

# Thinking without limits: developing and validating a transdisciplinary thinking scale for Filipino students

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## ABSTRACT

Transdisciplinary thinking is crucial for addressing global challenges, yet standardized assessment tools for high school students are lacking. This study addresses this gap by developing and validating a transdisciplinary thinking scale (TTS) tailored for this demographic. Following established methodologies, the TTS was crafted through expert interviews, resulting in a 20-item scale. A pilot test with 402 senior high school students showed strong internal consistency (Cronbach's Alpha=0.920) and a multidimensional structure: integrative thinking, inquiry skills, and collaborative problem-solving. The TTS supports existing models of transdisciplinary cognition, emphasizing its multifaceted nature. This scale offers educators a reliable tool to assess and foster transdisciplinary thinking skills. Integrating TTS-informed pedagogies can better prepare students for the complexities of the 21<sup>st</sup> century, promoting integrative and collaborative problem-solving. Validating the TTS marks a significant advance in educational research, promoting integrative thinking essential for addressing contemporary challenges.

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## 1. INTRODUCTION

Transdisciplinary thinking, essential for synthesizing knowledge across disciplines to tackle complex challenges, is increasingly vital in modern education [1]–[3]. It equips learners with the agility and integrative skills to navigate today's interconnected world [4], [5]. Despite its importance, standardized tools to assess transdisciplinary thinking, especially among high school students, are lacking.

This study addresses this gap by developing and validating a transdisciplinary thinking scale (TTS) tailored for high school students. This scale aims to provide educators and policymakers insights into the effectiveness of educational interventions promoting transdisciplinary skills [6], [7]. It can potentially transform educational practices by cultivating learners capable of innovative problem-solving in a complex global landscape [8], [9]. Recognizing transdisciplinary thinking as crucial for innovation and collaboration across disciplines, this research features the scale's role in nurturing essential competencies from early education through professional life [10], [11]. By offering educators a reliable tool to assess and foster transdisciplinary thinking, this study aims to empower a generation adept at addressing the multifaceted challenges of our times [12].

## 2. METHOD

The TTS was developed and validated using a systematic process grounded in established methodologies. These approaches ensured the scale's rigor and reliability. The process emphasized precision and adherence to recognized standards in scale development.

### 2.1. Scale development

The scale development process embarked upon a methodical journey, commencing with the thorough generation of scale items through cognitive interviews conducted with selected senior high school students to gather detailed information about their thoughts, memories, perceptions, and decision-making processes regarding transdisciplinary thinking [13], [14]. These interviews served as a rich source of insights, exploring nuanced dimensions of transdisciplinary cognition and identifying key competencies essential for effective transdisciplinary thinking. Through iterative refinement guided by principles of scale development, a comprehensive pool of 20 items was accurately crafted, each strategically designed to capture various facets of transdisciplinary thinking [15], [16].

Drawing upon the knowledge gleaned from these cognitive interviews, the pool of scale items was purposefully constructed to encompass a diverse array of dimensions inherent in transdisciplinary cognition. Notably, these dimensions included but were not limited to integrative problem-solving, interdisciplinary communication, collaborative inquiry, critical thinking, and creative synthesis [17], [18]. Each item was carefully crafted to resonate with the cognitive processes and metacognitive strategies characteristic of transdisciplinary thinking, ensuring comprehensive coverage of the cognitive landscape prevalent among high school students. Furthermore, the iterative refinement process facilitated the elimination of redundant or ambiguous items while emphasizing clarity, relevance, and comprehensiveness in item formulation, thereby enhancing the scale's validity and reliability [19]–[21].

### 2.2. Scale validation

Following the careful generation of scale items, the TTS underwent robust validation procedures to ensure its reliability and validity as a diagnostic tool for assessing transdisciplinary cognition among high school students. To establish content validity, a critical step in the validation process, an expert panel consisting of subject matter experts in transdisciplinary studies and educational assessment was convened [22], [23]. This panel thoroughly evaluated the scale items' relevance, clarity, and comprehensiveness, drawing upon their wealth of expertise to ascertain the alignment of each item with the targeted dimensions of transdisciplinary thinking.

Subsequently, a pivotal validation phase ensued, with the implementation of a pilot test involving a diverse sample of 402 senior high school students [24], [25]. This pilot test served as a crucial empirical validation step, allowing for the assessment of the scale's psychometric properties within the target population. This empirical inquiry evaluated the scale's robustness, providing insights into its reliability, validity, and utility in capturing transdisciplinary cognition among high school students.

Reliability analysis, a cornerstone of scale validation, was conducted utilizing Cronbach's Alpha coefficient, a widely employed measure of internal consistency reliability [26], [27]. Additionally, exploratory factor analysis (EFA) was used to elucidate the underlying factor structure of the scale and identify distinct dimensions of transdisciplinary thinking [28], [29]. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were employed to assess the suitability of the data for factor analysis, ensuring the robustness and appropriateness of the analytical approach [30]. Through this comprehensive validation process, the TTS emerged as an accurately validated instrument, poised to offer invaluable insights into the nuanced dimensions of transdisciplinary cognition among high school students.

## 3. RESULTS

The culmination of the scale development process yielded a carefully refined instrument comprising 20 items, each accurately crafted to capture the diverse dimensions of transdisciplinary thinking. These items were systematically rated on a four-point Likert scale from "strongly agree" to "strongly disagree," thereby facilitating nuanced responses from participants and enabling a comprehensive assessment of their transdisciplinary cognitive tendencies. Expert review was pivotal in this phase, confirming the scale's face and content validity [17], [18]. This rigorous evaluation ensured that the scale effectively encapsulated the breadth and depth of transdisciplinary thinking skills, enhancing its utility as a reliable diagnostic tool within educational contexts.

The subsequent psychometric analysis of the pilot test data unveiled a robust internal consistency, with Cronbach's Alpha coefficient attaining an impressive value of 0.920 [13], [14]. This noteworthy

reliability metric emphasizes the scale's consistency in measuring transdisciplinary cognition among high school students, instilling confidence in its efficacy as an assessment instrument. Moreover, EFA illuminated the underlying factor structure of the scale, revealing three distinct dimensions: integrative thinking, inquiry skills, and collaborative problem-solving [22], [17]. The delineation of these factors offers valuable insights into the multifaceted nature of transdisciplinary cognition and elaborates the scale's capacity to capture the diverse facets of this cognitive domain.

Table 1 presents the KMO measure and Bartlett's test, which assesses the adequacy of data for factor analysis by examining the proportion of variance among variables that might be common variance and determines whether the correlations between variables are sufficiently significant for a factor analysis to be meaningful, respectively. Based on Table 1, the KMO measure of sampling adequacy, with a value of 0.929, indicates a high degree of adequacy for conducting factor analysis on the dataset. This suggests that the variables in the dataset share a substantial amount of common variance, making them suitable for further analysis. Additionally, Bartlett's test of sphericity yielded an approximate chi-square value of 2657.795 with 231 degrees of freedom and a significance level of .000, indicating that the correlation matrix is significantly different from an identity matrix. Therefore, it can be concluded that the variables are sufficiently correlated for meaningful factor analysis.

On the other hand, the TTS illustrated three factors-integrative, inquiry-driven, and collaborative, when EFA was performed. Moreover, Table 2 indicates the scale's internal consistency values and its components using the Cronbach Alpha coefficient. The Table 2 presents descriptive statistics and Cronbach's Alpha coefficients for the TTS, which are three subscales: integrative, inquiry-driven, and collaborative. for the integrative subscale, consisting of 11 items, the mean score was 3.34 with a standard deviation of 4.81, and the internal consistency reliability, as indicated by Cronbach's Alpha coefficient, was .876. Similarly, the inquiry-driven subscale, comprising 6 items, had a mean score of 3.28 with a standard deviation of 2.90, and a Cronbach's Alpha coefficient of 0.826, indicating high internal consistency. The Collaborative subscale, with three items, had a mean score of 3.01 and a standard deviation of 1.77, with a Cronbach's Alpha coefficient of 0.799. The overall score, encompassing all 20 items, had a mean score of 3.27 and a standard deviation of 8.41, with a high internal consistency indicated by a Cronbach's Alpha coefficient of 0.915. These findings suggest that the TTS and its subscales demonstrate good internal consistency among the items, enhancing the instrument's reliability for measuring the targeted constructs.

The EFA results for the TTS in Table 3 reveal three distinct components: integrative, inquiry-driven, and collaborative. The integrative component is strongly associated with items like TTS\_Item8 (0.745) and TTS\_Item11 (0.706), indicating these items effectively measure the integration of multiple disciplines to create new insights. The inquiry-driven component is highlighted by high loadings on items such as TTS\_Item1 (0.802) and TTS\_Item16 (0.641), emphasizing curiosity and a question-driven process. The Collaborative component, with items like TTS\_Item7 (0.795) and TTS\_Item10 (0.651), underscores the importance of teamwork and collective problem-solving.

The factor loadings suggest that items such as TTS\_Item3 and TTS\_Item13, which load on both integrative and inquiry-driven components, may capture overlapping aspects of these dimensions. Similarly, TTS\_Item10 and TTS\_Item12 show notable loadings on both collaborative and other components, indicating these items might reflect multiple facets of transdisciplinary thinking. These insights help refine the TTS by emphasizing the strongest items for each component and reconsidering items that exhibit cross-loadings to ensure the scale accurately measures the intended constructs.

Table 1. KMO measure and Bartlett's test

Analysis	Terms	Values
Kaiser-Meyer-Olkin measure of sampling adequacy		.929
Bartlett's test of sphericity	Approx. Chi-square <i>df</i> Sig.	2657.795 231 .000

Table 2. Cronbach Alpha coefficient and descriptive statistics for TTS and its subscales

Component	No. of Items	<i>M</i>	<i>SD</i>	Cronbach's $\alpha$
Integrative	11	3.34	4.81	.876
Inquiry-driven	6	3.28	2.90	.826
Collaborative	3	3.01	1.77	.799
Overall	20	3.27	8.41	.915

Note. *N*=402

Table 3. EFA results on TTS

Item	Component		
	Integrative	Inquiry-driven	Collaborative
TTS_Item8	.745	.111	.181
TTS_Item11	.706	.165	.161
TTS_Item6	.692	.284	-.111
TTS_Item9	.673	.159	.296
TTS_Item17	.572	.345	.180
TTS_Item18	.571	.323	.168
TTS_Item5	.528	.372	.007
TTS_Item3	.508	.493	-.050
TTS_Item14	.483	.134	.255
TTS_Item13	.468	.461	.315
TTS_Item4	.401	.400	.132
TTS_Item1	.015	.802	.145
TTS_Item16	.248	.641	.378
TTS_Item15	.244	.599	.184
TTS_Item2	.504	.597	.116
TTS_Item19	.413	.546	.181
TTS_Item20	.445	.490	.129
TTS_Item7	-.026	.226	.795
TTS_Item10	.408	.107	.651
TTS_Item12	.232	.442	.453

#### 4. DISCUSSION

The robust validation of the TTS holds significant implications for theoretical frameworks and educational practices. Firstly, identifying three distinct factors within the scale integrative thinking, inquiry skills, and collaborative problem-solving-provides empirical support for existing theoretical models of transdisciplinary cognition [4], [5], [24], [31]. This delineation includes the multidimensional nature of transdisciplinary thinking, emphasizing the importance of integrative approaches, inquiry-based methodologies, and collaborative problem-solving strategies in fostering transdisciplinary competencies among high school students. These findings align closely with theoretical frameworks that emphasize the centrality of such skills in navigating complex, real-world challenges [6], [7], [25], [28].

From a practical standpoint, the validated TTS offers educators a valuable tool for assessing and cultivating transdisciplinary thinking skills in high school students. By providing a reliable means of evaluating students' proficiency in integrative thinking, inquiry skills, and collaborative problem-solving, educators can tailor instructional strategies and curriculum designs to meet the cognitive needs of their students better [10], [11], [27]–[30]. For instance, educators may integrate interdisciplinary projects, problem-based learning activities, and collaborative group work into their teaching practices to promote the development of transdisciplinary competencies [3], [11]–[14]. Furthermore, the scale's multidimensional structure allows targeted interventions to strengthen specific aspects of transdisciplinary thinking, facilitating more nuanced and effective educational interventions.

Moreover, validating the TTS highlights the importance of better fostering transdisciplinary competencies in educational settings to prepare students for the challenges of the 21<sup>st</sup> century. As globalization, technological advancements, and complex societal issues continue to reshape the landscape of work and society, the ability to think transdisciplinary becomes increasingly indispensable [15], [16], [22]–[25]. By integrating transdisciplinary pedagogies and assessment tools into educational practice, schools can empower students with the critical thinking, problem solving, and collaboration skills necessary to thrive in an increasingly interconnected and complex world.

In conclusion, validating the TTS significantly advances theoretical understanding and educational practice. By offering a reliable means of assessing and cultivating transdisciplinary thinking skills among high school students, the scale holds promise for fostering a generation of learners equipped with the cognitive agility and integrative prowess necessary to navigate the multifaceted challenges of the contemporary world.

#### 5. CONCLUSION

The development and validation of the TTS represents a seminal contribution to theory and practice in education. The thorough refinement of this instrument, guided by rigorous validation procedures, has provided educators with a reliable tool for assessing transdisciplinary thinking among high school students and advanced our theoretical understanding of this complex cognitive domain. By delineating three distinct factors-integrative thinking, inquiry skills, and collaborative problem-solving-the scale offers empirical

support for existing theoretical models while also underscoring the multidimensional nature of transdisciplinary cognition.

Furthermore, this research's implications extend far beyond academia's confines, resonating deeply with the evolving landscape of 21<sup>st</sup>-century education. The validated TTS equips educators with a powerful instrument for cultivating essential skills such as critical thinking, problem solving, and collaboration-indispensable for success in an increasingly interconnected and complex world. By integrating transdisciplinary pedagogies and assessment tools into educational practice, schools can nurture a generation of learners proficient in disciplinary knowledge and adept at navigating interdisciplinary boundaries and devising innovative solutions to real-world challenges.

Ultimately, the validation of the TTS heralds a transformative paradigm shift in education—one characterized by a holistic approach to learning that transcends disciplinary silos and fosters a culture of integrative thinking and collaborative problem-solving. As we navigate future uncertainties, we must equip our students with the cognitive tools and competencies necessary to thrive in an ever-changing global landscape. In this regard, the TTS stands as a beacon of progress, guiding educators towards a future where transdisciplinary thinking is not just a skill but a mindset—one that empowers individuals to confront the complexities of the modern world with creativity, resilience, and ingenuity.




## REFERENCES

- [1] S. Hansson and M. Polk, "Assessing the impact of transdisciplinary research: the usefulness of relevance, credibility, and legitimacy for understanding the link between process and impact," *Research Evaluation*, vol. 27, no. 2, pp. 132–144, Apr. 2018, doi: 10.1093/reseval/rvy004.
- [2] J. Honra, "Building on success: revisiting the tele-aral program through the lens of appreciative inquiry," *PUPIL: International Journal of Teaching, Education and Learning*, vol. 7, no. 2, pp. 147–170, Sep. 2023, doi: 10.20319/pijtel.2023.72.147170.
- [3] I. Warsah, R. Morganna, M. Uyun, H. Hamengkubuwono, and M. Afandi, "The impact of collaborative learning on learners' critical thinking skills," *International Journal of Instruction*, vol. 14, no. 2, pp. 443–460, Apr. 2021, doi: 10.29333/iji.2021.14225a.
- [4] J. Heinzmann, A. Simonson, and D. Kenyon, "A transdisciplinary approach is essential to community-based research with American Indian populations," *American Indian and Alaska Native Mental Health Research*, vol. 26, no. 2, pp. 15–41, 2019, doi: 10.5820/aian.2602.2019.15.
- [5] J. R. Honra, "Development and validation of Filipino learners' academic resilience scale (FLARS)," *American Journal of Education and Technology*, vol. 1, no. 2, pp. 107–113, Sep. 2022, doi: 10.54536/ajet.v1i2.664.
- [6] H. Pineo *et al.*, "A new transdisciplinary research model to investigate and improve the health of the public," *Health Promotion International*, vol. 36, no. 2, pp. 481–492, Apr. 2021, doi: 10.1093/heapro/daaa125.
- [7] C. Rigolot, "Transdisciplinarity as a discipline and a way of being: complementarities and creative tensions," *Humanities and Social Sciences Communications*, vol. 7, no. 1, Sep. 2020, doi: 10.1057/s41599-020-00598-5.
- [8] A. Horn, M. W. Visser, C. A. C. M. Pittens, E. Urias, M. B. M. Zweekhorst, and G. M. van Dijk, "Transdisciplinary learning trajectories: developing action and attitude in interplay," *Humanities and Social Sciences Communications*, vol. 11, no. 1, Jan. 2024, doi: 10.1057/s41599-023-02541-w.
- [9] T. Mashau, "Promoting transdisciplinary teaching and learning and research in a world that is faced with multifaceted challenges," *International Journal of Research in Business and Social Science (2147- 4478)*, vol. 12, no. 7, pp. 523–531, Oct. 2023, doi: 10.20525/ijrbs.v12i7.2774.
- [10] M. Rostoka, A. Guraliuk, G. Cherevychnyi, O. Vyhovska, I. Poprotskyi, and N. Terentieva, "Philosophy of a transdisciplinary approach in designing an open information and educational environment of institutions of higher education," *Revista Romaneasca pentru Educatie Multidimensionala*, vol. 13, no. 3, Aug. 2021, doi: 10.18662/rem/13.3/466.
- [11] T. S. Smyth, "Transdisciplinary pedagogy: a competency based approach for teachers and students to promote global sustainability," *Journal of Interdisciplinary Studies in Education*, vol. 64, no. 2, pp. 64–72, 2017.
- [12] A. Rola, "Transdisciplinary approach in development studies," *Journal of Public Affairs and Development*, vol. 1, no. 1, pp. 23–57, 2012.
- [13] J. R. Honra, S. C. Monterola, and R. T. Yangco, "Fortifying learners' self-regulation in biology through career-oriented teaching," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 13, no. 6, pp. 4330–4337, doi: 10.11591/ijere.v13i6.20324.
- [14] M. Souto-Manning *et al.*, "A transdisciplinary approach to equitable teaching in early childhood education," *Review of Research in Education*, vol. 43, no. 1, pp. 249–276, Mar. 2019, doi: 10.3102/0091732X18821122.
- [15] A. Baumber, G. Kligyte, M. van der Bijl-Brouwer, and S. Pratt, "Learning together: a transdisciplinary approach to student-staff partnerships in higher education," *Higher Education Research & Development*, vol. 39, no. 3, pp. 395–410, Apr. 2020, doi: 10.1080/07294360.2019.1684454.
- [16] A. Djunaidi, "Improving collaboration abilities and students' learning outcomes through presentation based cooperative," *Mathematics Education Journal*, vol. 5, no. 1, Mar. 2021, doi: 10.22219/mej.v5i1.15246.
- [17] S. Arslan, "Social emotional learning and self-regulation: the mediating role of critical thinking," *International Journal of Learning and Change*, vol. 10, no. 2, 2018, doi: 10.1504/IJLC.2018.090935.
- [18] E. Yeung, L. Carlin, S. Sandassie, and S. Jaglal, "Transdisciplinary training: what does it take to address today's 'wicked problems'?", *Innovation and Education*, vol. 3, no. 1, Dec. 2021, doi: 10.1186/s42862-021-00011-1.
- [19] N. Budwig and A. J. Alexander, "A transdisciplinary approach to student learning and development in university settings," *Frontiers in Psychology*, vol. 11, Oct. 2020, doi: 10.3389/fpsyg.2020.576250.
- [20] K. Ciepiela, "Toward a transdisciplinary approach to FL classroom interaction," *Yearbook of the Poznan Linguistic Meeting*, vol. 7, no. 1, pp. 75–97, 2021, doi: 10.14746/yplm.2021.7.3.
- [21] C. Dambre, J. G. Strack Diaz, R. Orhan, D. Montag, I. van der Zande, and V. Gallo, "Working toward a transdisciplinary approach to teaching and learning planetary health—A collective reflection," *Frontiers in Public Health*, vol. 10, Dec. 2022, doi: 10.3389/fpubh.2022.1039736.




- [22] A. Flogie and B. Aberšek, "Transdisciplinary approach of science, technology, engineering and mathematics education," *Journal of Baltic Science Education*, vol. 14, no. 6, pp. 779–790, Dec. 2015, doi: 10.33225/jbse/15.14.779.
- [23] L. Gebhardt, M. Brost, and A. König, "An inter- and transdisciplinary approach to developing and testing a new sustainable mobility system," *Sustainability*, vol. 11, no. 24, Dec. 2019, doi: 10.3390/su11247223.
- [24] O. Renn, "Transdisciplinarity: synthesis towards a modular approach," *Futures*, vol. 130, Jun. 2021, doi: 10.1016/j.futures.2021.102744.
- [25] J. M. R. Lopez, K. Tielbörger, C. Claus, C. Fröhlich, M. Gramberger, and J. Scheffran, "A transdisciplinary approach to identifying transboundary tipping points in a contentious area: experiences from across the Jordan River Region," *Sustainability*, vol. 11, no. 4, Feb. 2019, doi: 10.3390/su11041184.
- [26] G. Özcan, I. Aktaş, and K. Gülözer, "Developing the scale on discipline expectations of students: A validity and reliability study," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 9, no. 4, pp. 840–846, Dec. 2020, doi: 10.11591/ijere.v9i4.20585.
- [27] J. R. Honra, and S. L. C. Monterola, "Fostering cognitive flexibility of students through design thinking in biology education," *Cogent Education*, vol. 11, no. 1, pp. 1–14, Oct. 2024, doi: 10.1080/2331186X.2024.2415301.
- [28] T. Acar, "Measurement of attitudes regarding foreign language skills and its relation with success," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 5, no. 4, pp. 310–322, Dec. 2016, doi: 10.11591/ijere.v5i4.5959.
- [29] M. I. Kholili, A. Dewantoro, N. Surur, and N. T. Hapsari, "The 21st-century skills scales: many facet Rasch measurements," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 13, no. 3, Jun. 2024, doi: 10.11591/ijere.v13i3.26651.
- [30] M. R. Ridwan, S. Hadi, J. Jailani, and H. Retnawati, "The instrument development to measure the verbal ability of prospective high school students," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 12, no. 1, pp. 357–368, Mar. 2023, doi: 10.11591/ijere.v12i1.22736.
- [31] J. R. Honra, S. L. C. Monterola, and R. T. Yangco, "Career-focused teaching and its effects on students' biology-technical-vocational-fused skills," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 13, no. 5, pp. 3427–3434, Oct. 2024, doi: 10.11591/ijere.v13i5.29131.

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