Are growth mindset, mastery orientation, and grit promising for promoting achievement in the Global South? Psychometric evaluations among Indonesian adolescents

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Abstract

We examined the measurement characteristics and cross-cultural measurement invariance of growth mindset, mastery orientation, and grit among Indonesian ($N=55,964$) and US ($N=440$) adolescents. We found support for strong invariance across males and females for all factors in both contexts. Indonesian females reported higher growth mindset and mastery orientation latent means than Indonesian males. We found mixed evidence for cross-cultural measurement invariance using two approaches. A Bayesian approach supported measurement invariance for mastery orientation and grit, whereas each factor achieved only configural or weak invariance using subsampling approach based in frequentist estimation. Notably, higher levels of each construct were associated with higher grades in Indonesia and in the US. We conclude that while some measurement issues warrant future investigation, growth mindset, mastery orientation, and grit conceptually translate to the Indonesian context and are promising targets for academic achievement interventions for Indonesian youth and perhaps youth in the broader Global South.

Keywords: socioemotional skills; growth mindset; mastery orientation; grit; adolescence; Indonesia; measurement invariance

Are growth mindset, mastery orientation, and grit promising for promoting achievement in the Global South? Psychometric evaluations among Indonesian adolescents

Large-scale studies in high-income nations have demonstrated the potential for socioemotional skills¹ programs to improve students' academic performance (e.g., Yeager et al., 2019). These results have inspired non-governmental organizations and local policy makers to explore whether socioemotional skills programs may improve academic outcomes for youth in the Global South² (e.g., Claro, Paunesku, & Dweck, 2016). In the past five years, the World Bank has supported over 30 programs promoting socioemotional skill development for young people in these nations.

Despite this enthusiasm, little existing work explores the psychometric characteristics of prominent socioemotional skills measures among adolescents in the Global South. This deficiency in the literature precludes a clearer understanding of the effectiveness of these programs and thus the return on investment. In serving to address this deficiency, the present research examines the factor structure, reliability, validity, cross-gender and cross-cultural measurement invariance in measures of three prominent socioemotional skills: growth mindset (Blackwell, Trzesniewski, & Dweck, 2007), mastery orientation (Blackwell et al, 2007), and the perseverance of effort component of grit (Duckworth, Peterson, Matthews, & Kelly, 2007), doing so in a large sample of Indonesian adolescents ($N = 55,964$) and a comparison sample of US adolescents ($N = 440$).

¹ 1 We use the term *socioemotional skills*, but note that there are many other terms used to describe these thoughts, feelings, and behaviors, such as social, emotional, and behavioral skills (SEB) skills, non-cognitive factors, 21st century skills, social emotional competencies, character strengths, and virtues.

² Consistent with prevailing trends, we use the term “Global South” here instead of “developing nations” or “third-world” nations.

Why Study Socioemotional Skills?

Research suggests that socioemotional skills may show promise for promoting educational outcomes among youth in the Global South for four key reasons. First, converging evidence (Cunha & Heckman, 2008; Almlund, Duckworth, Heckman, & Kautz, 2011; Paunesku et al., 2015) points to adolescents' socioemotional skills as key factors that drive their academic success. Second, research findings suggest that socioemotional skills are potentially improved even in low cost, short-duration interventions (Yeager et al., 2019), although results are not uniformly supportive, such as for growth mindset interventions (Sisk et al., 2018.). Third, decades of research on socioemotional skills building in outside-of-school time youth development programs (Deutsch, Blyth, Kelley, Tolan, & Lerner, 2017; Lerner et al., 2012) have provided schools with a template for how to embed socioemotional skills interventions within existing or new curricula. Fourth, there is evidence of the impact of socioemotional skills programs at different points in the life span, although only about 15% of programs for adolescents were conducted in Global South countries (see Sánchez Puerta, Valiero, & Gutiérrez Bernal, 2016, for a systematic review). Taken together, this promise has resulted in growing enthusiasm for socioemotional skills-based interventions for youth around the world (e.g., Outes-León, Sánchez, & Vakis, 2020).

Why study growth mindset, mastery orientation, and grit?

Moving beyond addressing the importance of studying socioemotional skills in general, we now turn our attention towards the importance of studying growth mindset, mastery orientation, and the perseverance component of grit, the specific constructs assessed in this work. For each construct, there is at least some empirical evidence supporting their association with

youth academic achievement (e.g., Cellar et al, 2011; Claro, Paunesku, & Dweck, 2016; Duckworth, Peterson, Matthews, & Kelly, 2007; Eskries-Winkler, Shulman, Beal, & Duckworth, 2014; Wolters & Hussain, 2014; Yeager et al, 2019). However, most of the data on growth mindset, mastery orientation, and grit was not collected in the Global South.

Some conceptual and empirical issues with these constructs merit consideration. Overall, there are numerous competing terms and taxonomies for organizing the expansive domain of socioemotional skills (e.g., Duckworth & Yeager, 2015, Soto, Napolitano, & Roberts, in press), and the three skills that we assess in this research, while prominent, are not always components in every socioemotional skills taxonomy. More specifically, some have argued (Credé, 2018) and demonstrated (Credé, Tynan, & Harms, 2017; Ponnock et al., 2020), that grit's perseverance of effort facet³ – measured in the present research – reflects content and empirical relationships substantially overlap those found in trait conscientiousness, which predates the discussion of grit and demonstrates a robust association with academic achievement and other positive educational outcomes (e.g., Roberts et al, 2012). Thus, at some level, grit and conscientiousness could be considered redundant.

We assess grit in this research for several reasons. First, there is longitudinal evidence suggesting a reciprocal growth relationship between grit and growth mindset (Park et al, 2020). Thus, one could extrapolate and tentatively suggest that grit could indirectly support academic achievement by supporting the development of growth mindset. Moreover, recent work demonstrates that grit should not be completely viewed a trait; it seems amenable to intervention among young people (Alan, Boneva, & Ertac, 2019). Finally, returning to a recurring theme,

³ For ease of reporting, hereafter we primarily use the term “grit” when referring to the present data.

there is little psychometric research on grit among non-Western adolescents. Assessing grit in this research provides benchmarks for research interested in exploring grit among these youth.

What is the current state of the socioemotional skills measurement literature for youth in the Global South?

To summarize, we assessed growth mindset, mastery orientation, and grit in this research because they are prominent constructs in the socioemotional skills literature that have been linked to positive academic outcomes for young people. But most of the existing work on these constructs has been conducted in the US or other Western settings. There are number of recent, current, or future programs in low-income or middle-income countries with goals to boost growth mindset, mastery orientation, and/or grit in youth to promote their academic outcomes and career development. For example, beyond Indonesia, the focal setting in this research, we are aware of such programs in South Africa, Cyprus, Nicaragua, and North Macedonia. Understanding the impact of those programs requires improving our understanding of the measurement characteristics of these socioemotional skills among youth in the Global South.

Thus, it is critical to expand the emerging body of literature that explores socioemotional skill measurement and validation in contexts beyond the United States. For example, studies of early childhood development in Global South countries often include socioemotional development (Altafim et al. 2018; Rao et al., 2013a; Rao et al. 2013b) and a few studies have tested the validity of socioemotional constructs among rural adults (Bloem et al., 2018; Laajaj et al., 2019). In addition, recent work has also explored measurement properties of some socioemotional skills among Brazilian adolescents (Primi, Santos, John & de Fruyt 2016). In the broadest sense, a goal of this research is to improve our understanding as to whether prominent socioemotional skills – psychological constructs largely developed by American researchers and

tested mainly among American university students – can conceptually and empirically translate to adolescents in the Global South.

Why study socioemotional skills in Indonesia?

There are several reasons why our focus on whether socioemotional skills can promote academic outcomes among Indonesian youth is particularly merited. First, Indonesia is a populous nation with many young people: at present, about 40% of approximately 267,000,000 inhabitants are under 24. Second, compared to peers from other nations, Indonesian adolescents are struggling academically. Indonesian adolescents' academic performance is among the lowest of any Programme for International Student Assessment (PISA) participating nation, and Indonesian boys' academic performance lags behind that of their female peers (OECD, n.d.). Third, despite the growing evidence for the link between socioemotional skills and academic performance, there are very few existing studies that examine grit, growth mindset, and/or mastery orientation among Indonesian young people (e.g., Aditomo, 2015; World Bank, 2019).

The present research

Given these limitations in the literature, the purposes of the present research were to examine the factor structure, reliability, validity, and cross-gender measurement invariance in measures of growth mindset, mastery orientation, and grit among a large sample of Indonesian adolescents ($N = 55,964$), and to assess whether the resulting socioemotional skills factors among the Indonesian sample could be invariantly measured with reference to a comparison sample of American adolescents ($N = 440$). The present research is based on five research questions.

Research Question 1: What is the optimal approach for independently modeling the focal socioemotional skills? Are these approaches consistent across Indonesia and the US?

We will test univariate models within cultural context for each construct. Addressing this initial question is not trivial: socioemotional skills reflect constructs that have rarely been assessed in Indonesia. Because the Indonesian measure had never been translated before, alternative factor structures, low loadings on particular items, or unacceptably low levels of reliability are plausible.

Research Question 2: Can the focal socioemotional skills be equated for boys and girls within each cultural context?

Recent evidence suggests an achievement gap in Indonesia: boys' academic performance lags behind that of their female peers (OECD, n.d.). Given the existing research linking socioemotional skills to academic performance, we will test for gender measurement invariance among the focal socioemotional skills within Indonesia and the US. Should growth mindset, mastery orientation, and grit be characterized by strong invariance across boys and girls, future research could then rest more comfortably when reporting and interpreting mean gender differences.

Research Question 3: What is the optimal approach for concurrently modeling the focal socioemotional skills? Are these approaches consistent across Indonesia and the US?

Existing research demonstrated misfit in structural models of personality and socioemotional skills in low and middle-income countries (Laajaj et al., 2019). We will test four models to ascertain the optimal way to model these socioemotional skills concurrently. In these models, we will also include a measure of self-esteem (which represents a general, global feeling of positivity toward the self), a construct that we anticipate being somewhat correlated with our focal socioemotional skills factors, but less proximal to academic outcomes themselves. Including self-esteem allows us to initially assess whether responses represent a general response

tendency that might reflect a misunderstanding of the concepts (e.g., all of the items sound like they are asking about the same thing, none of these concepts make sense to me) or a positive response bias (e.g., I say yes to everything that sounds positive about myself) either of which would likely result in a significantly-better fitting higher-order factor model that includes self-esteem in addition to socioemotional skills.

Research Question 4: Can measurement of the focal socioemotional skills be equated across the Indonesian and US samples?

Assuming configural invariance is found (Research Question 1), we will test weak invariance (i.e., metric invariance, or equal factor loadings), and, if found, strong invariance (i.e., scalar invariance, or equal factor loadings and item intercepts). If we find strong latent measurement invariance, we will test for mean-level differences (Ployhart & Oswald, 2004). Recent research on related socioemotional skills (He, Barrera-Pedemonte, & Bucholz, 2017) showed at least weak invariance across samples in 29 countries.

Research Question 5: Within cultures, do the focal socioemotional skills show similar patterns of convergent and predictive validity?

We anticipate that each socioemotional skill will predict grades in Indonesia and in the United States at statistically and practically significant levels. To go beyond measurement invariance tests within each country and assess whether the measures appear to have the same meaning in Indonesia as in the US, we will test convergent validity by examining whether across the Indonesian and American contexts there are significant positive correlations between each of the socioemotional skills factors. As noted earlier, there is evidence suggesting that growth mindset, mastery orientation, and grit are associated with academic achievement in the US. Evidence of predictive and convergent validity from the Indonesian sample would support the

contention that enhancing these socioemotional skills could be a promising approach to promoting academic outcomes among adolescents in Indonesia and across the Global South.

Method

Participants

Indonesian participants were recruited as part of the impact evaluation of the Semua Bisa Sukses (“All Can Succeed”) program, which is a collaboration between the Indonesian Ministry of Education and Culture and the World Bank. Participants in the Indonesian sample ($N = 55,964$; $M_{\text{age}} = 14.18$, $SD_{\text{age}} = 0.74$, 52% female) are representative of public, secular middle-school students on the islands of Java and Sumatra, which together account for more than three quarters of Indonesia’s population. Participants in the American sample ($N = 440$; $M_{\text{age}} = 15.19$, $SD_{\text{age}} = 0.81$, 56% female) were recruited online. The ethnic breakdown for the American sample was: White (62%), Latino (17%), or African American (12%). In terms of maternal education, 61% of Indonesian and 10% of American mothers, respectively, had completed less than a high school degree, whereas 24% of Indonesian and 27% of American mothers, respectively, had completed high school only.

Procedure

In Indonesia, adolescents responded to a paper-based survey administered in the classroom setting by a third-party local research firm as the baseline survey for a randomized controlled trial. Overall, 2,097 schools were selected in Java and Sumatra, and one classroom per school was randomly selected by the research firm to complete the surveys. Power was based on school-level randomization to detect treatment effects for a larger, two-wave impact evaluation research project, and provides sufficient power for the present study. All measures in the current study were collected at baseline, prior to intervention activities.

Due to budget limitations, the methods for collecting data in the US differed. Lucid (<https://luc.id>), a firm which recruits participants from a broad range of online and offline sources, recruited adolescents based on: (1) being from the US, (2) between 14 and 16 years of age, and (3) representative of US gender, ethnicity, and maternal education. Participants who met these criteria received an email inviting them to respond to an online survey based in Qualtrics. Based on the literature for detecting a .20 difference in factor loadings, we selected a minimum sample size of 400 (Meade & Bauer, 2007), but collected data from 440 participants to use up the balance in an account.

Measures

In Indonesia, surveys were administered in Bahasa Indonesia (the official national language), after being translated and back-translated by different translators, with discrepancies discussed by the multilingual project team. US participants took an English version using the back-translated survey. Survey development included two pilots in Indonesia. Adaptations to the items and response categories were made based on feedback from teachers, students, and native-speaking researchers. All items in both languages can be found in the online supplementary materials. See Table 1 for item texts and descriptive statistics.⁴

Growth mindset

Growth mindset captures the degree to which students believe that their intelligence can change. It was measured by four items (adapted from Dweck, 1999), ranging from (1) *Not true at all* to (5) *Completely true*.⁵ An example item was “You cannot change how smart you are.”

Mastery orientation

⁴ The data that support the findings of this study are openly available and can be found here: https://osf.io/j9zx5/?view_only=a7d25178a0c147c781c487d8f9a5dca0.

⁵ The concept of “neutral” does not translate well into Bahasa Indonesia. Indonesian participants’ middle response option in this and in other Likert-type scales represents a very slight “positive” response.

Mastery orientation captures individual learning goals concerned with developing a deep understanding and competence in academic contexts. It was assessed with three items (adapted from the Patterns of Adaptive Learning Scale, Midgley et al., 2000), ranging from (1) *Not true at all* to (5) *Completely true*. An example item was “In my math class, it’s okay to make mistakes as long as you learn from those mistakes.”

Grit

Grit captures the degree to which students show perseverance and passion for long-term outcomes or goals. Grit was measured with four items (adapted from the Short Grit Scale, Duckworth & Quinn, 2009), ranging from (1) *Almost never* to (5) *Almost always*. The four items were derived from the “perseverance of effort” subscale, which, in a recent meta-analysis (Credé, Tynan, & Harms, 2017) was the component of grit most associated with academic performance. An example item was “I stay committed to my goal, even if it takes a long time.”

Insert Table 1 here

Self-esteem

Self-esteem captures people’s subjective evaluation of themselves. Self-esteem was assessed with four items from the Lifespan Self-Esteem Scale (Harris, Donnellan, & Trzesniewski, 2016), ranging from (1) *Really sad* to (5) *Very happy*. An example item was “How do you feel about yourself?”

School grades

In Indonesia, grades were provided by schools and range from 0 to 100 (75 is a passing grade) for the core subjects of math, science, English, and Bahasa Indonesia. US adolescents self-reported their grades using the following item: “What grades (A, B, C, or D) do you usually

get in school?” (1 = *Mostly Ds*, 2 = *Mix of Cs and Ds*, 3 = *Mostly Cs*, 4 = *Mix of Bs and Cs*, 5 = *Mostly Bs*, 6 = *Mix of As and Bs*, and 7 = *Mostly As*).

Analyses

Our analyses had five main steps. First, we developed and refined unidimensional models for each construct within cultures. This step included calculating each factor’s reliability using the resultant latent factors. Second, we tested for measurement invariance for each construct across participant gender within cultures. Third, we modeled all constructs simultaneously in a single model for each culture, both to assess the interrelationships between factors, and also to ascertain which of several possible modeling approaches is best suited to these data. Fourth, we tested each construct individually for cross-cultural measurement invariance. Finally, to gauge validity, we assessed the relations between the constructs of interest and participant grades.

Confirmatory factor analyses (CFAs) were modeled in Mplus 8.1 (Muthén & Muthén, 1998-2018) and MplusAutomation in R (Hallquist & Wiley, 2018). We used two estimators: “MLR,” a maximum likelihood estimator that is robust to potential non-normality, and “Bayes,” which uses a Gibbs sampler and Markov Chain Monte Carlo approach to estimate Bayesian latent models.

All datasets and analyses are listed as links in the OSM.

Given that Indonesian adolescent data were collected within specific schools, the data are nested. We corrected standard errors of parameters estimates for school clustering (i.e., TYPE = COMPLEX argument in Mplus). The range of intraclass correlations for each measure was: .09-.15 for growth mindset items, .07-.09 for mastery orientation items, .06-.09 for grit items, and .08-.11 for self-esteem items, indicating some between-school means on these constructs, justifying this standard-error correction for clustering. This correction, however, was not

applicable for US adolescents because they were sampled using an online platform and were not asked to report the name of their school.

Note that although the correction is conceptually and statistically appropriate in the Indonesian sample, analyses that ignore school clustering led to virtually identical results for the configural model (factor loadings, item intercepts, and residual variances; see figures S3-S5 in the online supplement for details). We therefore decided to proceed without clustering when testing invariance *across* countries. This more-parsimonious model does not impose the unreasonable assumption that all US adolescents were clustered in the same school.

Invariance testing

Analyses for Research Question 4 involved testing cross-cultural measurement invariance using two CFA-based techniques (Meredith, 1993): a subsampling approach based in traditional frequentist techniques and a Bayesian approach. We employed these two cutting-edge approaches because there is currently limited guidance in the literature about how to best conduct multigroup invariance testing when groups dramatically differ in size. Beyond improving the robustness of our interpretation of measurement invariance for the present research, we hope that our description of these methods is also broadly useful for future researchers conducting similar analyses with imbalanced groups. In this section, we further expand our analytical plan for each of these techniques.

Subsampling approach. Our first approach included frequentist statistics and pooled results from a technique that draws subsamples from the considerably larger Indonesian sample, so that the subsample is comparable in size with the US sample. If such subsampling is not conducted, then measurement invariance results would be dominated by the larger Indonesian sample, instead of equally influenced by both samples (Linda Muthen, personal communication

with Oswald, April 20, 2020). This sample size imbalance across groups would poses a threat to drawing conclusions from measurement invariance tests when decisions in the testing process rely on fit statistics. More specifically, as explained by Yoon and Lai (2018), fit statistics in multi-group CFA are a weighted combination of the model fit across groups, where the larger group contributes a larger weight. In other words, the larger group may “absorb” differences in parameter estimates with the smaller group, which tends to exacerbate the Type I error of concluding that measurement invariance holds when, in fact, it does not (Brace & Savalei, 2017).

To ascertain potential limitations of the traditional two-group approach for this unbalanced sample, we followed Yoon and Lai’s strategy to reduce imbalance by fitting multi-group models in which the US sample was compared to a random subsample of Indonesian participants. We created 100 random subsamples (~550 participants each), fit 100 different models, and then averaged the fit statistics across models.

Model fit was assessed using the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and root mean square error of approximation (RMSEA). Well-fitting models were expected to have CFI and TLI values close to .95, and RMSEA values close to .06 (Hu & Bentler, 1999). Testing for configural invariance involved specifying the same factor structure across each group and assessing model fit (factor loadings and item intercepts can be unequal). Testing for weak (metric) invariance involved equating loadings across groups (intercepts can be unequal), while testing for strong (scalar) invariance involved also equating indicator loadings and intercepts across groups. We concluded support for invariance of these models invariant when $\Delta\text{CFI} < .01$ between each invariance “step” (Cheung & Rensvold, 2002). Models testing configural invariance freely estimated each indicator loading.

Bayesian structural equation modeling approach. Our second approach used Bayesian statistical modeling. Bayesian structural equation modeling (BSEM) has a potential advantage over traditional frequentist structural equation modeling in that BSEM accommodates *approximate* forms of measurement invariance (e.g., loadings that are similar within the bounds of practical significance) as opposed to the *exact* tests of model parameter invariance (e.g., loadings that are exactly equal; Asparouhov & Muthén, 2014). Under BSEM, factor model parameter estimates—e.g., loadings, intercepts, residual variances—are estimated as distributions instead of point estimates (Kaplan & Depaoli, 2012). These posterior distributions for loadings and intercepts are then used to determine of whether a set of items is invariant across countries (Asparouhov & Muthén, 2014). That is, conclusions about invariance are based on the probability that, for example, the posterior distribution of item A's loading in Indonesia is practically different from the posterior distribution of item A's loading in the US. Furthermore, even when some loadings and intercepts can be deemed noninvariant across countries, BSEM allows for comparisons of latent means assuming some degree of noninvariance (this is called *partial invariance* in the more traditional/frequentist form of testing for measurement invariance; Schmitt & Kuljanin, 2008).

The Bayesian posterior distribution of model parameters is calculated from the multiplicative combination of (a) the likelihood function of the data at hand and (b) the prior belief as represented by the prior probability distribution of model parameters. This Bayesian prior distribution operationalizes a realistic assumption that parameter differences between countries are small and distributed around zero, rather than assumed to be strictly zero, as it is in the frequentist paradigm. In particular, we followed De Bondt and Van Petegem (2015) who used strong priors, $N(0, .01)$, for the differences in factor loadings and intercepts across

countries. This prior distribution imposes the assumption that the differences in loadings and intercepts across countries are normally distributed, centered around zero, and show relatively small variance around zero. To the extent that non-invariance exists in our data, it must be strong enough empirically to overwhelm or “swamp” the prior distribution in the resulting posterior distribution.

There are other benefits to the Bayesian approach for these data. Because the Indonesian adolescent sample is much larger than the US sample, the Indonesian posterior loadings and intercepts were bound to be more precise (i.e., narrower distributions). Taken together, the combination of our prior (i.e., small differences in parameters across countries) and the unique characteristics of the imbalanced samples ensured that this Bayesian approach was conservative: minimal deviations of the US parameters compared to the Indonesia parameters would result in some degree of noninvariance.

Results

Research Question 1: What is the optimal approach for independently modeling the focal socioemotional skills? Are these approaches consistent across Indonesia and the US?

Table 2 (Single Group row) shows that a unidimensional factor structure with adequate fit and reliability was found within the US and Indonesia for each construct. We direct readers to Table S1 in the online supplement for detailed information on model parameters.

Three additional results bear reporting. First, for the US sample, the four-item model for grit resulted in a model with inadequate fit ($CFI = .978$; $TLI = .933$, $RMSEA = .097$; $RMSEA$ 90% $CI = [.045, .160]$). We removed the item (“I finish whatever I start”) with the lowest standardized loading (“I finish whatever I start;” $.623$) and used the remaining three items to model grit in both samples. Second, two of the three factors were modeled by three indicators.

Thus, the models had zero degrees of freedom and because they fit the data perfectly, they were characterized by saturated fit indices. Third, growth mindset, mastery orientation, and grit responses had higher estimates of reliability in the US ($\omega = .89, .74, .76$, respectively) than in Indonesia ($\omega = .60, .44, .45$, respectively). See Tables S2 and S3 in the online supplement for details on omega reliabilities in configural models by gender (within country) and by country (traditional invariance approach). Although the reliability levels for the Indonesian data are lower than conventional standards, they are consistent with prior research in the socioemotional skills domain conducted in the Global South (e.g., Laajaj et al., 2019).

Insert Table 2 here

Research Question 2: Can the focal socioemotional skills be equated for boys and girls within each cultural context?

All three constructs met our criteria for strong invariance across genders within contexts. Table 2 shows the results of gender invariance tests within each country. Given these results, we estimated and interpreted differences in latent means. In the US, males and females did not differ in growth mindset, mastery orientation, and grit. Similarly, Indonesian males and females did not differ in grit (latent $d = .01$, 95% Confidence Interval = $[-.05, .06]$; $p = .865$). However, Indonesian females showed higher levels of growth mindset (latent $d = .10$, 95% Confidence Interval = $[.08, .13]$; $p < .001$) and mastery orientation (latent $d = .47$, 95% Confidence Interval = $[.44, .49]$; $p < .001$) compared to Indonesian males.⁶

Research Question 3: What is the optimal approach for concurrently modeling the focal socioemotional skills? Are these approaches consistent across Indonesia and the US?

⁶ Based on Hancock's guidelines (2001), standardized latent mean differences are comparable to Cohen's d when parameterizing models through fixing latent variance

Separately for the US and Indonesian samples, we conducted a series of analyses that compared four ways that growth mindset, mastery orientation, grit, and self-esteem⁷ might be structured. Across both contexts, we concluded that the optimal approach was to model the socioemotional skills and self-esteem as distinct correlated factors.

The four modeling approaches were: 1) *Single factor*, which tests whether there is a single global factor that cuts across the four constructs (all items are indicators of a single factor); 2) *Second-order factor*, which tests a hierarchical model, where a single second-order factor (a general factor) that gives rise to the domain-specific factors, that in turn give rise to individual items for each measure ; 3) *Bifactor*, which is less constrained than the second-order model, testing whether all the items load on a general factor, in addition to loading on the domain-specific factors ; and 4) *Correlated factors*, which tests whether domain-specific constructs are independent, but correlated (i.e., with our four constructs, there are six correlations being modeled here, versus four loadings onto the second-order factor in the first model).

Across both contexts, the single factor approach fit poorly. The other three approaches did not significantly differ in fit from each other (Table 3). We elected to use the correlated factors model for these data, as this model is consistent with prior conceptualizations of the socioemotional skills factor space and allows us to assess the unique contributions that each factor may play in predicting academic achievement.

Insert Table 3 here

⁷ We also conducted a series of CFAs and across-gender invariance tests for self-esteem in both cultural contexts. The results of these analyses can be found in Table S5 in the supplementary material. In brief, our four-item index of self-esteem exceeded some, but not all, thresholds for good fit in both contexts. Because self-esteem was not a focal factor of interest, we elected to proceed with this four-item operationalization of self-esteem. The US data was characterized by partial strong invariance, whereas the Indonesian data was characterized by strong invariance across participant gender.

Research Question 4: Can measurement of the focal socioemotional skills be equated across the Indonesian and US samples?

Subsampling approach

Across cultures, grit and mastery orientation were characterized by only weak invariance, and growth mindset showed only configural invariance when using the subsampling approach (see Table 4 for average fit indices across the 100 subsamples). More specifically, the grit strong invariance model showed a ΔCFI over $|.01|$ compared to the weak invariance model in all 100 subsamples (average $\Delta CFI = -.086$). The mastery orientation strong invariance model showed a ΔCFI value over $|.01|$ compared to the weak invariance model in all 100 subsamples (average $\Delta CFI = -.146$). The growth mindset weak invariance model showed a CFI value over $|.01|$ compared to the configural invariance model in 57% of the subsamples (average $\Delta CFI = -.027$). See Table S4 in the online supplement for effect size estimates of the extent to which mastery orientation, growth mindset, and grit items are non-invariant.

Insert Table 4 here

Bayesian structural equation modeling approach

Invariance testing from the Bayesian perspective provided new information and insights. Approximate measurement invariance (i.e., strong measurement invariance allowing for slight variation in loadings and intercepts across groups) was supported for mastery orientation and grit, but not for growth mindset items based on the posterior predictive p -value (PPP). Table 5 shows that the PPP for the growth mindset model is close to zero, indicating that simulating new data from the parameters in the model shows consistent differences from the data used to estimate the model.

Comparing the posterior distributions for intercepts and loadings between countries suggested that some measurement parameters for growth mindset likely differ across contexts. For example, the factor loading for growth mindset item 3 (“How smart I am is something about me that I cannot change very much”) was consistently lower in the Indonesian model than in the US model ($M = -0.17$, 95% CI $[-0.25, -0.10]$), whereas the intercept was consistently higher in Indonesia ($M = 0.32$, 95% CI $[0.24, 0.40]$). In addition, the factor loading for growth mindset item 1 (“I can learn new things, but I cannot make myself smarter”) was consistently higher in the Indonesian model than in the US model ($M = 0.18$, 95% CI $[0.09, 0.30]$), whereas the intercept was consistently lower in Indonesia ($M = -0.08$, 95% CI $[-.19, -.04]$). Given that the measurement parameters for growth mindset differed across countries and the PPP indicated poor fit, we do not report latent mean differences between countries here.

However, mastery orientation and grit provided results that allow for latent mean comparisons. Indonesian youth showed higher levels of a mastery orientation than US adolescents (latent Mean = 0.46, 95% CI $[\.34, \.58]$), whereas there were no systematic differences in grit between Indonesian and US adolescents (latent mean = -0.02, 95% CI $[-0.13, 0.09]$).

Insert Table 5 here

Summary of invariance testing results

Results from measurement invariance testing were mixed. The Bayesian analyses provided evidence for measurement invariance for mastery orientation and grit, but not growth mindset⁸. This allowed for comparison of latent means: Indonesian youth reported significantly higher mastery orientation than US youth, but there were no significant cross-cultural differences

⁸ Anecdotally, these findings align with reports from some Bahasa Indonesia-speaking members of the Indonesia-based data collection team, who noted challenges translating the growth mindset items.

in grit. In contrast, results the subsampling approach showed that the mastery orientation and grit factors achieved weak, but not strong invariance across cultures. Growth mindset achieved only configural invariance across cultures in the subsampling approach. To summarize, the results provide good evidence of a shared factor structure for the focal socioemotional skills across constructs, but the evidence is inconclusive regarding invariance of item loadings and intercepts. We caution against overinterpreting any differences between latent means across context.

Research Question 5: Within cultures, do the focal socioemotional skills predict grades and demonstrate patterns of convergent validity?

We used traditional frequentist models to assess Research Question 5. Within each cultural context, the socioemotional factors demonstrated predictive validity with small associations with student grades (Table 6). The size of these correlations was consistent with previous work predicting grades from self-perceptions (e.g., Burnette, O’Boyle, VanEpps, Polak, & Finkel, 2013). Mastery orientation and growth mindset showed similar magnitude of effect sizes, whereas grit showed a more divergent pattern across the US and Indonesia. In addition, within each cultural context, growth mindset, mastery orientation, and grit latent factors were, for the most part, moderately correlated (r s ranged from .07 to .48 for US and .03 to .56 for Indonesia; Table 6).

Insert Tables 6 & 7 here

Within each cultural context, the socioemotional factors demonstrated predictive validity with small associations with student grades (Table 7). The size of these correlations were consistent with previous work predicting grades from self-perceptions (e.g., Burnette, O’Boyle, VanEpps, Polak, & Finkel, 2013). Mastery orientation and growth mindset showed similar

magnitude of effect sizes, while grit showed a more divergent pattern across the US and Indonesia.

Discussion

The purpose of the present research was to assess the factor structure, reliability, validity, cross-gender and cross-cultural measurement invariance in measures of growth mindset, mastery orientation, and grit in samples of Indonesian and US adolescents. In reviewing the results as a whole, we conclude that there is evidence that growth mindset, mastery orientation, and the perseverance of effort component of grit conceptually translate to the Indonesian adolescent context, and that higher levels of each construct are indeed associated with higher academic achievement. These results imply that these socioemotional skills constructs, which have been shown to be associated with academic performance in the US, could prove useful targets for interventions aimed at promoting academic achievement among Indonesian youth, or among youth in the Global South more generally. However, there remain some open questions as to whether the measure of these constructs (in particular, that of growth mindset) may vary when compared to US adolescents.

We briefly review those psychometric and measurement invariance results here. We found that for Indonesian and US adolescents, growth mindset, mastery orientation, and grit could each be modeled by a unidimensional factor structure, and that these latent factors represented distinct, correlated constructs. These factors had lower reliability in the Indonesian sample than would be desired by conventional cutoffs, but they showed expected associations among themselves (convergent validity) and with grades (predictive validity), suggesting reliable and valid variance is being captured by the assessments. In addition, we found that each measure could be equated across gender within both cultural contexts. Indonesian girls had significantly

more mastery orientation and more of a growth mindset than did Indonesian boys, factors that may contribute to the gender-based academic achievement gap in that country.

However, across two different methodological techniques, the cross-cultural measurement invariance analyses were inconclusive. Results from the Bayesian approach supported measurement invariance in mastery orientation and grit, with Indonesian adolescents reporting a significantly higher mastery orientation. The Bayesian results also suggested that growth mindset did not achieve cross-cultural measurement invariance. In contrast, the frequentist subsampling approach suggested that the mastery orientation and grit factors achieved weak, but not strong invariance. Growth mindset achieved only configural invariance across cultures in the subsampling approach.

As a result, while more work is needed to understand potential cross-cultural variation in their measure, we believe that intervening upon these socioemotional skills could prove a valuable strategy for promoting the positive development of Indonesian youth. Furthermore, from a methodological perspective, we believe that further work is needed to investigate the utility of the Bayesian and frequentist subsampling techniques as approaches to assess measurement invariance in samples with imbalanced groups.

Contributions of the present research

We believe this research contributes to the field in several ways. First, these results provide new evidence of the potential role that socioemotional skills play in the academic achievement of adolescents from around the world. In particular, there is little previous work that includes growth mindset, mastery orientation, and grit within the same study and tests the unique contribution of each to grades. In the US, all three socioemotional skills have unique correlations with self-reported grades. In Indonesia, growth mindset and mastery orientation had unique

correlations with school-reported grades; grit, although statistically significant, did not reach the small-effect-size threshold (standardized $\beta = .07$). Moreover, we know of no other work that has tested the factor structure of these constructs to evaluate whether they are part of a higher-order global factor or whether they represent unique constructs. We concluded that they represent unique, correlated factors, but note that this model fit about as well as the second-order and bifactor model. More research is needed to test these measurement models across diverse samples and a wider range of socioemotional constructs.

There is growing interest in large-scale, cross-cultural research on socioemotional skills or related constructs. A second contribution of this research is that it highlights the ongoing need to develop and refine methodologies and guidelines for improved interpretation of invariance testing. We provided detailed comparison of two techniques for assessing cross-cultural measurement invariance among the focal socioemotional skills constructs. Inconsistency in the results from these approaches likely derives from their statistical assumptions and grouping approaches. We note that there are approaches beyond those used here to assessing measurement invariance, and these other approaches may prove valuable for similar datasets with unbalanced groups (see Boer, Hanke, & He, 2018). For example, Davidov et al. (2012) suggests testing impacts of contextual variables on noninvariance, which could prove especially useful the cultural contexts researchers are comparing are substantially different. In addition, although the multiple-group factor analysis alignment approach (Asparouhov & Muthén, 2014) does not expressly address imbalanced sample sizes, it may prove useful, given its practicality for estimating factor means and variance independent of achieving traditional measurement invariance.

A third contribution of this research is that it demonstrates the potential of these data to inform the field's conceptualization of socioemotional skills development and the role of socioemotional skills in promoting academic outcomes in Indonesian and in similar nations in the Global South. We provided a summary of initial results from a large study conducted in a diverse nation. Future work should continue to explore these patterns of validity, reliability, and measurement invariance with regards to investigations of Indonesian samples that may vary by socioeconomic status, urban or rural surroundings, Indonesian province, school characteristics, or other factors. Furthermore, future qualitative and mixed-methods research will be important to better understand culturally specific variation in the way that Indonesian young people may conceptualize socioemotional skills constructs.

Limitations

Our interpretations of the results should be qualified by several limitations. First, Indonesian adolescents' socioemotional skills were characterized by lower reliability when compared to American adolescents and conventional standards. Although these lower levels of reliability are consistent with prior research conducted in the Global South (Laajaj et al., 2019), future work should explore potential sources of systematic error. Relatedly, second, our constructs were necessarily assessed using short scales due to limited administration time. Although the small number of items appear to capture the intended constructs, it may have limited our ability to detect additional cross-cultural variation. Third, to ensure construct validity for the focal socioemotional skills, future research should identify other constructs that could be used to index discriminant validity for growth mindset, mastery orientation, and grit in the Global South. Fourth, budgetary limitations meant that the US data were collected online, whereas practical limitations (e.g., access to digital devices) required the Indonesian data to be

collected via a pencil and paper questionnaire. Thus, we cannot account for possible mode effects that may have confounded cross-cultural comparisons. Finally, given the existing research suggesting that socioemotional skills may prove especially important in promoting academic achievement among disadvantaged groups (Claro, Paunesku, & Dweck, 2016), future research should incorporate measures of socioeconomic status that were outside the scope of the present work.

Summary

Our results demonstrated that standard measures of growth mindset, mastery orientation, and grit seem to index the same underlying latent constructs across American and Indonesian adolescents. We also found that higher levels of each construct were associated better grades among adolescents in both contexts. Therefore, given the existing research conducted in the US, future interventions designed to promote Indonesian students' academic achievement through enhancing these socioemotional skills may prove valuable. In the spirit of developing a generalizable science of socioemotional skills development and promotion in the Global South, we encourage scientists, policymakers, and practitioners to examine the psychometric properties of these and other socioemotional skills measures among adolescents in the Global South.

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Table 1

Descriptive Statistics for Each Survey Item, by Country

	Indonesia		USA		<i>d</i>	95% CI
	Mean	SD	Mean	SD		
<i>Growth mindset</i>	3.21	0.8	3.64	1.13	-0.45	-0.55, -0.35
1. I cannot change how smart I am.	3.13	1.03	3.37	1.26	-0.21	-0.31, -0.11
2. How smart I am is something about me that I cannot change very much.	3.23	1.02	3.77	1.29	-0.47	-0.57, -0.37
3. I was born a certain way, smart or not smart, and I can't change that.	2.94	1.03	3.61	1.3	-0.58	-0.68, -0.48
4. I can learn new things, but I cannot make myself smarter.	3.56	1.46	3.81	1.34	-0.18	-0.27, -0.08
<i>Mastery orientation</i>	4.34	0.58	3.94	0.87	0.55	0.45, 0.65
1. One of my goals in class is to learn as much as I can even if I make a lot of mistakes along the way.	4.36	0.83	3.69	1.14	0.68	0.58, 0.78
2. It's important to me that I completely understand my class work.	4.38	0.75	3.99	1.04	0.44	0.34, 0.54
3. I will feel successful if I improve my academic skills at school this year.	4.27	0.8	4.14	1.02	0.14	0.05, 0.23

Table 1 (cont.)

Descriptive Statistics for each survey item by country

	Indonesia		USA		<i>d</i>	95% CI
	Mean	SD	Mean	SD		
<i>Grit</i>	3.65	0.62	3.76	0.79	-0.16	-0.25, -0.07
1. I finish whatever I start.	3.51	0.82	3.82	0.87	-0.37	-0.47, -0.27
2. I stick with tasks or activities for more than a few weeks.	3.44	0.95	3.67	1.01	-0.23	-0.33, -0.13
3. I try very hard even after I fail.	3.71	0.97	3.73	1.05	-0.02	-0.11, 0.07
4. I stay committed to my goal, even if it takes a long time.	3.92	0.96	3.82	1.08	0.10	0.01, 0.19
<i>Self-esteem</i>	3.53	0.65	3.41	1.06	0.14	0.05, 0.23
1. How do you feel about yourself?	3.96	0.86	3.4	1.2	0.54	0.44, 0.64
2. How do you feel about the kind of person you are?	3.7	0.83	3.68	1.11	0.02	-0.07, 0.11
3. When you think about yourself, how do you feel?	3.21	1.01	3.26	1.23	-0.04	-0.13, 0.05
4. How do you feel about the way you are?	3.25	1.01	3.32	1.24	-0.06	-0.15, 0.03
<i>School grades</i>						
Math	77.19	6.57				
Science	78.37	6.05				
English	78.05	6.32				
Bahasa	80.08	5.8				
Composite	78.42	8.86	5.64	2.38		

Note. $N_{ID} = 55,964$, $N_{US} = 440$. CI = Confidence Interval. Item and scale means and standard deviations reflect recoded items. *d* represents Cohen's *d* with positive effect sizes representing higher means for Indonesia.

Table 2

Model Fit Indices for Overall Model (Single Group) and Invariance Tests Across Gender for Each Construct, by Country

Model	Parameters	χ^2	df	p	CFI	Δ CFI	TLI	RMSEA	90% CI LL	90% CI UL
USA										
Growth Mindset										
Single group	12	0.16	2	.923	1.000		1.012	0	0	.032
Configural	24	0.25	4	.993	1.000	0	1.026	0	0	0
Weak	21	0.50	7	.999	1.000	0	1.000	0	0	0
Strong	18	3.31	10	.973	1.000	0	1.000	0	0	0
Mastery										
Single group	9	0	0	0	1.000		1.00	0	0	0
Configural	18	0	0	0	1.000	0	1.000	0	0	0
Weak	16	0.63	2	.729	1.000	0	1.000	0	0	.095
Strong	14	2.49	4	.646	1.000	0	1.000	0	0	.082
Grit										
Single group	9	0	0	0	1.000		1.000	0	0	0
Configural	18	0	0	0	1.000	0	1.000	0	0	0
Weak	16	2.54	2	.280	.998	.002	.994	.035	0	.144
Strong	14	5.32	4	.256	.995	.003	.992	.039	0	.115
Indonesia										
Growth Mindset										
Single group	12	289.21	2	0	.987		.962	.051	.046	.056
Configural	24	322.22	4	0	.986	.001	.958	.053	.048	.058
Weak	21	421.52	7	0	.985	.001	.975	.041	.038	.045
Strong	18	515.97	10	0	.982	.003	.978	.038	.035	.042

Socioemotional skills in Indonesia

Mastery										
Single group	9	0	0	0	1.000		1.000	0	0	0
Configural	18	.002	0	0	1.000	0	1.000	0	0	0
Weak	16	4.580	2	.101	1.000	0	.999	.007	.000	.015
Strong	14	13.458	4	.009	.999	0.001	.998	.009	.004	.015
Grit										
Single group	9	0	0	0	1.000		1.000	0	0	0
Configural	18	0	0	0	1.000	0	1.000	0	0	0
Weak	16	2.184	2	.336	1.000	0	1.000	.004	.000	.028
Strong	14	3.727	4	.444	1.000	0	1.000	0	0	.020
Strong Partial	15	3.670	3	.299	1.000	0	.999	.007	0	.025

Note. $N_{ID} = 55,964$, $N_{US} = 440$. CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA = Root Mean Square Error of Approximation; LL.= Lower limit in RMSEA confidence interval; UL = Upper limit in RMSEA confidence interval. The constructs measured by only three items have zero degrees of freedom and because they fit the data perfectly, they were characterized by saturated fit indices (e.g., CFI = 1.00).

Table 3

Model Fit Indices for Models that Estimated Four Constructs Simultaneously in Each Country

Model	Param- eters	χ^2	df	<i>p</i>	CFI	TLI	RMSEA	90% CI LL	90% CI UL
USA									
Single factor	42	1499.638	77	<.001	.411	.304	.205	.196	.214
Second order	46	125.000	73	<.001	.978	.973	.040	.028	.052
Bi-factor	56	98.491	63	.003	.985	.979	.036	.021	.049
Correlated	48	116.932	71	.001	.981	.976	.038	.025	.050
Indonesia									
Single factor	42	51662.636	77	<.001	.250	.114	.109	.109	.110
Second order	46	2301.968	73	<.001	.968	.960	.023	.023	.024
Bi-factor	56	1664.943	63	<.001	.977	.966	.021	.020	.022
Correlated	48	2154.283	71	<.001	.970	.961	.023	.022	.024

Note. $N_{ID} = 55,964$, $N_{US} = 440$. CFI = Comparative Fit Index; TLI = Tucker Lewis Index ; RMSEA = Root Mean Square Error of Approximation; LL.= Lower limit in RMSEA confidence interval; UL = Upper limit in RMSEA confidence interval.

Table 4

Average Values for Fit Indices Across 100 Iterations of Cross-cultural Invariance Testing

Model	CFI	TLI	RMSEA
Growth Mindset			
Configural	0.998	0.998	0.017
Weak	0.987	0.978	0.051
Strong	0.960	0.952	0.079
Mastery orientation			
Configural	1.000	1.000	0.000
Weak	0.991	0.977	0.038
Strong	0.845	0.767	0.149
Grit			
Configural	0.976	0.929	0.081
Weak	0.975	0.958	0.063
Strong	0.889	0.867	0.111

Note. $N_{ID} = 55,964$, $N_{US} = 440$. CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA = Root Mean Square Error of Approximation

Table 5

Bayesian Model Testing Results for Cross-cultural Invariance

Construct	PPP	95% CI	Nonvariant Intercepts	Nonvariant Loadings
Growth mindset	> .001	[449.23, 492.30]	None	None
Mastery orientation	0.43	[-15.61, 20.04]	2	1, 2, 3
Grit	0.48	[-16.23, 16.27]	2	1, 2, 3

Note. $N_{ID} = 55,964$, $N_{US} = 440$. PPP = Posterior predictive p -value; CI = Credibility interval; Numbers under nonvariant intercepts and loadings represent item numbers for their respective scales (see Table 1).

Table 6

Correlations (Standard Errors), p-values, and Confidence Intervals for Association Among Latent Factors Within Each Country

Construct	Indonesia			
	Growth mindset	Mastery orientation	Grit	Self esteem
USA	Growth mindset	.03 (0.01), $p = .000$, 95% CI [.02, -.04]	.10 (0.01), $p = .000$, 95% CI [.09, .11]	.12 (.01), $p = .000$, 95% CI [.10, .13]
	Mastery orientation	.25 (0.06), $p = .000$, 95% CI [.13, .37]	.56 (0.01), $p = .000$, 95% CI [.54, .57]	.25 (0.01), $p = .000$, 95% CI [.24, .27]
	Grit	.18 (0.06), $p = .002$, 95% CI [.07, .29]	.48 (0.06), $p = .000$, 95% CI [.36, .60]	.30 (0.01), $p = .000$, 95% CI [.28, .31]
	Self esteem	.07 (0.06), $p = .239$, 95% CI [-.04, .17]	.39 (0.06), $p = .000$, 95% CI [.28, .50]	

Note. $N_{ID} = 55,964$, $N_{US} = 440$. The lower left side of the diagonal shows correlations within the American sample, whereas the top right side of the diagonal shows correlations within the Indonesian sample.

Table 7

Standardized Regression Coefficients, Standard Errors, p-values, and Confidence Intervals for Latent Socioemotional Skill Factors Predicting School Grades

Skills	Estimate	SE	<i>p</i>	95% CI LL	95% CI UL
USA					
DV: Composite Grades					
Growth Mindset	.131	.055	.016	.024	.237
Mastery Orientation	.161	.071	.024	.022	.301
Grit	.220	.068	.001	.086	.353
Indonesia					
DV: Composite Grades					
Growth Mindset	.182	.009	< .001	.164	.200
Mastery Orientation	.133	.011	< .001	.111	.155
Grit	.066	.011	< .001	.044	.088
DV: Natural Sciences Grades					
Growth Mindset	.144	.009	< .001	.127	.162
Mastery Orientation	.126	.011	< .001	.105	.147
Grit	.047	.011	< .001	.025	.069
DV: English Grades					
Growth Mindset	.156	.010	< .001	.137	.174
Mastery Orientation	.084	.011	< .001	.062	.105
Grit	.068	.011	< .001	.047	.089
DV: Indonesian Bahasa Grades					
Growth Mindset	.146	.008	< .001	.130	.163
Mastery Orientation	.133	.011	< .001	.111	.155
Grit	.056	.011	< .001	.034	.077
DV: Math Grades					
Growth Mindset	.151	.009	< .001	.134	.168
Mastery Orientation	.096	.011	< .001	.075	.117
Grit	.048	.011	< .001	.026	.069

Note. $N_{ID} = 55,964$, $N_{US} = 440$. 95% CI LL.= Lower limit in confidence interval; 95% CI UL = Upper limit in confidence interval. Standardized parameters reported to account for cross-cultural variation in grading metrics.