

Structural Validity of Incremental and Entity Beliefs Among Filipino Junior High School Students

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ABSTRACT

Beliefs about the malleability of intelligence are central to how adolescents interpret challenge and regulate effort, yet measures of these beliefs require careful validation within specific cultural and linguistic contexts. This study examined the structural validity and reliability of an Implicit Theory of Intelligence instrument in a large Filipino secondary sample. Grade 7 to Grade 10 students from four public schools completed a fourteen item scale adapted from prior work. Data screening followed standard practice, and construct validation proceeded sequentially with exploratory factor analysis using maximum likelihood and Promax rotation, followed by confirmatory factor analysis with maximum likelihood estimation and multiple fit criteria. The exploratory analysis recovered a two factor configuration consistent with incremental and entity beliefs, but the extracted structure was weak, with modest cumulative variance and several indicators showing small loadings and very low communalities. In the confirmatory stage, absolute fit indices were acceptable, while comparative fit was only adequate and the Tucker–Lewis Index fell below preferred thresholds. Composite reliability for both factors failed to reach conventional levels and average variance extracted was below the criterion for convergent evidence. Together, the results indicate that the correlated two factor representation is visible at the model level but not yet measurement strong in this context. The findings support targeted item refinement, especially for fixed belief statements, cognitive interviewing to improve clarity and cultural resonance, replication in independent cohorts, and formal tests of measurement invariance before school level use beyond formative or research purposes.

RESUMO

As crenças sobre a maleabilidade da inteligência são centrais para entender como adolescentes interpretam desafios e regulam o esforço, mas as medidas dessas crenças exigem validação cuidadosa em contextos culturais e linguísticos específicos. Este estudo examinou a validade estrutural e a confiabilidade de um instrumento de Teoria Implícita da Inteligência em uma amostra ampla de estudantes filipinos do ensino fundamental II. Alunos do 7º ao 10º ano de quatro escolas públicas responderam a uma escala de quatorze itens adaptada de trabalhos anteriores. A triagem dos dados seguiu procedimentos padronizados e a validação construtiva ocorreu de forma sequencial: análise fatorial exploratória com extração por máxima verossimilhança e rotação Promax, seguida de análise fatorial confirmatória com estimação por máxima verossimilhança e múltiplos critérios de ajuste. A análise exploratória recuperou uma configuração de dois fatores consistente com crenças incrementais e crenças de entidade, porém a estrutura extraída mostrou-se fraca, com variância cumulativa modesta e vários indicadores apresentando cargas fatoriais pequenas e communalidades muito baixas. Na etapa confirmatória, os índices de ajuste absolutos foram aceitáveis, enquanto o ajuste comparativo foi apenas adequado e o Índice Tucker–Lewis permaneceu abaixo dos limiares preferidos. A confiabilidade composta de ambos os fatores não atingiu níveis convencionais e a variância média extraída ficou abaixo do critério para evidência convergente. Em conjunto, os resultados indicam que a representação de dois fatores correlacionados é visível no nível do modelo, mas ainda não é psicometricamente robusta neste contexto. As evidências sustentam um programa de refinamento direcionado de itens, sobretudo das afirmações de crenças fixas, o uso de entrevistas cognitivas para aprimorar clareza e ressonância cultural, a replicação em coortes independentes e testes formais de invariância de medida antes de qualquer aplicação em nível escolar além de fins formativos ou de pesquisa.

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Introduction

Beliefs about the malleability of intelligence offer a framework for understanding how adolescents interpret challenge, regulate effort, and set goals. Foundational work distinguishes an incremental view that intellectual ability can develop through sustained effort, strategy, and instruction from an entity view that ability is largely fixed (Dweck & Leggett, 1988; Dweck, 1999, 2006). These belief systems help explain why students with comparable prior attainment diverge in persistence, help seeking, and responses to failure. Incremental beliefs are linked to learning goals and adaptive regulation, whereas entity beliefs are associated with performance concerns, avoidance of difficulty, and withdrawal when confronted with the possibility of failure (Elliott & Dweck, 1988; Stipek & Gralinski, 1996; Elliot & McGregor, 2001; Blackwell, Trzesniewski, & Dweck, 2007).

Empirical studies connect mindset content to motivation and achievement, with effects that are modest and conditioned by context (Blackwell et al., 2007; Yeager & Dweck, 2020). Growth oriented beliefs have been associated with more adaptive responses to difficulty and with achievement advantages in settings marked by adversity, including economic disadvantage (Claro, Paunesku, & Dweck, 2016). At the same time, scholars note that endorsement patterns can be complex in adolescence. Learners may affirm that ability can improve while still acknowledging stable differences in initial aptitude, which implies that incremental and entity beliefs can be related rather than strict opposites in practice (Tempelaar, Rienties, Giesbers, & Schim van der Loeff, 2012; Tempelaar, Rienties, Giesbers, & Gijsselaers, 2015; Limeri et al., 2020).

Measurement quality is therefore central to scientific and practical progress. Early instruments used a small set of items to index fixed and growth beliefs, followed by expanded pools, first person formulations, and broader structures that separate a general malleability factor from more specific expressions (Dweck, 1999; Abd-El-Fattah & Yates, 2006; De Castella & Byrne, 2015; Karwowski, 2014). Recent validation work across cultures and age groups reports heterogeneous item performance, frequent weakness among strongly fixed statements, and evidence that the two belief systems are related but not simple opposites. These patterns underscore the need to establish structural validity, reliability, and convergent evidence in each linguistic and cultural context rather than assuming universal dimensional forms (Midkiff, Langer, Demetriou, & Panter, 2017; Chen, Ding, & Liu, 2021; Scherer & Campos, 2022; Yilmaz, 2022).

Within the Philippines, mindset measures have been used in secondary and tertiary settings, yet full validation remains limited, especially for adolescent populations where language, school culture, and social desirability may shape responses to fixed statements (Calingasan & Plata, 2018; Mabandos & Moneva, 2020; Repuya, 2021; Calingasan & Plata, 2022; Viña, Mamalampay, Mascud, Liscano, & Quiñones, 2022; Mariano-Dolesh, Collantes,

Ibanez, & Pentang, 2022). The present study addresses this gap by examining whether a two-factor representation of incremental and entity beliefs is visible and measurement strong among Filipino junior high school students, and by drawing implications for item clarity, cultural resonance, generalizability, and responsible scope of use in school contexts.

This study evaluates the measurement properties of the Implicit Theory of Intelligence Scale among Filipino junior high school students by establishing structural validity through exploratory and confirmatory factor analyses, estimating internal consistency and composite reliability, and assessing convergent and discriminant evidence. The objective is to determine whether a two-factor representation of incremental and entity beliefs is defensible in this context, to identify items that weaken the latent structure, and to generate a concise and culturally appropriate version suitable for research and formative use in Philippine secondary schools.

Methods

Participants and Sampling

Participants were drawn from four public secondary schools in the Division of Malaybalay City, Bukidnon, Philippines: Bukidnon National High School, Malaybalay City National Science High School, Casisang National High School, and Kalasungay National High School. For descriptive clarity, the schools are commonly classified by enrollment size as mega, large, medium, and small. In this division, a mega school enrolls approximately ten thousand students, a large school about two thousand, a medium school at most one thousand, and a small school fewer than five hundred. All study activities took place within these schools in Malaybalay City.

The target population comprised students in Grades 7 to 10 who were enrolled during school year 2022 to 2023. A disproportionate stratified random sampling approach was used to ensure representation of key subgroups across schools and grade levels (Maheshwari, 2017). The planned sample size was set at one thousand three hundred students, which comfortably exceeds common rules of thumb for factor analytic studies that recommend a minimum of four respondents per indicator and favor larger samples for stable parameter estimation (Bryman & Cramer, 2002; Comrey & Lee, 1992). Given that the Implicit Theory of Intelligence instrument included fourteen items, the achieved sample provided a strong respondent to item ratio for both exploratory and confirmatory analyses.

Data screening followed established practice. Cases with more than ten percent missing responses on the Implicit Theory of Intelligence Scale were excluded, which removed one hundred ninety-seven records. Outliers were then identified using box plot inspection and removed to reduce undue influence of extreme values (Gaskin, 2020). After these steps, the

analytic sample comprised nine hundred thirty students, representing approximately seventy two percent of the initial sample. Ages ranged from eleven to nineteen years (mean equals 12.7, standard deviation equals 2.4). Males comprised fifty six percent of the sample and females forty four percent. The final sample size meets recommended standards for factor analysis in applied educational research and supports stable estimation of communalities, factor loadings, and fit indices (Bryman & Cramer, 2002; Comrey & Lee, 1992).

Measures

Implicit Theory of Intelligence Scale (ITIS). The instrument generated by Abd-El-Fattah and Yates (2006) is a four-point Likert type instrument with 1 as strongly disagree and 4 as strongly agree. The said scale is composed of 14 items with half reflecting entity theory and the other half indicating incremental theory. The reported Cronbach alpha of the scale ranges from .78 to .83 for the two components.

Data Gathering Procedure

All data collection followed institutional and Department of Education protocols for research with minors. Prior to fieldwork, the research team requested permission from the Schools Division Superintendent of Malaybalay City and then secured written approval from the principals of Bukidnon National High School, Malaybalay City National Science High School, Casisang National High School, and Kalasungay National High School. Each school received an information packet describing the study purpose, procedures, potential risks and benefits, and data protection measures.

Recruitment and consent were conducted in two stages. First, parent or guardian consent forms and student information sheets were distributed through class advisers. Second, students who returned signed parental consent provided written assent on the day of administration. Participation was voluntary, students were informed that they could decline or withdraw at any time without penalty, and no incentives were offered. No identifying information was collected on the questionnaire; each form carried only a study code to preserve confidentiality.

Administration was standardized across sites. Data collection was scheduled during regular class periods in consultation with school heads to minimize disruption. Trained proctors used a common script to introduce the study, emphasize voluntary participation, and explain how to respond to the four-point response options. The Implicit Theory of Intelligence Scale was administered in a quiet classroom setting. Students were given adequate time to read the assent form and complete the instrument at their own pace, typically within fifteen to twenty minutes. For classes that were temporarily learning online, an identical version of the questionnaire was delivered through a secure school approved platform during a monitored

session, using the same instructions and time allotment. Questions about wording were answered publicly using the script to avoid introducing variation in interpretation.

Completed paper forms were placed in sealed envelopes and transferred to the research office the same day. Digital responses were downloaded to an encrypted drive. A data management log recorded site, date, section, and the number of distributed and returned questionnaires. Two trained encoders performed double entry of paper responses, followed by reconciliation of discrepancies. Prior to analysis, the dataset was screened for completeness and quality. Cases with more than ten percent missing responses on the scale were removed. Basic distribution checks were run for each item, and obvious data entry errors were corrected against the original forms. Outliers were flagged through box plot inspection and removed only when values were extreme and unsupported by adjacent responses. The final anonymized dataset was stored in a password protected folder accessible only to the research team.

Statistical Treatment

Data were screened before modeling to ensure quality and factorability. Records with more than ten percent missing responses on the Implicit Theory of Intelligence Scale were removed. Univariate distributions were inspected through skewness and kurtosis; absolute skew values near or below two and absolute kurtosis near or below seven were treated as acceptable for maximum likelihood estimation in large samples (Hair et al., 2010; Field, 2013). Outliers were identified via box plot inspection and deleted only when values were extreme and unsupported by adjacent responses (Gaskin, 2020). Factorability was then evaluated using the Kaiser–Meyer–Olkin measure and Bartlett’s test of sphericity. KMO values at or above .70 and a significant Bartlett’s test were taken as evidence that the correlation matrix was suitable for factor analysis. The determinant and inter item correlations were reviewed to rule out problematic multicollinearity (Field, 2013; Hair et al., 2010).

Exploratory factor analysis was conducted in IBM SPSS version 23 using maximum likelihood extraction with Promax rotation to allow correlated factors, consistent with theory on related belief systems. Factor retention relied on eigenvalues greater than one and visual inspection of the scree plot. Item retention emphasized clear primary pattern loadings and adequate communalities, with standardized primary loadings of at least .40 preferred, cross loading below .30, and communalities at or above .30 treated as acceptable (Comrey & Lee, 1992; Hair et al., 2010; Field, 2013).

Furthermore, Confirmatory factor analysis was performed in IBM SPSS Amos version 23 using maximum likelihood estimation on the item set retained from exploration. Model evaluation followed multiple indices and conventional thresholds: a chi square to degrees of freedom ratio at or below three, Comparative Fit Index and Tucker–Lewis Index at or above .90 for acceptable fit and at or above .95 for strong fit, Goodness of Fit Index at or above .90,

Standardized Root Mean Square Residual at or below .08, and Root Mean Square Error of Approximation at or below .08 for acceptable fit and at or below .06 for close fit, with PClose at or above .05 indicating adequate closeness of fit (Hu & Bentler, 1999; Brown, 2006; Hair et al., 2010; Gaskin, 2020). Standardized factor loadings of .50 or higher were preferred, with .40 treated as a practical minimum when supported by theory (Brown, 2006; Hair et al., 2010).

Convergent and discriminant evidence were examined using composite reliability and average variance extracted computed from standardized loadings and error variances. Composite reliability values at or above .70 and average variance extracted at or above .50 were taken as evidence of adequate convergence. Discriminant validity was evaluated by comparing the square root of average variance extracted for each factor with the corresponding inter factor correlation and by confirming that average variance extracted exceeded the shared variance between factors (Fornell & Larcker, 1981; Brown, 2006; Hair et al., 2010).

Ethical Considerations

The study adhered to the ethical guidelines of Bukidnon State University and the Department of Education in the Philippines, and it complied with the Philippine Data Privacy Act of 2012. Prior to fieldwork, written permissions were secured from the Schools Division Superintendent of Malaybalay City and from the principals of the participating public secondary schools. Participation was voluntary. Students were informed that they could decline or withdraw at any time without penalty and that non participation would not affect grades, school services, or relations with teachers.

Because the participants were minors, a two-stage consent process was implemented. Parent or guardian consent was obtained in writing before data collection. On the day of administration, students provided written assent after a clear explanation of the study purpose, procedures, expected time, potential risks and benefits, and contact information for the research team. No incentives were offered. Teachers did not remain in the room during administration to minimize perceived pressure, and a standard script was used to reduce the risk of undue influence.

Risks were assessed as minimal. Items concerned beliefs about learning and intelligence and did not solicit sensitive personal information. Even so, students were reminded that they could skip any item that made them uncomfortable. If a student showed distress or asked to stop, the session was ended for that student without consequence, and the school guidance office was identified as the point of referral for support if needed.

Confidentiality and data protection were prioritized. Questionnaires carried only study codes, not names or student numbers. Paper forms were kept in locked storage accessible only to the research team. Digital files were stored on a password protected device with restricted access. A data log tracked receipt, entry, and verification activities. Identifiers, if any, were stored separately from response data. Only aggregate results are reported, and no school or

individual is identifiable in any output. Data will be retained for a defined period consistent with university guidance, after which paper records will be shredded and electronic files permanently deleted.

All procedures were designed to respect the rights and welfare of child participants in a school setting, to preserve privacy and confidentiality, and to ensure that findings are used only for scholarly and formative purposes within the bounds of informed consent.

Results and Discussion

Exploratory Factor Analysis

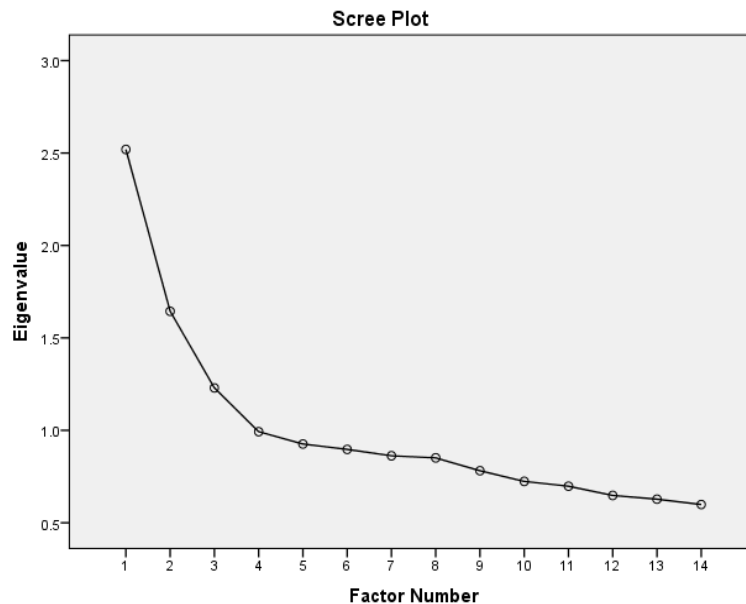
The Implicit Theory of Intelligence (ITI) Scale was administered to 1,300 Grade 7 to Grade 10 Filipino public high school students from a single school division in Region X, Philippines during School Year 2022–2023. This large adolescent sample size is consistent with best practices for factor-analytic validation studies in educational and psychological measurement, where high participant-to-item ratios are recommended to stabilize parameter estimates and improve generalizability in applied school settings (Maheshwari, 2017; McDermott, 1993; Morgan et al., 2004). Before factor extraction, the data were screened for suitability. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.752, which exceeds the commonly accepted .70 threshold for conducting factor analysis in social science instruments (Büyüköztürk, 2011; Field, 2013; Hair, Black et al., 2010). Bartlett’s test of sphericity was statistically significant, indicating that the correlation matrix was factorable and that the observed correlations among items were sufficiently large to justify latent structure extraction (Bryman & Cramer, 2002; Comrey & Lee, 1992; Cabrera-Nguyen, 2010). The determinant of the correlation matrix did not indicate problematic multicollinearity, suggesting that the items were related but not redundant, which is desirable in early-stage construct validation (Bryman & Cramer, 2002; Cabrera-Nguyen, 2010).

Exploratory factor analysis was conducted using maximum likelihood extraction with Promax oblique rotation. An oblique solution was theoretically warranted because the focal constructs are conceptually related rather than independent: incremental beliefs about intelligence, which hold that intellectual ability can grow through effort and strategy, and entity beliefs about intelligence, which view intellectual ability as fixed. This rationale follows Dweck (2006). The chi-square goodness-of-fit test for the two-factor EFA model was statistically significant, but this is expected in very large samples because even small residuals can trigger statistical significance; therefore, chi-square alone is not sufficient to reject the factor structure (Brown, 2006; Hair et al., 2010; Gaskin, 2020). The EFA yielded two interpretable factors with eigenvalues greater than 1. The first factor accounted for 17.996% of the variance, the second factor accounted for 11.743%, and the cumulative explained variance was 29.740%. This two-factor solution aligns with the theoretical structure of implicit theories of intelligence, which

distinguishes between an incremental or growth mindset factor and an entity or fixed mindset factor (Dweck, 2006; Blackwell et al., 2007; Claro et al., 2016; Tempelaar et al., 2015).

Figure 1.

Scree plot of eigenvalues for the Implicit Theory of Intelligence Scale



Items that loaded on the first factor indexed incremental beliefs about intelligence, indicating endorsement of the view that intellectual ability can develop through effort, persistence, and deliberate strategy use. Loadings on this factor ranged from moderate to weak, and the associated communalities indicated that the items shared a modest amount of common variance. Items that loaded on the second factor indexed entity beliefs about intelligence, namely the view that intellectual ability is largely fixed and stable. Loadings on this factor were generally weaker, and several items displayed extremely low communalities (below .10), indicating that they contributed very little to the shared latent variance of the construct (Comrey & Lee, 1992; Costello & Osborne, 2005; Fabrigar, Wegener, MacCallum, & Strahan, 1999). Factor interpretability and the observed pattern of loadings are consistent with prior work showing that incremental and entity beliefs tend to emerge as distinguishable but related latent dimensions in adolescents, university students, and adults in both Western and non-Western samples (Dupeyrat & Mariné, 2005; Howell & Buro, 2009; Karwowski, 2014; Cooper, Lee, Jeter, & Bradley, 2020; Chen, Ding, & Liu, 2021).

The correlation between the two EFA factors was weakly negative (approximately $r = -.14$), indicating that stronger endorsement of incremental beliefs was associated with slightly lower endorsement of fixed beliefs, but the association was small in magnitude. According to conventional benchmarks, an r of this size reflects a small effect (Evans, 1996). This finding supports the interpretation that incremental and entity beliefs are not full opposites in practice, but partially independent belief systems that can coexist in the same learner

(Blackwell et al., 2007; Chen, 2012; Malmberg & Little, 2007; Tempelaar et al., 2015; Limeri et al., 2020).

Table 1.
Exploratory Factor Analysis of the Implicit Theory of Intelligence Scale (ITIS):
Maximum Likelihood Extraction, Promax-Rotated Loadings, and Communalities

Item	Factor Loadings		Communalities
	Factor 1	Factor 2	
Incremental			
Item_6	.578		.238
Item_13	.571		.219
Item_11	.556		.214
Item_9	.477		.178
Item_3	.474		.191
Item_7	.316		.099
Item_10	.273		.094
Entity			
Item_8		.501	.208
Item_2		.402	.087
Item_12		.399	.118
Item_5		.323	.076
Item_1		.251	.042
Item_14		.225	.034
Item_4		.120	.067
Eigen-values	2.5195	1.6441	
% of Variance	17.996	11.743	
Cumulative %	17.996	29.740	

Two important psychometric issues emerged from the EFA. First, the total variance explained by the two extracted factors (29.740%) is relatively low for a focused socio-cognitive belief scale. Although it is common for belief-oriented measures to yield modest explained variance because these constructs are cognitively and contextually complex, many validation studies aim for cumulative explained variance closer to 40–60% in early development phases (Comrey & Lee, 1992; Costello & Osborne, 2005; Fabrigar et al., 1999; Hair et al., 2010). The relatively low variance in this sample suggests that, although the two extracted factors are meaningful and theoretically aligned with mindset theory, the current item set is not yet highly efficient in capturing how Filipino secondary students conceptualize beliefs about intelligence. Cultural interpretation may play a role here.

Evidence from effort-oriented and collectivist educational settings indicates that learners can simultaneously agree with statements such as “you can improve with effort” (incremental) and also partially agree that “some students are naturally smarter than others” (which leans entity), instead of treating these as mutually exclusive positions (Hong et al., 1998; Malmberg & Little, 2007; Tempelaar, Rienties, Giesbers, & Schim van der Loeff, 2012;

Tempelaar et al., 2015; Limeri et al., 2020). Such coexistence, rather than adherence to a strict either-or stance, diminishes factor distinctiveness and suppresses communalities.

Second, several of the entity-oriented items had weak loadings (below .40) and extremely low communalities (below .10), implying that they were not functioning well psychometrically in this adolescent Filipino sample. This pattern is common when items assert very absolute, fixed-ability statements (e.g., “intelligence cannot be changed”), which many students find socially undesirable or discouraging to endorse (Mueller & Dweck, 1998; Blackwell et al., 2007; Claro et al., 2016; Yeager & Dweck, 2020). In Philippine classrooms specifically, growth-oriented messages around effort, persistence, and self-improvement are often framed not just as academic advice but as a moral expectation, reinforced through teacher praise for effort and resilience (Calingasan & Plata, 2018; Calingasan & Plata, 2022; Mabandos & Moneva, 2020; Mariano-Dolesh, Collantes, Ibanez, & Pentang, 2022; Repuya, 2021; Viña, Mamalampay, Mascud, Liscano, & Quiñones, 2022).

When learners internalize such discourse, endorsing fixed-ability statements becomes socially unattractive, which compresses the response range, weakens inter-item correlations, and leads to poor psychometric behavior among entity items (Hong et al., 1998; Dweck, 2006; Yeager & Dweck, 2020). Accordingly, the EFA indicates that although the hypothesized Incremental and Entity factors are conceptually coherent and theoretically grounded in the mindset literature (Dweck, 1999, 2006; Dweck & Leggett, 1988; Elliott & Dweck, 1988; Levy, Stroessner, & Dweck, 1998), the current item pool, particularly the indicators of entity beliefs, requires refinement.

Confirmatory Factor Analysis

The emergent two-factor structure from the EFA was subsequently evaluated using Confirmatory Factor Analysis (CFA). Two alternative two-factor models were tested, each treating Incremental and Entity beliefs as correlated latent factors. Global fit indices for both models were evaluated against widely cited benchmarks for structural equation modeling, where SRMR values below .08 and RMSEA values below approximately .06–.08 indicate good absolute fit, while CFI and TLI values of .90 or higher indicate acceptable comparative fit and values closer to .95 indicate excellent fit (Hu & Bentler, 1999; Brown, 2006; Hair et al., 2010; Gaskin, 2020).

In this study, both models demonstrated excellent SRMR and RMSEA values. One of the two-factor models also achieved a CFI at or above .90, indicating acceptable global fit. The Tucker–Lewis Index (TLI) remained below .90, indicating modest misfit relative to an optimally specified model. This pattern, in which some fit indices fall within the acceptable to excellent range while others are slightly below recommended thresholds, is frequently observed in applied educational psychology when the underlying constructs are theoretically

coherent but the observed indicators have not yet reached full psychometric optimization (Brown, 2006; Hair et al., 2010; Hu & Bentler, 1999; Gaskin, 2020).

In practical terms, the CFA indicates that the correlated two-factor structure (Incremental vs. Entity) is structurally defensible for this Filipino secondary sample, which is consistent with longstanding work arguing that implicit theories of intelligence are best modeled as two related but distinguishable belief systems rather than as a single bipolar continuum (Blackwell et al., 2007; Chen, 2012; Tempelaar et al., 2015; Yeager & Dweck, 2020). However, examination of internal consistency and convergent validity indices revealed serious weaknesses. For each latent factor, composite reliability (CR) and average variance extracted (AVE) were assessed. CR values for both factors fell below the commonly recommended .70 threshold, indicating that the items loading on each factor were not consistently measuring the same underlying construct with adequate internal consistency (Fornell & Larcker, 1981; Brown, 2006; Hair et al., 2010).

Table 2.
Confirmatory Factor Analysis Fit Indices for the Two-Factor Measurement Models of the Implicit Theory of Intelligence Scale

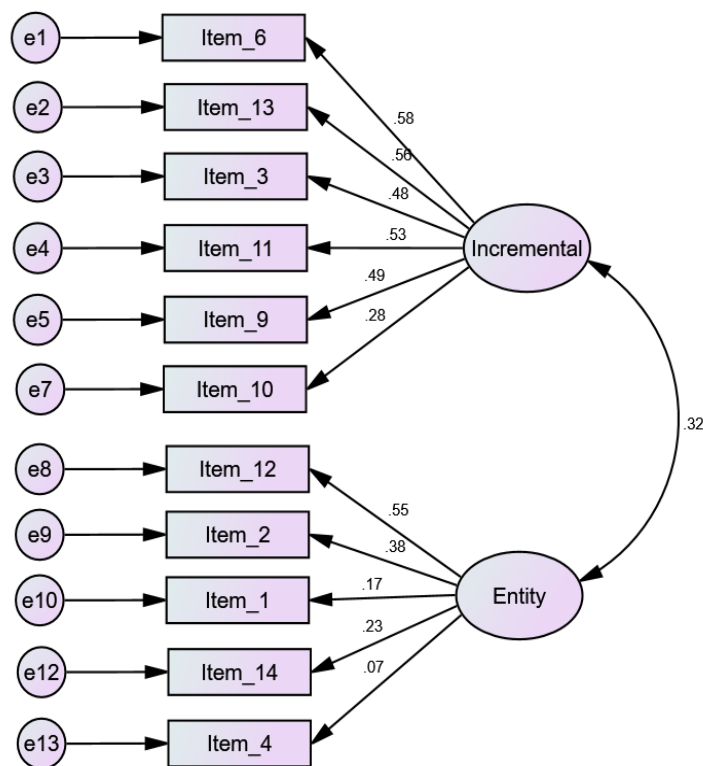
Model	Cmin/df	TLI	CFI	SRMR	RMSEA	PClose
Two-Factor Model 1	2.546*	.872***	.882***	.047*	.041*	.974*
Two-Factor Mode 2	2.606*	.879***	0.906**	.045*	.042*	.926*
Criterion	< 3	> .90	> .90	< .08	< .08	< .08
Interpretation: *Excellent fit, **Acceptable Fit, *** Poor Fit						

AVE for both factors fell well below the conventional .50 criterion, indicating that each latent factor captured less than one half of the variance in the corresponding indicators, which is evidence of weak convergent validity (Fornell & Larcker, 1981; Reis, Hino, & Añez, 2010; Hair et al., 2010). Although the two-factor model achieves acceptable global fit, the items do not yet function as strong and reliable indicators of Incremental and Entity beliefs. As a result, the interpretability and stability of subscale scores are constrained, and the instrument does not at present demonstrate mature psychometric adequacy. Inspection of item-level diagnostics in the CFA suggested that certain items were dragging down CR and AVE. For example, removing specific low-performing items within the Incremental factor and the Entity factor was projected to improve internal consistency and shared variance. This pattern mirrors findings in other mindset and self-belief scales, where poorly performing entity items are often the first to be removed or reworded because they tend to generate defensiveness, misunderstanding, or socially filtered responses among adolescents (Duckworth & Quinn, 2009; Midkiff, Langer, Demetriou, & Panter, 2017; Chen et al., 2021; Yilmaz, 2022).

It also aligns with recommendations in modern scale validation that emphasize iterative refinement: early item pools tend to be intentionally broad, but subsequent CFA-based pruning aims to retain only the most discriminating and psychometrically efficient items (Comrey & Lee, 1992; Costello & Osborne, 2005; Fabrigar et al., 1999; Brown, 2006; Cabrera-Nguyen, 2010). In this case, the refinement process ultimately led to a shorter version of the ITI scale, with approximately seven items retained as psychometrically stronger indicators for Filipino high school students. This shorter form is described as performing better than the original 14-item pool that was adapted from earlier implicit theory measures (Abd-El-Fattah & Yates, 2006).

Figure 2.

Path diagram of the two factors in the Implicit Theory of Intelligence model



The CFA therefore provides a mixed but actionable inference. On one hand, the structural evidence supports a correlated two-factor model of Incremental and Entity beliefs about intelligence. This is theoretically meaningful and consistent with decades of mindset research showing that students can endorse growth-oriented beliefs (intelligence can develop through effort and appropriate strategies) without fully rejecting the idea that some people begin with higher initial ability (Hong et al., 1998; Malmberg & Little, 2007; Tempelaar et al., 2012; Tempelaar et al., 2015; Karwowski, 2014; Yeager & Dweck, 2020). On the other hand, the reliability and convergent validity evidence indicates that the current full item set is not yet

psychometrically efficient. The Incremental and Entity subscales in their present form do not meet conventional thresholds for CR and AVE (Fornell & Larcker, 1981; Brown, 2006; Hair et al., 2010; Hu & Bentler, 1999; Gaskin, 2020). This means that although the theoretical structure is visible and statistically defensible at the model level, the operationalization of that structure still requires refinement, particularly for fixed-mindset (Entity) items.

Taken together, the confirmatory analyses indicate that a correlated two factor representation of beliefs about intelligence is defensible at the model level but not yet measurement strong in this sample. Absolute indices suggest adequate reproduction of the covariance structure, yet comparative indices are only acceptable, and reliability and convergent validity fall below conventional benchmarks. In practical terms, the latent configuration is visible, but the indicators do not cohere tightly enough to yield precise subscale scores. The pattern of weak loadings and very low communalities for several fixed belief statements points to content that adolescents may find absolute, discouraging, or culturally misaligned. In effort-oriented school contexts, students can readily affirm that ability develops through strategy and persistence while hesitating to endorse statements that imply ability is immovable. This coexistence helps explain the small negative association between the two factors and the uneven contribution of entity items to the measurement model.

Accordingly, scores from the present form are best interpreted as group level signals of belief orientation rather than stable measures for individual classification or program evaluation. Before using the scale for comparisons across classes or schools, future work should improve item clarity and shared variance, replicate the structure in independent cohorts, and establish whether the model holds across sex, grade level, and school context. Once a concise version demonstrates stronger loadings, higher reliability, clearer convergent evidence, and evidence of invariance, the measure can support classroom diagnostics, monitoring of belief change, and evaluation of growth-oriented initiatives in Philippine secondary education.

Several methodological considerations warrant attention. The study drew data from Grade 7 to Grade 10 students within a single public-school division in Region X, which may limit generalizability to other regions, private schools, and alternative curricular tracks. Although the sample size and preliminary screening supported factor analytic procedures, the stability of the two-factor structure should be examined across additional cohorts and settings, with formal tests of measurement invariance by sex, grade level, language background, and school context. The instrument assesses beliefs about the nature of intelligence rather than academic performance or diagnostic characteristics. Scores should therefore be interpreted as indicators of belief orientation, not as classifications of learners or judgments about ability. Because responses were obtained through self-report questionnaires administered in school settings, results may be influenced by social desirability, acquiescence, or reference group

effects. Balanced keying, social desirability controls, and method factors related to wording were not modeled and should be considered in future work.

Quite a few psychometric indices fell below recommended thresholds, particularly composite reliability and average variance extracted for selected factors. This suggests a need for item refinement, including the rewording or removal of weak indicators and closer attention to translation and cultural adaptation. Cognitive interviews and expert review can clarify response processes, reduce linguistic ambiguity, and ensure that items are appropriate for the reading level of junior high school students. The design was cross sectional, so test–retest stability, sensitivity to change, and predictive validity were not assessed. Future research should replicate the model with more diverse samples, evaluate longitudinal stability, and situate the measure within a broader network of related constructs and outcomes. Item response theory and differential item functioning analyses can further examine fairness and precision across groups.

In sum, the present findings provide evidence for an emerging measurement model of incremental and entity beliefs in the Filipino secondary context, but the scale should not yet be used for high stakes decisions at the level of individual learners. With targeted item refinement and additional validation across settings and time, a concise form can support classroom and program level diagnostics, evaluation of mindset related initiatives, and research on belief change in Philippine secondary education.

Conclusion

This study examined the psychometric structure of the Implicit Theory of Intelligence Scale among Filipino junior high school students using exploratory factor analysis and confirmatory factor analysis. Although the exploratory factor analysis recovered a two-factor solution consistent with incremental and entity beliefs, the extracted structure was weak. Factor loadings were often small or inconsistent, several items did not align with their intended construct, communalities for a number of indicators were very low, and the total explained variance was modest. These features indicate that the two-factor solution in this sample was statistically extractable but not psychologically stable. The confirmatory factor analyses reinforced this conclusion. Absolute fit indices were within preferred ranges, yet comparative fit was acceptable rather than strong, and the Tucker–Lewis Index fell below recommended levels. Composite reliability and average variance extracted were also below conventional thresholds. These findings show that beliefs about intelligence, as measured by the current item set, were not captured in this sample as either two distinct yet related factors or as a single coherent latent trait.

Taken together, the results suggest that the present version of the Implicit Theory of Intelligence Scale may not function as a structurally sound and generalizable measure in this adolescent, non-Western educational context without additional development. The

assumption that the instrument can be used interchangeably across populations is therefore not supported. More broadly, the findings add to evidence that the dimensional representation of beliefs about intelligence is not automatically invariant across cultural and developmental settings, and that the factor structure should not be presumed to be universal. A program of item refinement, replication with diverse cohorts, and formal tests of measurement invariance is warranted before the scale is used for summative decisions or cross group comparisons.

Recommendation

Based on the findings, recommendations should address the specific weaknesses observed in both exploratory and confirmatory analyses. First, revise or remove items with small loadings and very low communalities, especially fixed belief statements that contain absolute or culturally discordant wording, and verify all revisions through cognitive interviews with students in Grades 7 to 10 and expert review to ensure clarity and developmental appropriateness. Second, re estimate the structure in an independent cohort, beginning with a fresh exploratory factor analysis followed by confirmatory factor analysis, and set explicit thresholds of primary loadings at .50 or higher with minimal cross loading, composite reliability at .70 or higher, and average variance extracted at .50 or higher. Third, to address modest comparative fit and a low Tucker–Lewis Index, evaluate theoretically plausible alternatives such as bifactor and hierarchical representations when a general mindset influence is expected alongside specific incremental and entity factors.

Fourth, strengthen validity by collecting test-retest data, examining convergent and discriminant relations with effort beliefs, achievement goal orientations, persistence, and self-regulation, and relating scores to behavioral and academic outcomes under appropriate ethical safeguards. Fifth, establish generalizability and fairness by testing measurement invariance across sex, grade level, school type, and language version, and by applying item response theory and differential item functioning analyses to evaluate item performance across groups. Until a concise and well calibrated form demonstrates stable structure, adequate reliability, clear convergence, and invariance across key subgroups, limit interpretation to research and formative use at the group level rather than decisions about individual learners.

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