am learning with things I already knew[4,6]		.64[b]		
10. I work with other students and we learn from each other[2]		.63		
11. If I make a mistake, I try to figure out where I went wrong[5]			.80	
12. I go back over things I don't understand[4]			.78	
13. I think deeply when I take quizzes in this class[2]			.75[b]	
14. I ask myself some questions as I go along to make sure the work make sense to me[4]			.76	
15. I search for information from different places and think about how to put it together[2]			.73	
16. If I'm not sure about things, I check my book or use other materials like charts[4]			.67	
17. I judge the quality of my ideas or work during class activities[2]			.65	
18. I try to figure out the hard parts on my own[2]			.56	
19. I am "zoned out;" not really thinking or doing class work[2]				.87[b]
20. I let my mind wander[3]				.82

21. I just pretend like I'm working[3]	.75

Note. All items begin with the stem "In this class," The eight items for Cognitive Engagement are on a 7-point scale. The other items are on a 5-point scale. Sources from which items were adapted were (1) Watson and Clark (1994), and Bergin and Bergin (2009), (2) Painter and Valentine (1996), (3) Skinner et al. (2009), (4) Stipek and Gralinski (1996), (5) Linnenbrink (2005), and (6) DeBacker and Crowson (2006).

[a] Reliability coefficient calculated as McDonald's omega (McDonald, 1999).

[b] Items had unstandardized loadings fixed to unity.

Table 2

Model Fit Statistics and Testing Measurement Invariance (Equal Factor Loadings and Thresholds) by Groups in Study 1

Model	#Parameters	χ^2	df	RMSEA	90% CI RMSEA		CFI	TLI
Whole Sample (n=3477)	127	2409.4*	183	.059	.057	.061	.965	.960
Age Level Groups (n=3477), $\Delta \chi^2$=637.5, Δdf=184,p<.001								
Configural Invariance	381	2875.0*	549	.060	.058	.063	.961	.955
Measurement Invariance	197	3213.4*	733	.054	.052	.056	.959	.964
Class Subject Groups (n=2488), $\Delta \chi^2$=528.1, Δdf=276,p<.001								
Configural Invariance	508	2368.9*	732	.060	.057	.063	.966	.961
Measurement Invariance	232	2626.2*	1008	.051	.048	.053	.966	.972
Gender Groups (n=2906), $\Delta \chi^2$=282.3, Δdf=92,p<.001								
Configural Invariance	254	2419.0*	366	.062	.060	.064	.963	.957
Measurement Invariance	162	2483.5*	458	.055	.053	.057	.963	.966
Free/Reduced Lunch Status Groups (n=2906),$\Delta \chi^2$=121.4, Δdf=92,p=.022								
Configural Invariance	254	2392.3*	366	.062	.059	.064	.963	.957
Measurement Invariance	162	2250.8*	458	.052	.050	.054	.967	.970

Note. Sample sizes differed when different grouping variables were used due to missing values on grouping variables. The chi-square difference test is based on the DIFFTEST in Mplus for testing the difference between the configural invariance model and the measurement invariance model using the WLSMV estimator. RMSEA = root mean square error of approximation; CFI = comparative fit index; TLI = Tucker Lewis index; WRMR = weighted root mean square residual.
*p<.001

Table 3
Model Fit Indices in Study 2

	# Parameters	χ^2	DF	RMSEA	90% CI RMSEA		CFI	TLI
Model 1	127	3053.3*	183	.066	.064	.069	.956	.950
Model 2	122	2396.8*	164	.062	.060	.064	.965	.959
Model 3	151	5366.2*	265	.074	.072	.075	.933	.925
Model 4	147	10417.8*	269	.103	.101	.105	.868	.853
Model 5	155	4693.2*	265	.069	.067	.070	.942	.934
Model 6	141	2849.8*	220	.058	.056	.060	.964	.959
Model 7	146	3214.9*	242	.059	.057	.061	.961	.956
Model 7a	141	4531.3*	247	.070	.068	.072	.944	.938
Model 7b	146	2834.0*	242	.056	.054	.057	.965	.960

Model 1: 4-factor CFA model obtained in Study 1
Model 2: Model 1 without item "I compare things I am learning with things I already knew."
Model 3: Model 2 plus a "Negative Feelings" factor
Model 4: Model 2 with "Negative Feelings" items loading on "Affective Engagement"
Model 5: Model 2 plus a "Compliance" factor with 5 items
Model 6: Model 2 plus a "Compliance" factor with 3 items
Model 7: Model 6 plus one additional item, "In this class, I do not want to stop working at the end of class" on the "Behavioral Engagement - Effortful Class Participation" factor. A 5-factor CFA model.
Model 7a: Model 7 with a second-order factor
Model 7b: Model 7 with Study 1 data
*$p<.001$

Table 4
Factor Loadings (Pattern Coefficients) of Five-Factor CFA Model (Model 7) in Study 2

Item	Affective (ω=.90)[a] (ICC=.16)[b]	Behavioral-Compliance (ω=.82)[a] (ICC=.10)[b]	Behavioral-Effortful Class Participation (ω=.82)[a] (ICC=.20)[b]	Cognitive (ω=.88)[a] (ICC=.15)[b]	Dis-engagement (ω=.82)[a] (ICC=.18)[b]
1. I feel interested[1]	.87				
2. I feel proud[1]	.85				
3. I feel excited[1]	.84				
4. I feel happy[1]	.78[c]				
5. I feel amused (smile, laugh, have fun)[1]	.68				
6. I listen very carefully[3]		.87[c]			
7. I pay attention to the things I am supposed to remember[4]		.82			
8. I complete my assignments[7]		.61			
9. I get really involved in class activities[3]			.82		
10. I form new questions in my mind as I join in class activities[2]			.69[c]		
11. I do not want to stop working at the end of class[6]			.68		
12. I actively participate in class discussions[2,3]			.67		
13. I work with other students and we learn from each other[2]			.58		
14. I go back over things I don't understand[4]				.79	
15. if I make a mistake, I try to figure out where I went wrong[5]				.79	
16. I ask myself some questions as I go along to make sure the work makes sense to me[4]				.76	
17. I think deeply when I take quizzes in this class[2]				.70[c]	
18. I search for information from different				.68	

Item		
places and think about how to put it together[2]		
19. If I'm not sure about things, I check my book or use other materials like charts[4]	.64	
20. I try to figure out the hard parts on my own[2]	.59	
21. I judge the quality of my ideas or work during class activities[2]	.58	
22. I am "zoned out," not really thinking or doing class work[2]		.82[c]
23. I let my mind wander[3]		.74
24. I just pretend like I'm working[3]		.77

Factor Correlation	Affective	Behavioral-Compliance	Behavioral-Effortful Class Participation	Cognitive
Behavioral-Compliance	.68			
Behavioral- Effortful Class Participation	.90	.75		
Cognitive	.66	.77	.80	
Disengagement	.56	.73	.57	.60

Note. All items begin with the stem "In this class," The eight items for Cognitive Engagement are on a 7-point scale. The other items are on a 5-point scale. Sources from which items were adapted were (1) Watson and Clark (1994), and Bergin and Bergin (2009), (2) Painter and Valentine (1996), (3) Skinner et al. (2009), (4) Stipek and Gralinski (1996), (5) Linnenbrink (2005), (6) Archambault et al. (2009), and (7) Maehr and Pintrich (2001), and Pintrich and Maehr (2002).
[a] Reliability coefficient calculated as McDonald's omega (McDonald, 1999)
[b] Intra-class correlation in two-level factor analysis. Within level is student level and between level is classroom level.
[c] Items had unstandardized loadings fixed to unity.

Table 5

Model Fit Indices and Testing Measurement Invariance (Equal Factor Loadings and Thresholds) by Groups in Study 2

Model	#Parameters	χ^2	df	RMSEA	90% CI RMSEA		CFI	TLI
Age Level Groups (n=3548), $\Delta \chi^2$=677.8, Δdf=204, p<.001								
Configural Invariance	438	3762.6*	726	.059	.058	.061	.958	.952
Measurement Invariance	234	3988.9*	930	.053	.051	.054	.957	.962
Class Subject Groups (n=2764), $\Delta \chi^2$=558.0, Δdf=306, p<.001								
Configural Invariance	584	3090.4*	968	.056	.054	.059	.966	.962
Measurement Invariance	278	3258.9*	1274	.047	.045	.050	.969	.973
Gender Groups (n=2520), $\Delta \chi^2$=191.9, Δdf=102, p<.001								
Configural Invariance	292	2469.3*	484	.057	.055	.059	.963	.957
Measurement Invariance	190	2366.7*	586	.049	.047	.051	.967	.969
Free/Reduced Lunch Status Groups (n=2520), $\Delta \chi^2$=180.0, Δdf=102, p<.001								
Configural Invariance	292	2388.3*	484	.056	.054	.058	.964	.959
Measurement Invariance	190	2267.8*	586	.048	.046	.050	.968	.970

Note. Sample sizes differed when different grouping variables were used due to missing values on grouping variables. The chi-square difference test is based on the DIFFTEST in Mplus for testing the difference between the configural invariance model and the measurement invariance model using the WLSMV estimator. RMSEA = root mean square error of approximation; CFI = comparative fit index; TLI = Tucker Lewis index; WRMR = weighted root mean square residual.
*p<.001

Table 6

Effect Sizes (Cohen's d*) of Latent Mean Differences between Groups in Study 2*

	Affective	Behavioral-Compliance	Behavioral-Effortful Class Participation	Cognitive	Disengagement[a]
Middle school - Elementary school	-0.64*** (-0.72,-0.55)	-0.45*** (-0.53,-0.37)	-0.68*** (-0.76,-0.6)	-0.60*** (-0.69,-0.52)	0.70*** (0.62, 0.79)
High school - Elementary school	-0.66*** (-0.75,-0.58)	-0.69*** (-0.78,-0.61)	-0.92*** (-1.01,-0.83)	-0.82*** (-0.91,-0.73)	0.94*** (0.85, 1.03)
Free/Reduced lunch - No Free/reduced lunch	-0.04 (-0.12, 0.04)	-0.22*** (-0.29, -0.14)	-0.12** (-0.20, -0.04)	-0.09* (-0.16, -0.01)	0.06 (-0.02, 0.14)
Female - Male	0.13** (0.06, 0.21)	0.32*** (0.24, 0.40)	0.17*** (0.09, 0.25)	-0.01 (-0.09, 0.07)	-0.22*** (-0.30, -0.15)
Language arts - Math	0.09 (-0.01, 0.19)	-0.15* (-0.25, -0.05)	0.09 (0.00, 0.19)	-0.05 (-0.15, 0.04)	0.04 (-0.06, 0.13)
Science - Math	0.20** (0.09, 0.31)	-0.16* (-0.28, -0.05)	0.18** (0.06, 0.29)	-0.01 (-0.12, 0.11)	0.06 (-0.05, 0.17)
Social Studies - Math	0.10 (-0.01, 0.22)	-0.09 (-0.21, 0.02)	0.02 (-0.09, 0.13)	-0.05 (-0.16, 0.07)	0.08 (-0.03, 0.19)

Note. Values in parentheses are the 95% confidence intervals of each Cohen's *d*. A negative value means that the group before the minus (-) sign in the first column of the same row had a lower latent factor mean than the group after the minus sign.

[a] The sign of latent mean differences in disengagement was reversed so that a higher value meant more disengagement.

* $p<.05$

** $p<.01$

*** $p<.001$

Table 7

Correlations between Engagement Factors and Validity Variables in Study 2

Validity Variable	Affective	Behavioral - Compliance	Behavioral - Effortful Class Participation	Cognitive	Disengagement
Teacher Behavior – Whole Class Activities (.77)	.50	.49	.57	.57	-.34
Teacher Behavior – Questioning Practices (.62)	.37	.35	.44	.41	-.17
Self-Efficacy (.86)	.55	.63	.61	.67	-.49
Mastery Goals (.82)	.60	.70	.68	.77	-.59
Performance-Approach Goals (.76)	.39	.40	.44	.49	-.31
Performance-Avoid Goals (.56)	.25	.31	.31	.39	-.22
School-prompted Interest (.86)	.57	.49	.61	.55	-.39
Self-reported Grades	.34	.39	.35	.30	-.37

Note. Reliabilities (Cronbach's alpha coefficients) are in parentheses. All correlations are significant at .001 level.

Supplementary Material

Likelihood Ratio Chi-Square Difference Test for Each Item by Grouping Variable

Item	Age Level (3 Groups) $\Delta\chi^2$	Δdf	$K_{adjusted}$ [a]	Class Subject (4 Groups) $\Delta\chi^2$	Δdf	$K_{adjusted}$ [a]	Gender (2 Groups) $\Delta\chi^2$	Δdf	$K_{adjusted}$ [a]	Free/Reduced Lunch Status (2 Groups) $\Delta\chi^2$	Δdf	$K_{adjusted}$ [a]
1	11.34	8	84.44	23.00	12	65.76	4.91	4	37.77	10.87	4	36.19
2	79.06	8	84.44	61.98	12	65.76	5.63	4	37.77	9.63	4	36.19
3	30.44	8	84.44	14.04	12	65.76	5.14	4	37.77	4.47	4	36.19
4	37.33	8	84.44	16.78	12	65.76	2.09	4	37.77	1.79	4	36.19
5	63.32	8	84.44	21.91	12	65.76	31.50	4	37.77	2.36	4	36.19
6	11.38	8	84.44	34.45	12	65.76	- [b]	-	-	8.86	4	36.19
7	25.71	8	84.44	13.83	12	65.76	4.40	4	37.77	- [b]	-	-
8	6.39	8	84.44	6.07	12	65.76	3.36	4	37.77	22.11	4	36.19
9	19.39	8	84.44	22.16	12	65.76	6.45	4	37.77	-	-	-
10	9.86	8	84.44	5.53	12	65.76	- [b]	-	-	14.80	4	36.19
11	29.70	8	84.44	12.32	12	65.76	23.89	4	37.77	- [b]	-	-
12	9.15	8	84.44	16.70	12	65.76	2.81	4	37.77	10.29	4	36.19
13	27.28	8	84.44	26.41	12	65.76	24.96	4	37.77	5.19	4	36.19
14	32.33	12	109.48	25.46	18	86.73	2.18	6	49.87	19.58	6	47.78
15	37.39	12	109.48	19.69	18	86.73	4.09	6	49.87	5.81	6	47.78
16	20.14	12	109.48	25.64	18	86.73	7.94	6	49.87	12.54	6	47.78
17	74.93	12	109.48	47.87	18	86.73	12.11	6	49.87	- [b]	-	-
18	33.65	12	109.48	49.77	18	86.73	17.34	6	49.87	- [b]	-	-
19	47.37	12	109.48	74.22	18	86.73	20.58	6	49.87	11.42	6	47.78
20	5.33	12	109.48	47.16	18	86.73	16.53	6	49.87	5.47	6	47.78
21	106.31	12	109.48	36.33	18	86.73	2.97	6	49.87	15.87	6	47.78
22	37.36	8	84.44	28.08	12	65.76	1.61	4	37.77	- [b]	-	-
23	21.44	8	84.44	3.33	12	65.76	- [b]	-	-	7.85	4	36.19
24	43.32	8	84.44	4.03	12	65.76	2.36	4	37.77	5.74	4	36.19

Note. Item order is the same as in Table 4.

[a] Adjusted critical chi-square value

[b] The fully constrained measurement invariance had a lower function value (i.e., better fit) than the less constrained model. Therefore, no likelihood ratio test could be conducted. See http://www.statmodel.com/discussion/messages/23/3201.html?1299784497 for a discussion.