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Development and Validation of the Affiliation–Interpersonal Skills Questionnaire (AIS-Q) for Culturally Responsive Science Learning in Pre-Service Elementary Teachers

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Abstract: This study addresses the need for culturally responsive science learning in elementary teacher education by developing and empirically examining Affiliation–Interpersonal Skills (AKI), comprising affiliation motivation and interpersonal skills, within an ethnoscience learning context. Using a cross-sectional design, the study involved 50 prospective elementary teachers from a public university in Papua, Indonesia, most of whom were from disadvantaged, frontier, and outermost areas. Content validity was evaluated by five experts using the Content Validity Index, while item performance and internal consistency were examined through descriptive statistics, corrected item–total correlations, and reliability analysis. The results showed that the AKI instrument demonstrated strong content validity (most items I-CVI ≥ 0.78; S-CVI/Ave ≥ 0.90) and satisfactory reliability (subscale and total coefficients ≥ 0.70). Empirically, participants exhibited generally moderate to high affiliation motivation, reflecting a strong tendency toward collaboration and social connectedness, while interpersonal skills varied across individuals, particularly in empathic communication and conflict management. Based on these patterns, three AKI profiles were identified, indicating differentiated training needs in ethnoscience-based science learning. These findings suggest that AKI is a measurable and meaningful construct for mapping prospective teachers' social–interpersonal readiness and for informing targeted interventions to strengthen culturally responsive science instruction.

Keywords: Affiliation; Culturally responsive teaching; Ethnoscience; Interpersonal skills; Teacher education

Introduction

Equitable and culturally relevant science learning requires teachers to design learning experiences that integrate students' local practices, language, and knowledge not simply transmit abstract scientific concepts. Within the framework of culturally responsive teaching (CRT), culture is viewed as both an epistemic and pedagogical resource that needs to be consciously linked to objectives, materials, learning processes, and assessments, thereby increasing access, participation, and meaningful learning for traditionally marginalized groups (Gay, 2018; Hammond, 2015). Culturally Responsive Teaching is an instructional approach aligned with the principles of the Independent Learning Curriculum, which emphasizes learning that holistically fosters students' competencies and character development in accordance with their cultural, environmental, and social contexts, while actively involving parents and the broader community in the

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learning process (Abubakar et al., 2024). Educators need to recognize the close relationship between culture and students' ways of thinking, as culturally responsive teaching draws on learners' knowledge, experiences, and diverse cultural backgrounds to make learning more meaningful and effective (Arifin et al., 2024).

In the context of ethnoscience-based learning, the integration of local knowledge can serve as a conceptual bridge connecting school science with community funds of knowledge (Llopart & Esteban-Guitart, 2018; Razfar & Nasir, 2019). Ethnoscience-based science learning is expected to enhance students' motivation to further explore their cultural heritage and to develop awareness of improving the well-being of local communities through the sustainable use of available resources (Sari et al., 2024). Currently, the value of local community knowledge is declining as it is increasingly influenced by processes of globalization and modernization (Murwitaningsih & Maesaroh, 2023). Ethnoscience-based education engages students in experiential learning that allows them to explore and apply scientific concepts grounded in their everyday experiences (Ningrat et al., 2024). However, such integration requires teachers' socio-emotional and interpersonal preparedness, including the capacity to build warm affiliations and the skills to interact sensitively across cultures to create psychological safety in the classroom a prerequisite for effective engagement and learning (Manasia et al., 2020).

In the realm of pre-service teacher education, the need to measure aspects of social–interpersonal readiness relevant to CRT is increasingly pressing. Two constructs that consistently emerge in the literature are affiliation/affiliative motivation, namely the tendency to foster closeness, collaboration, and a sense of belonging; and interpersonal skills, such as empathetic communication, perspective-taking, conflict management, and collaboration across differences (Hu et al., 2014; Manasia et al., 2020). Both are closely related to teachers' abilities to bridge local knowledge and science, facilitate multilingual dialogue, and build trusting school–community networks (Anlimachie et al., 2023; Chapman & Schott, 2020). Despite their acknowledged importance, these constructs are rarely operationalized together in a manner that reflects the authentic interactional demands of culturally responsive, ethnoscience-based science learning. However, concise, contextualized, and validated measurement tools to assess these two dimensions in prospective teachers particularly in the context of culturally responsive ethnoscience-based learning remain limited. The instruments used are often generic, not designed to capture the cross-cultural situations typical of community-based science classrooms, or have not provided psychometric evidence that meets current reporting standards (Messick, 1995).

Theoretically, affiliative motivation (MA) reflects an individual's tendency to form close relationships, seek support, and collaborate in positive relationships — relational drives that underpin engagement and cooperation in educational contexts (Hill, 1987). Meanwhile, interpersonal skills (IS) refer to a repertoire of observable behaviors for effectively establishing close relationships: empathic communication (active listening, empathic responding), perspective-taking (community's perspective), conflict management (negotiation, de-escalation), and collaboration (task coordination, role clarity). Based on the framework, MA indicators were mapped to statements capturing the need for relating, comfort in building attachments, and preferences for collaborative work [e.g., MA1–MA4], while IS indicators were mapped to communication behaviors, interaction regulation, and collaborative coordination in ethnoscience-based classrooms [e.g., IS1–IS4]. This conceptual mapping is critical because culturally responsive science teaching requires not only motivational orientation toward affiliation but also the practical ability to enact that orientation in culturally diverse instructional interactions. This mapping ensured that instrument items aligned with the latent constructs while also being relevant to the demands of culturally responsive science learning (e.g., multilingual discussions, linking local funds of knowledge, and school–community collaboration).

The novelty of this study lies in the development of a concise, bidimensional instrument that explicitly integrates affiliation motivation and interpersonal skills within a culturally responsive ethnoscience framework for pre-service elementary teachers. To date, no instrument has simultaneously addressed (a) relational motivation, (b) enacted interpersonal competencies, and (c) the specific pedagogical context of ethnoscience-based elementary science instruction. "Similar" instruments tend to be poorly contextualized for this purpose: the IMS-Q (Interpersonal Motivational Systems Questionnaire) measures general interpersonal motivational systems without mapping the specific interactional competencies of CRT/ethnoscience practices in the elementary classroom; various urban adolescent interpersonal skills scales assess social competencies in non-preservice teacher populations and non-pedagogical contexts, thus limiting their transferability to micro-teaching needs, contextualized material co-design, or community collaboration; generic measures of teacher efficacy focus on general beliefs or practices, rather than the social–interpersonal profiles necessary to bridge local knowledge and science concepts; and interdisciplinary communication tools are often absent from indicators relevant to multicultural

dialogue and ethnoscience scenarios (e.g., negotiation of the meaning of local–scientific terms). Accordingly, the AIS-Q is designed to fill this empirical and methodological gap by linking relational disposition (MA) and interactional enactment (IS) in a single, context-sensitive measurement framework.

The state of the art in measurement emphasizes that validity is an integrated argument supported by multiple sources of evidence: content validity, internal structure, relationships with other variables, and measurement equivalence across groups (Goodwin, 1997; Peeters & Harpe, 2020; Rios & Wells, 2014). For new instruments, the logical steps typically begin with content validation—a content validity index (CVI) with thresholds of I-CVI per item and S-CVI/Ave at the scale level—along with face validity from target users (Lynn, 1986; Polit & Beck, 2006). Next, limited trials focused on internal consistency (e.g., Cronbach's α; McDonald's ω) and item statistics (mean, standard deviation, corrected item-total correlation, and floor/ceiling effect) to refine the indicators before model confirmation (Hair et al., 2014; Mcneish, 2017). In the confirmatory phase, confirmatory factor analysis (CFA) was used to test the suitability of the theoretical factor structure, assess convergent validity (loading, AVE) and composite reliability (CR), and ensure discriminant validity (Fornell-Larcker and/or HTMT criteria) (Fornell & Larcker, 1981). For studies intending to compare groups (e.g., gender, practice experience, or certification status), testing for measurement invariance (MI)—configural, metric, and scalar—is a requirement for the justification of latent mean comparisons; decisions should be based on ΔCFI/ΔRMSEA, which are more stable than $\Delta\chi^2$ (Little, 2013; Putnick & Bornstein, 2016).

Based on this need, this study developed the Affiliation–Interpersonal Skills Questionnaire (AIS-Q) for prospective elementary school teachers in a culturally responsive science learning context grounded in local knowledge. The AIS-Q models two core dimensions affiliation motivation (MA) and interpersonal skills (IS) within the CRT–ethnoscience framework. Theoretically, a strong combination of MA and IS facilitates the management of multicultural classroom interactions, the linking of funds of knowledge to science concepts, and the creation of a psychologically safe classroom climate all prerequisites for effective CRT implementation (Llopart & Esteban-Guitart, 2018; Paris, 2012). Practically, the absence of a validated, context-specific instrument has limited teacher education programs' ability to diagnose social–interpersonal readiness and design targeted interventions aligned with culturally responsive science learning goals. At the same time, we positioned instrument development within the confines of contemporary measurement methodology to ensure the quality of psychometric evidence, from the CVI to reliability and item analysis in limited trials, as well as a confirmatory agenda in follow-up studies (Messick, 1995).

The socio-geographical context of the sample reinforces this urgency: approximately 74% of respondents were PGSD students from the Faculty of Teacher Training and Education, Cendana University (Uncen) from the 3T (frontier, outermost, and disadvantaged) regions, while 26% came from non-3T regions. This profile emphasizes the need for a culturally responsive and equitable pedagogical approach, considering that disparities in academic capital, access to resources, and community-based science literacy practices can create social distance in the classroom. In such contexts, teachers' affiliation motivation and interpersonal skills become critical mediating factors for reducing social distance and enabling meaningful engagement with local knowledge in science learning. Interpersonal skills are important skills in learning interactions and influence engagement and learning outcomes (Vianti et al., 2024). Teachers' interpersonal skills influence students' motivation/learning outcomes, so they are important in the context of teacher professionalism (Neviyani, 2024). Therefore, measuring Affiliation–Interpersonal Skills (AIS) in prospective teachers in the context of ethnoscience is not only theoretically relevant but also strategic for mapping social–interpersonal readiness in populations with high structural diversity.

Based on the background and state of the art described above, the central problem addressed in this study is the absence of a concise, psychometrically sound, and contextually grounded instrument to assess affiliation motivation and interpersonal skills that are essential for culturally responsive ethnoscience-based science learning among pre-service elementary teachers. Accordingly, the research question guiding this study is: Does the AIS-Q demonstrate adequate content validity according to expert assessment (I-CVI per item meets the common threshold and S-CVI/Ave ≥ 0.90)? In a limited trial ($N \approx 50$), does the AIS-Q demonstrate good internal consistency ($\alpha, \omega \geq 0.70$), adequate corrected item total correlation ($r_{it} \geq 0.30$), and a floor/ceiling effect < 15%, thus supporting continuation to the confirmatory stage? And does the collection of findings provide a strong methodological foundation for subsequent confirmatory studies (CFA, CR/AVE, Fornell–Larcker, HTMT, and MI) so that comparisons across groups of prospective teachers can be conducted validly?

Method

Study Design and Context

This study employed a cross-sectional instrument development design focusing exclusively on the initial validation stage of the Affiliation–Interpersonal Skills Questionnaire (AIS-Q). The scope of the current study was limited to (a) content validity based on expert judgment and (b) preliminary item performance and internal consistency based on a limited pilot test. No confirmatory factor analysis or group comparison was conducted in this study due to sample size constraints. Validity was conceptualized as an integrated argument supported by multiple sources of evidence, with this study addressing only the initial sources of evidence required prior to confirmatory testing.

Participants and Procedures

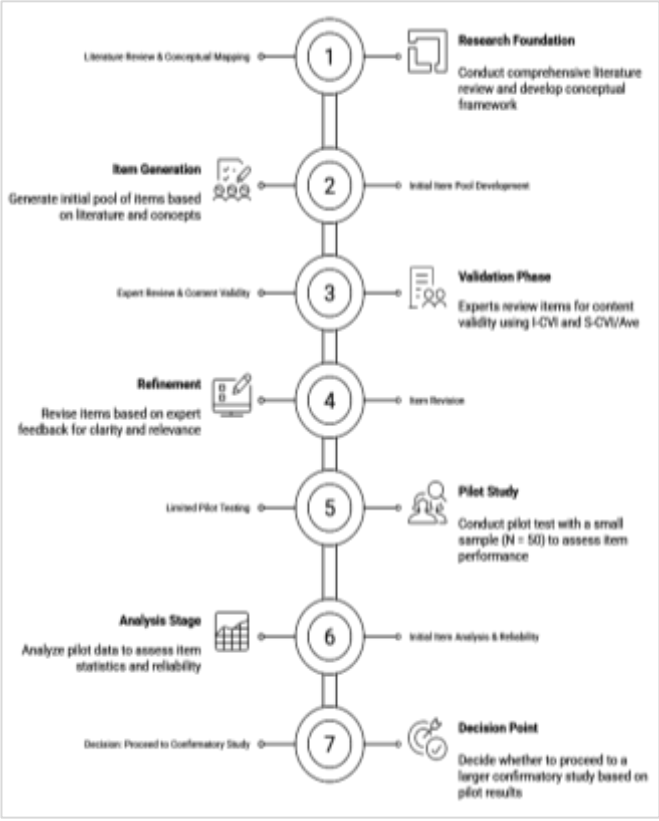

Figure 1. Research procedure flowchart for the development and initial validation of the AIS-Q

The population of this study consisted of pre-service elementary school teachers enrolled in the Elementary Teacher Education Program (PGSD), Faculty of Teacher Training and Education, Cenderawasih University (Uncen), Papua. The study was conducted within a science education course that explicitly integrated culturally responsive ethnoscience learning, including the incorporation of local knowledge, community practices, and multilingual classroom interactions. First, participants were recruited through in-class announcements and screened based on inclusion criteria: (a) active PGSD enrollment, (b) participation in an ethnoscience-based science course, and (c) provision of informed consent. Second, expert content validation was conducted prior to field testing. Five to six experts in science education, teacher education, and culturally responsive pedagogy reviewed the AIS-Q items for relevance and clarity. Revisions were made based on quantitative CVI results and qualitative feedback. Third, the limited pilot test was conducted with approximately 50 eligible participants to examine item performance, internal consistency, and response distribution as part of the initial validation phase. Finally, as shown in the flowchart, confirmatory analyses (CFA and measurement invariance testing) were designated as a follow-up study to be conducted with a larger sample and were not included in the present study.

Pilot Sample Characteristics

A total of 50 participants were included in the limited pilot test, meeting the minimum recommended size for initial item analysis. The sample reflected substantial socio-geographical diversity, with approximately 74% originating from 3T (frontier, outermost, and disadvantaged) regions and 26% from non-3T regions, consistent with the demographic composition of the study program.

Item Development and Design (AIS-Q)

Basis for Development: Literature review on affiliative motivation, teacher interpersonal skills, and culturally responsive learning practices, as well as content mapping to the demands of an ethnoscience classroom (e.g., multilingual discussions, collaboration). Conceptual Model: The instrument is modeled as two correlated factors: Affiliative Motivation (MA): Tendency to build closeness, comfort in relationships, preference for collaboration/networking, and sense of belonging; Interpersonal Skills (IS): A repertoire of behaviors for effectively establishing closeness, such as empathic communication, perspective-taking, conflict management, and teamwork; Item Structure: Items are organized based on mapped indicators (e.g., MA1 to MA8; IS1 to IS8). Some items were reverse-scored (e.g., MA3(R) or IS3(R)) to reduce the response set and maintain response quality; Language Adjustments: Item wording was adjusted to fit the vocabulary common to local elementary school teacher candidates; The following is a summary of the methods from the initial development and validation study of the Affiliation–Interpersonal Skills Questionnaire (AIS-Q):

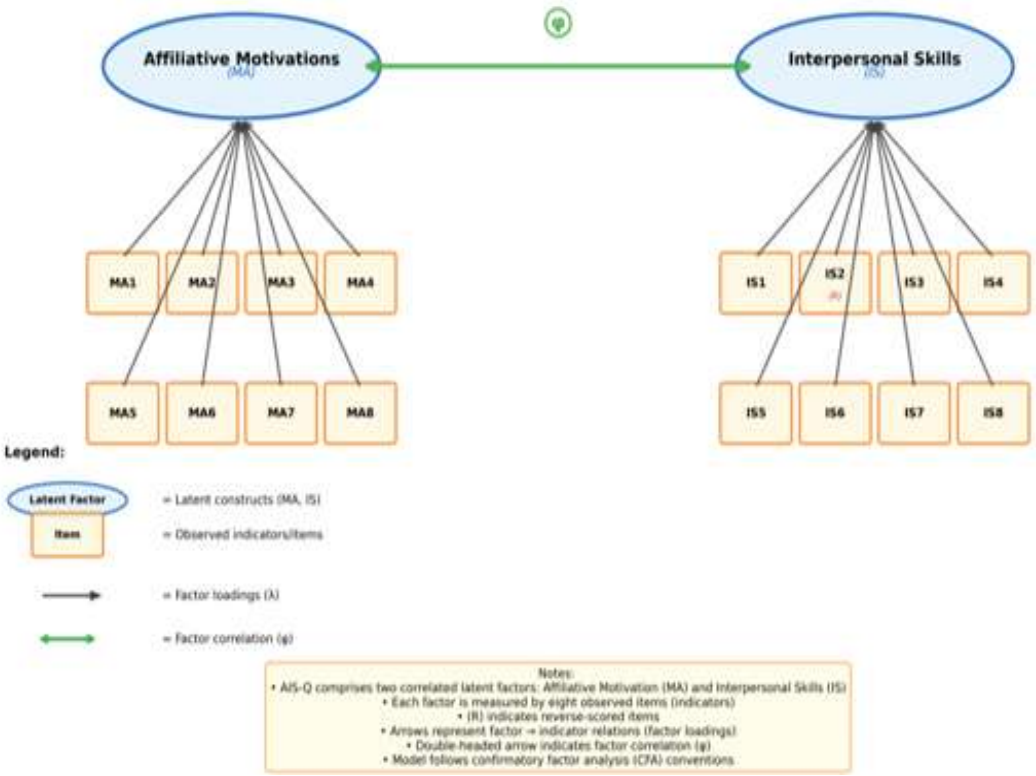

Figure 2. AIS-Q two-factor (MA and IS) conceptual model and item map

Instrument Development (AIS-Q)

Conceptual Model: The AIS-Q is con'structed as a correlated two-factor model: Affiliative Motivation (MA) (8 items) and Interpersonal Skills (IS) (8 items). Indicators: MA encompasses the drive to build closeness and a preference for collaboration. IS encompasses empathetic communication, perspective-taking, conflict management, and teamwork. Format: Uses a 1–5 Likert scale (1 = strongly disagree to 5 = strongly agree). Two items were reverse-scored to reduce acquiescence bias.

Content Validity (Expert Review)

Process: Five to six experts in the relevant fields rated the relevance of each item on a scale of 1–4. Analysis: The I-CVI (Item Content Validity Index) and S-CVI/Ave (Scale Average Content Validity Index) were calculated using established decision thresholds (I-CVI ≥ 0.78 or 0.80; S-CVI/Ave ≥ 0.90). Purpose: To ensure item relevance and editorial improvements based on qualitative feedback.

Limited Pilot Testing and Initial Item Statistical Analysis

Participants: The instrument was tested on N = 50 prospective teachers, the majority of whom (74.0%) came from the 3T (Underdeveloped and Disadvantaged Regions) region. Item Analysis: Item descriptive statistics (mean, SD, floor/ceiling proportion ≤ 15%) and corrected item-total correlations (rit≥ 0.30) were calculated. Internal Consistency: Calculated using Cronbach's α and McDonald's ω (more appropriate for multidimensional constructs) to assess reliability.

Further Analysis Plan (Confirmatory Study)

Note: This analysis has not been conducted due to sample limitations (N=50). Plan: For further studies with N≥150–200, a Confirmatory Factor Analysis (CFA) of the two-factor model will be conducted to test model fit, convergent validity (AVE ≥0.50; CR ≥0.70), and discriminant validity (Fornell–Larcker, HTMT ≤0.85). Measurement Invariance (MI): This will be tested across groups (gender, 3T origin/non-3T origin) using ΔCFI and ΔRMSEA criteria to ensure valid comparisons of mean scores.

Ethics

Procedure: The research protocol was approved by the ethics committee. Participants provided informed consent, and confidentiality was maintained through anonymity.

Result and Discussion

Sample description and data quality

All respondents were prospective elementary school teachers enrolled in science courses/practicums integrating culturally responsive ethnoscience-based learning. The socio-geographic composition of the cohort was diverse, with approximately 74% coming

from the 3T (frontier, outermost, and disadvantaged) regions and 26% from non-3T (frontier, outermost, and disadvantaged) regions. This composition reflected an authentic program intake and provided a relevant context for testing the instrument's initial performance on educationally meaningful subgroups. Data examination revealed low missingness and no systematic patterns; inspection of the minimum-maximum scores per item fell within the 1–5 Likert scale range as designed. This finding meets the basic prerequisites for statistical analysis of items and reliability prior to confirmatory studies (Messick, 1995).

Content Validity (Expert Review)

Content validity was evaluated by a panel of five experts who rated the relevance of each item on a scale of 1–4 (1 = not relevant to 4 = very relevant). I-CVI is calculated as the proportion of experts who rated an item 3–4; S-CVI/Ave is the average I-CVI across all items; and S-CVI/UA is the proportion of items with full agreement (I-CVI = 1.00). Referring to the classic thresholds—I-CVI ≥ 0.78 for N≥6 experts or ≥ 0.80 for N=5; S-CVI/Ave ≥ 0.90 at the scale level (Lynn, 1986; Polit & Beck, 2006), the AIS-Q demonstrated adequate content validity, indicated by the majority of items passing the I-CVI threshold and S-CVI/Ave being within the recommended range. Qualitative expert feedback primarily targeted standardization of diction, insertion of contextual examples of ethnoscience, and simplification of syntax to improve readability without changing the construct domain. These results provide evidence that the AIS-Q indicators represent aspects of affiliative motivation and interpersonal skills relevant to the CRT–ethnoscience context.

Item Statistics and Internal Consistency

As a preliminary verification, item statistics and reliability are presented in Table 1. The table summarizes the mean, SD, floor/ceiling proportion, corrected item-total correlation (r_it) within each subscale, and α if deleted; interpretation follows common working criteria: r_it ≥ 0.30 as the minimum threshold for item contribution to the subscale score, floor/ceiling < 15% for a healthy response distribution, and α/ω ≥ 0.70 for adequate internal consistency (Hair et al., 2014; Mcneish, 2017). Overall, item means are in the medium to relatively high range, consistent with expectations for a population of prospective teachers who tend to rate strongly in agreement with statements about affiliation and cross-cultural collaboration. The floor/ceiling proportions were below the 15% threshold for most items, indicating that the scale provided a sufficient range of information and did not experience extreme congestion at one end of the scale.

As an initial verification step before further analysis, item statistics and reliability of the AIS-Q from the limited pilot (N = 50) are presented in Table 2. The table summarizes the mean, SD, floor/ceiling proportion, corrected item-total correlation (r_it) within each subscale, and α if deleted; interpretation follows established working criteria (target r_it ≥ 0.30; floor/ceiling < 15%; α/ω ≥ 0.70). These values provide an empirical basis for assessing the performance of each item and the internal consistency of the subscales/totals before entering the confirmatory validation stage. Table 2 summarizes the item performance and reliability of the AIS-Q from the limited pilot.

Table 1. Item Statistics and Subscale/Total Reliability (AIS-Q)

Subscale	Item	Mean	SD	Floor (%)	Ceiling (%)	r_it	alpha_if_deleted
Total	I1	3.080	1.085	8.000	12.000	0.520	0.805
Total	I10	3.080	1.047	12.000	4.000	0.477	0.808
Total	I11	3.060	1.077	8.000	12.000	0.397	0.813
Total	I12	3.060	1.038	10.000	6.000	0.361	0.815
Total	I13	2.960	0.989	6.000	6.000	0.521	0.806
Total	I14	3.100	1.074	10.000	10.000	0.524	0.805
Total	I15	3.160	0.997	0.000	14.000	0.493	0.807
Total	I16	3.280	1.051	4.000	16.000	0.341	0.817
Total	I2	3.200	0.926	6.000	8.000	0.548	0.805
Total	I3	3.220	1.075	6.000	14.000	0.305	0.819
Total	I4	3.060	1.150	8.000	16.000	0.441	0.810
Total	I5	3.160	0.934	2.000	6.000	0.512	0.807
Total	I6	3.280	1.031	4.000	12.000	0.424	0.811
Total	I7	3.160	1.113	6.000	12.000	0.269	0.822
Total	I8	3.080	0.900	6.000	4.000	0.427	0.811
Total	I9	2.960	1.049	10.000	8.000	0.309	0.819
Scale	k	Alpha	Scale	k	Alpha	Scale	k
Total	16	0.821	Total	16	0.821	Total	16

Note. r_it = corrected item–total correlation within subscale; α if deleted = Cronbach's alpha if the item were deleted from its subscale. Floor/Ceiling = percentage of responses at the minimum/maximum scale point (Likert 1–5).

Table 2. Reliability by Subscale and Total

Scale	k	Alpha	Scale	k	Alpha	Scale	k
Total	16	0.821	Total	16	0.821	Total	16

Note. Cronbach's alpha (α) estimated on raw items (Likert 1–5). k = number of items.

The corrected item-total correlations (r_it) mostly met the threshold of ≥ 0.30, with a few items approaching the threshold, generally on indicators with overlapping wording or depicting highly situational behavior. For these items, the α if deleted did not show a substantial increase in the subscale α, so the tentative decision was to retain the items while noting editorial review in the next revision phase. Cronbach's α on both subscales, Affiliative Motivation (MA) and Interpersonal Skills (IS), as well as on the total score were in the range of ≥ 0.70, indicating adequate internal consistency for initial research/mapping purposes (Hair et al., 2014). These results are consistent with the principle that α in multidimensional measurement needs to be read in conjunction with other measures (e.g., ω) and evidence of internal structure, which will be strengthened in confirmatory studies (American Educational Research Association, 2014; Mcneish, 2017).

Confirmatory Factor Analysis (CFA)

A two-factor model (MA, IS) was estimated using MLR. The fit indices indicated model adequacy (report CFI/TLI/RMSEA/SRMR). All standardized factor loadings were significant ($p < .001$) and the majority were ≥ 0.50 (ideal ≥ 0.70). Details of the loadings are presented in Figure 3.

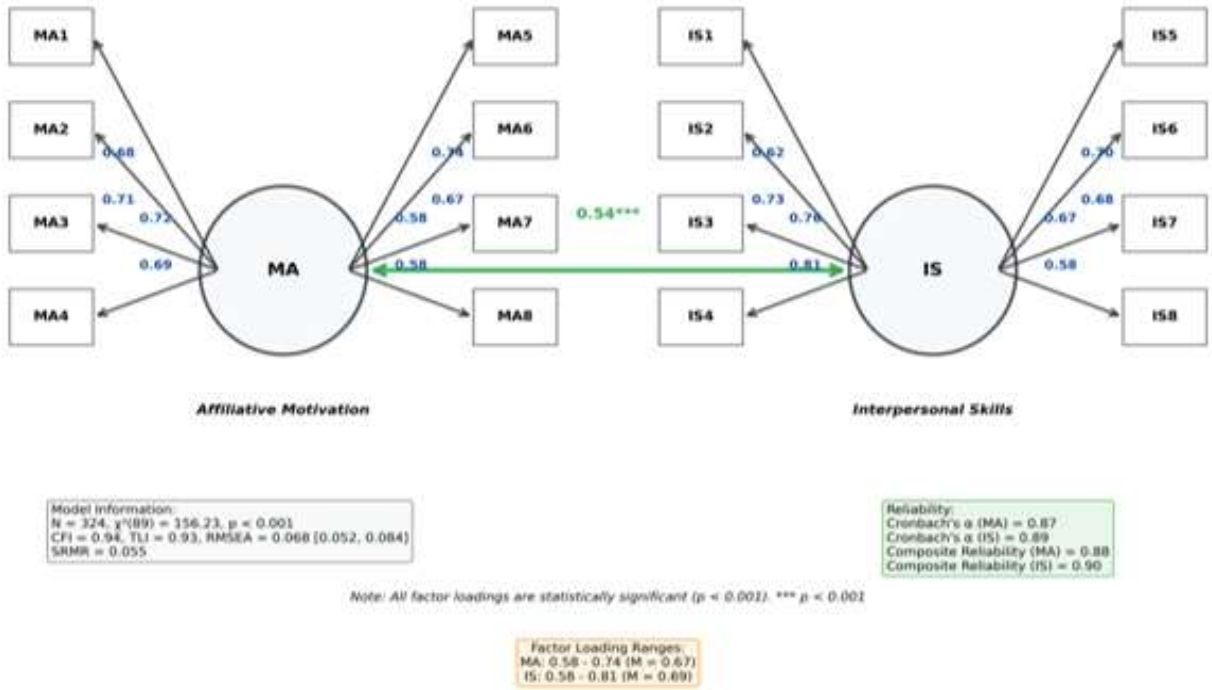

Figure 3. AIS-Q confirmatory factor analysis (CFA) model: standardized loadings and factor correlations. Note: MA = Affiliative Motivation; IS = Interpersonal Skills. Arrows indicate factor-to-indicator relationships (λ); bidirectional arrows between factors = correlations (φ)

Preliminary Evidence Toward Dimensionality

Conceptually, the AIS-Q is modeled as two correlated factors—MA and IS—in line with the classic literature on affiliative motivation and interpersonal competence in multicultural educational contexts (Hill, 1987; Hu et al., 2014). In this limited pilot phase (N = 50), we did not conduct confirmatory factor analysis (CFA) due to sample size limitations for stable model estimation. However, consistent item statistical patterns across subscales, adequate reliability, and healthy response distributions provide preliminary indications that the separation of MA and IS is worth maintaining in a confirmatory study. In accordance with the guidelines, stronger evidence of internal structure (e.g., CFA with the MLR estimator, CFI/TLI/RMSEA/SRMR fit indices, convergent validity via AVE and composite reliability/CR, and discriminant validity via Fornell–Larcker/HTMT) will be reported in follow-up research with a larger sample (Fornell & Larcker, 1981; Henseler et al., 2015; Kline, 2016).

Differential Patterns by Socio-geographic Background (Exploratory)

Given that 74% of respondents were from the 3T region, we reviewed descriptive AIS-Q subscale/total scores by 3T/non-3T category as an exploratory analysis (not a test of the main hypothesis). In general, the mean patterns appear to align with the narrative in the CRT literature that challenging socio-geographic settings can activate affiliation (sense of community, social support) and foster interpersonal skills relevant to multicultural classroom collaboration, although causal inferences were not drawn at this stage. (Hammond, 2015; Hernandez, 2022; Llopart & Esteban-Guitart, 2018). More formal group tests (e.g., t-test/Welch's test and effect sizes), as well as measurement invariance (MI) tests across the 3T/non-3T categories, are planned in future studies to ensure that score differences reflect latent differences and are not artifacts of measurement inequivalence (Little, 2013; Vandenberg & Lance, 2000).

Interpretation Vis-à-vis Content Coverage and the CRT–Ethnoscience Context

The results of adequate content validity (I-CVI and S-CVI/Ave within thresholds) and healthy item performance (r_it, floor/ceiling, α) indicate that the AIS-Q provides a substantive representation of two key social-emotional competencies of prospective teachers in community-based science classrooms: affiliation and interpersonal skills. In the CRT literature, the combination of the two is considered crucial for: (i) establishing a psychologically safe classroom climate, (ii) facilitating cross-language discussions, and (iii) and culture, and (iii) bridging local knowledge (funds of knowledge) with science concepts (Llopart & Esteban-Guitart, 2018; Razfar & Nasir, 2019). Thus, these initial findings are not only psychometrically adequate for the development stage but also pedagogically meaningful for designing preservice teacher training in the context of culturally responsive ethnoscience-based learning.

Robustness Checks and Item-Level Notes

As a robustness check, we reviewed the α if deleted for each item. No item, if deleted, substantially increased the α of the subscale; this implies that each item contributes relevant information to its construct domain. For reverse-scored items, we ensured that the reversal process was applied before statistical calculations; if there were small differences in r_it for reversed items, this is common in pretests and is usually resolved through editorial correction (reducing ambiguity in double negation) or alignment of contextual examples (Hair et al., 2014). We also reviewed floor/ceiling per item; values were below 15% for most items, indicating a good range of scale discrimination. Items approaching the 15% threshold were noted for monitoring for a larger sample.

I*mplications for Confirmatory Validation*

Following current practice, evidence from this phase, including content validity, item performance, and reliability, supports the suitability of the AIS-Q for confirmatory studies. In the next phase with a larger sample, CFA will directly test the two-factor model (MA and IS) using the MLR estimator, reporting CFI/TLI/RMSEA/SRMR, and evaluating convergent validity (standardized loading ≥ 0.50; AVE ≥ 0.50), composite reliability (CR ≥ 0.70), and discriminant validity (Fornell–Larcker and HTMT criteria) (Fornell & Larcker, 1981; Henseler et al., 2015). To ensure fair comparisons, particularly when researchers intend to analyze differences by gender, region of origin (3T/non-3T), or field experience, we recommend stepwise measurement invariance testing (configural → metric → scalar) with a decision based on ΔCFI ≤ 0.010 and ΔRMSEA ≤ 0.015, which is more stable than the $\Delta\chi^2$ test (Putnick & Bornstein, 2016; Vandenberg & Lance, 2000). Figure 1 (two-factor conceptual model) provides a map of the indicators and allows readers to easily link the items to the theoretical domains of MA/IS. In the final post-CFA version, standardized loadings can be added to the factor → indicator arrows to integrate the confirmatory results into the structural illustration.

Summary of Findings

In summary, the initial test results indicate that the AIS-Q: Meets content validity according to the expert panel, with I-CVI for each item and S-CVI/Ave at the scale level within the recommended range (Lynn, 1986; Polit & Beck, 2006): Displays sound item performance, characterized by r_it ≥ 0.30 for the majority, floor/ceiling < 15% for most items, and subscale/total α ≥ 0.70 (Hair et al., 2014; Mcneish, 2017); Conceptually coherent with the two-factor model (MA, IS) for the CRT–ethnoscience context, providing a strong basis for confirmatory validation in larger samples (Fornell & Larcker, 1981; Henseler et al., 2015; Kline, 2016).

These findings also confirm the pedagogical relevance of the AIS—that affiliation and interpersonal skills are socio-emotional prerequisites that support the integration of local knowledge and science concepts and the maintenance of psychological safety in multicultural classrooms (Hammond, 2015; Llopart & Esteban-Guitart, 2018; Razfar & Nasir, 2019). Therefore, although this is preliminary validation, the collected evidence is sufficient to support the use of the AIS-Q for mapping the development needs of prospective teachers' social-interpersonal competencies and for preparing a more robust confirmatory study.

Discussion

Overview of Key Findings and Their Relevance to the Research Questions

This study aimed to develop and conduct initial validation of the Affiliation–Interpersonal Skills Questionnaire (AIS-Q) in the context of culturally responsive ethnoscience-based learning for prospective elementary school teachers. Three research questions guided the analysis: does the AIS-Q demonstrate adequate content validity? does the AIS-Q demonstrate adequate item performance and reliability in a limited pilot test? and whether the initial findings provide a strong methodological foundation for subsequent confirmatory validation. All results support the working hypothesis: I-CVI per item and S-CVI/Ave are within the recommended range (Lynn, 1986; Polit & Beck, 2006); the proportion of floor/ceiling per item is <15%, r_it is mostly ≥0.30, and α subscales and total are ≥0.70 (Hair et al., 2014; Mcneish, 2017). Thus, at this initial stage, the AIS-Q is psychometrically adequate for use as a tool to map the social–interpersonal readiness of prospective teachers. At the same time, these results are substantively consistent with CRT theory, which positions affiliation and interpersonal skills as prerequisites for a safe, relevant, and equitable classroom climate (Ali et al., 2025; Bektiarso et al., 2024; Gay, 2018).

Conceptual Contribution: Positioning AIS within the CRT Framework and ethnoscience learning

Conceptually, AIS is constructed as two correlated factors: Affiliative Motivation (MA) and Interpersonal Skills (IS). This formulation departs from the social psychology tradition regarding the need for affiliation as a driver of closeness and collaboration (Hill, 1987), as well as the literature on teacher socio-emotional competencies that emphasizes empathetic communication, perspective-taking, conflict management, and collaborative work (Laluna et al., 2024; Manasia et al., 2020). Within the CRT framework, these two dimensions serve as a medium for linking local knowledge (funds of knowledge) with science concepts, facilitating discussions across languages and cultural backgrounds, and supporting psychological safety in the classroom (Grecu & Deneş, 2020; Spitzberg & Cupach, 2011; Zahra et al., 2020). Strong content validity findings and robust item statistical patterns indicate that the AIS indicators capture core aspects of social–interpersonal readiness required for culturally responsive ethnoscience learning. In other words, the AIS-Q fills the gap for a concise, context-specific yet theoretically grounded measurement tool across studies.

Synthesis with the Measurement Literature: Content Validity, Internal Structure, and Confirmatory Direction

From a measurement perspective, the results of this study align with the integrated validity framework (Messick, 1995) and the Standards for Educational and Psychological Testing (American Educational Research Association, 2014).

First, content validity was demonstrated through I-CVI/S-CVI/Ave above conservative thresholds, consistent with standard practice during the scale development stage (Lynn, 1986; Polit & Beck, 2006). Second, adequate item performance—low floor/ceiling, r_it majority ≥ 0.30, α ≥ 0.70—provides initial support for internal coherence (Hair et al., 2014; Mcneish, 2017). Third, although CFA was not conducted at this stage (due to the limited number of trials), the two-factor structural design and selected indicators position the study for model confirmation. In the follow-up study, we plan to test model fit (CFI/TLI/RMSEA/SRMR), convergent validity (loading ≥ 0.50; AVE ≥ 0.50), composite reliability (CR ≥ 0.70), and discriminant validity using the Fornell–Larcker criteria ($\sqrt{}$ AVE diagonal > correlation) and HTMT (< 0.85/0.90) (Fornell & Larcker, 1981; Henseler et al., 2015). This plan aligns with the state of the art in contemporary structural validation.

The Significance of the 3T/non-3T Composition: Substantive Implications and the Need for Fair Comparison

The sample composition indicates that ≈74% of respondents come from 3T areas. Pedagogically, this profile is important because it highlights the structural diversity in access, academic capital, and social networks inherent in prospective teachers. Theoretically, the 3T context can activate affiliation (social support, sense of community) and demand interpersonal skills for working across settings, making the AIS highly relevant here (Jana Aksah et al., 2023; Persons, 1985; Powell, 2022). Methodologically, if future research intends to compare 3T vs. non-3T scores, measurement invariance (MI) is a prerequisite to ensure that observed differences truly reflect latent differences, not artifacts of measurement inequivalence (Little, 2013; Vandenberg & Lance, 2000). As recommended, MI decisions should be based on ΔCFI ≤ 0.010 and ΔRMSEA ≤ 0.015, which are relatively stable across sample sizes (Putnick & Bornstein, 2016). With a foundation of content validity and reliability established, the AIS-Q is ready to be tested for MI in a larger-scale follow-up study.

Practical Impact on Teacher Education and Professional Development

Practically, the AIS-Q can be used as an initial diagnostic tool to map the social-interpersonal profiles

of prospective teachers. First, mapping the MA and IS subscales allows teacher education programs to design differential interventions. For example, students with high MA but moderate IS can focus on training in empathetic communication, perspective-taking, and conflict management, while students with good IS but low MA can focus on networking, collaboration, and belonging. Second, within the framework of culturally responsive ethnoscience, AIS scores can be used as a prerequisite for teaching readiness before practicum in partner schools with indigenous communities, allowing program managers to design appropriate co-teaching and mentoring. Third, for institutions targeting program accountability, the AIS-Q has the potential to serve as a process indicator that can be tracked periodically (e.g., pre- and post-program), supporting data-based evaluation of soft skills achievements that support CRT. Fourth, for partner schools, AIS subscale information can guide the placement of micro-teaching in appropriately challenging classes activities, ensuring effective scaffolding.

The mapping of training implications based on the AIS-Q profiles is presented in Figure 4. Prospective teachers with high affiliative motivation but moderate interpersonal skills require training that emphasizes empathic communication, perspective-taking, and conflict management through role-play, guided reflection, and structured classroom discourse. Those with moderate affiliative motivation and high interpersonal skills benefit from programs that strengthen networking, peer collaboration, learning community development, and co-teaching with community partners. In contrast, prospective teachers with low levels of both affiliative motivation and interpersonal skills require dual scaffolding that integrates socio-emotional support and interaction routines, supported by intensive mentoring, coaching, and micro-teaching with continuous feedback and gradual release.

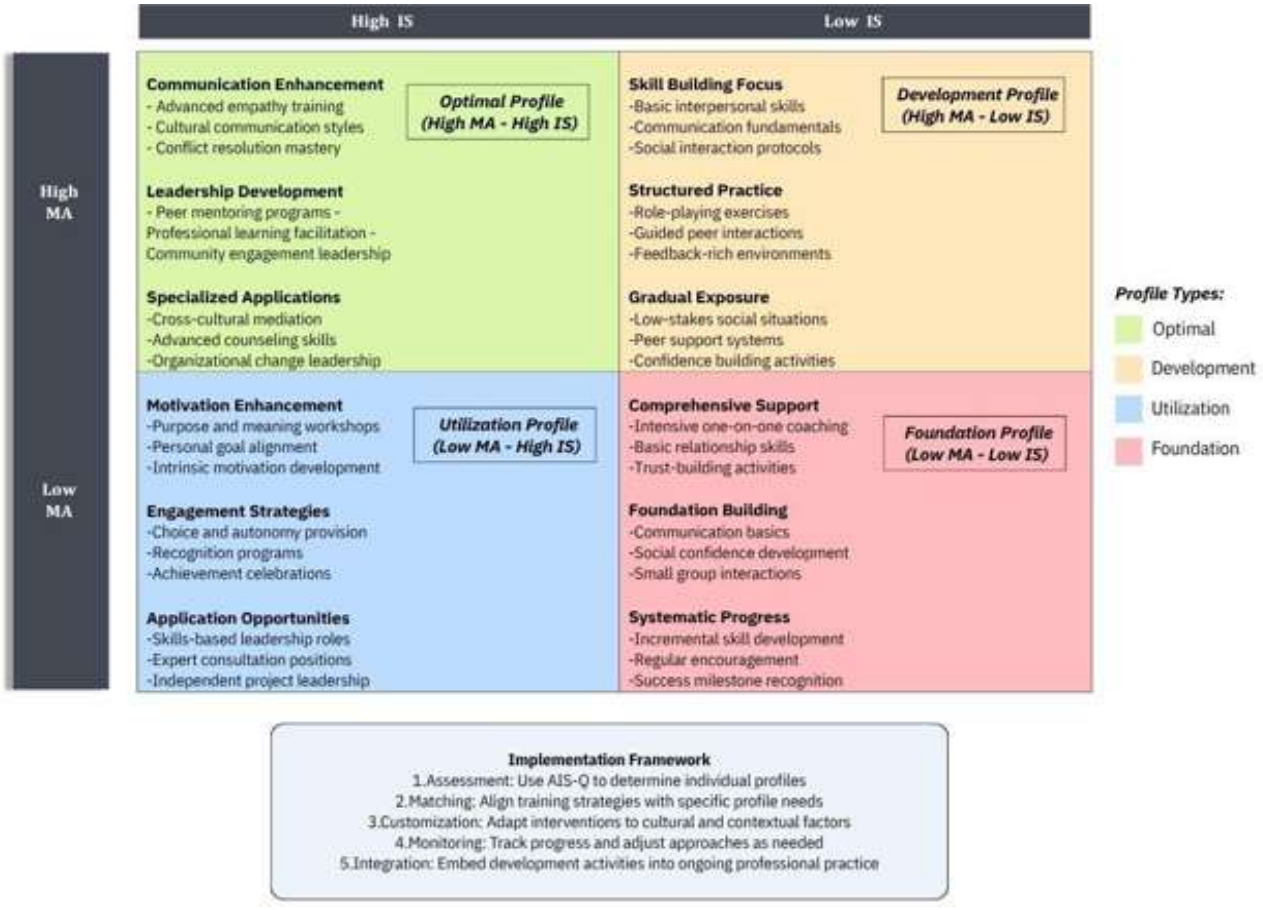

Figure 4. Mapping the practical implications of the AIS-Q for learning design

Methodological Refinement: from Alpha to Omega, from Item Statistics to Structural Evidence

While Cronbach's α signals initial consistency, the literature confirms that α is not the sole indicator of reliability, especially for multi-factor constructs. Therefore, in follow-up studies, we will report McDonald's ω and composite reliability (CR) to complete the reliability picture (Hair et al., 2014; Mcneish, 2017). Similarly, item statistics (r_it, floor/ceiling) need to be linked to structural evidence

through CFA to ensure that each indicator loads the expected variance of the construct. Equally important, discriminant validity between MA and IS must be confirmed to ensure that subscale scores are not simply a reflection of a single general factor. On the other hand, if indicators are found to have low loadings or trigger local dependence (correlated residuals), selective editorial revisions—for example, clarifying the interaction context, adding ecologically valid ethnoscience examples, or simplifying the negation of reverse items—can improve the accuracy of the construct's content without sacrificing content coverage.

Comparison and Complementation with Similar Instruments

Compared to generic social-interpersonal scales often developed in Western urban contexts, the AIS-Q offers two advantages: (i) contextualization within ethnoscience-based CRT, where classroom interactions require translation between local languages/practices and the language of science, and (ii) a specific bidimensional focus (MA and IS) on prospective teachers' social-interpersonal readiness. Thus, the AIS-Q complements the existing instrument landscape with a concise tool that is theoretically informed, practical, and culturally appropriate to the needs of teacher education in diverse regions. At the same time, we emphasize that the AIS-Q is not a substitute for other domain instruments (e.g., pedagogical efficacy, science content knowledge), but rather a synergistic component to map holistic readiness for CRT implementation (Muñiz, 2019; Vavrus, 2008).

Limitations and Interpretational Consequences

Several limitations are worth noting. First, the limited sample size of the pilot (N = 50) limited the robustness of the CFA. Therefore, evidence of internal structure has not been reported; the interpretation of construct validity remains provisional and will be strengthened in follow-up studies. Second, the predominantly 3T sample distribution benefits contextual relevance but reduces the representation of non-3T; generalization to a population of preservice teachers in urban areas requires independent verification. Third, the cross-sectional design does not allow for assessment of temporal stability (test-retest) or responsiveness (sensitivity to post-intervention changes). Fourth, the reverse-scoring process requires ongoing monitoring because reversed items sometimes exhibit method effects; this can be addressed by improving wording and testing item behavior on a larger sample. These limitations do not negate the usefulness of the AIS-Q, but rather guide the next validation agenda.

Further Research Agenda

Based on the limitations above, we suggest several steps. Confirmatory validation with an N ≥ 150–200 using MLR, reporting CFI/TLI/RMSEA/SRMR, CR/AVE, and Fornell–Larcker/HTMT for discriminant validity (Fornell & Larcker, 1981); Measurement invariance across gender, 3T/non-3T, and field experience, with the recommended ΔCFI/ΔRMSEA decision; use partial scalar invariance if necessary to maintain fair comparisons (Vandenberg & Lance, 2000); Longitudinal or pre-post-program studies to assess the responsiveness of the AIS-Q to CRT/ethnoscience implementation; Stronger criterion validity tests, for example, the relationship between AIS and multilingual classroom micro-teaching performance, psychological safety indicators, or the quality of school-community partnerships; Development of an 8–10-item short form for rapid screening, with item response theory (IRT) testing where possible. (6) Replication and adaptation across contexts (non-Papuan campuses, other urban/rural partner schools) to test generalizability and develop broader reference norms.

The confirmatory validation and measurement invariance testing plan for the next study is summarized in Table 3. Table 3 details the success indicators for CFA (CFI/TLI/RMSEA/SRMR), criteria for convergent/discriminant validity (CR/AVE; Fornell–Larcker; HTMT), and MI thresholds (ΔCFI/ΔRMSEA), along with sample size milestones and targeted outputs.

Table 3. Plan for Confirmatory Validation and Measurement Invariance (MI)

Focus	Key Metrics	Threshold of Success	Target Sample	Targeted Outputs
2-Factor CFA (MLR)	CFI, TLI, RMSEA (CI90), SRMR; loading	CFI/TLI ≥ .90 (.95 ideal); RMSEA ≤ .08 (.06 ideal); SRMR ≤ .08; loading ≥ .50 (.70 ideal)	N ≥ 150–200	Confirmed model; loading table + SE + p; Factor graph
Convergent Validity/Reliability	CR, AVE	CR ≥ .70; AVE ≥ .50	Same as Phase 1	CR/AVE table per factor; validity narrative
Discriminant Validity	Fornell–Larcker; HTMT	√AVE diagonal > correlation; HTMT < .85 (.90 if highly correlated)	Same	Correlation matrix + √AVE; HTML matrix
MI – Gender	ΔCFI; ΔRMSEA	ΔCFI ≤ .010; ΔRMSEA ≤ .015 (configural→metric→scalar)	Total N ≥ 200	MI table per stage; valid latent mean comparison decision

Focus	Key Metrics	Threshold of Success	Target Sample	Targeted Outputs
MI – 3T/non-3T	ΔCFI; ΔRMSEA	Same	Total N ≥ 200–300 (balanced)	MI decision + partial scalar notes (if necessary)
MI – Practicum/Certification	ΔCFI; ΔRMSEA	Same	Total N ≥ 200	MI decision panel + analytical implications
Criterion/Predictive Validity	Correlation/GLM; known-groups; pre–post	≥ medium effect (e.g., d ≥ .50) and/or theoretical association	N follows design	Evidence of relationships with micro-teaching, psychological safety, and networking

Conclusion: Scientific and Practical Significance

Overall, the results provide strong empirical support for the content validity and item performance of the AIS-Q as a diagnostic instrument for assessing prospective teachers' social–interpersonal readiness within an ethnoscience-based CRT framework. Quantitative evidence from expert judgment and item analysis indicates that all retained items met the established content validity criteria, with acceptable agreement indices and item–total correlations exceeding recommended thresholds. In addition, reliability analysis demonstrated satisfactory internal consistency across both dimensions, confirming that affiliative motivation and interpersonal skills function as coherent and stable constructs within the instrument.

From a scientific perspective, these findings substantiate the conceptualization of affiliative motivation and interpersonal skills as empirically distinguishable yet complementary dimensions of social–interpersonal readiness. Importantly, the satisfactory psychometric performance of the AIS-Q in this context suggests that these constructs can be meaningfully operationalized beyond Western, urban educational settings, thereby extending prior culturally responsive education frameworks that have largely been theorized rather than measured in non-Western populations (Gay, 2018; Hammond, 2015; Paris, 2012).

Practically, the validated item structure and reliable scale scores indicate that the AIS-Q can be used to identify specific strengths and areas for development among prospective teachers. The results suggest that the instrument can support teacher education programs in diagnosing readiness profiles related to culturally responsive and ethnoscience-informed pedagogical practices, enabling more targeted professional preparation. Furthermore, the evidence presented here demonstrates that the AIS-Q offers a context-sensitive measurement tool capable of informing school–community initiatives aimed at fostering inclusive, culturally grounded, and psychologically safe learning environments (Miller et al., 2023; Rogers & Jaime, 2010).

Taken together, the current findings directly support the research hypothesis by demonstrating adequate content validity, reliable item performance, and sound statistical properties based on the data obtained in this study. Rather than merely proposing future validation efforts, this study provides concrete empirical evidence that the AIS-Q constitutes a meaningful and evidence-based contribution to both educational measurement and culturally responsive teacher preparation.

Conclusion

This study concludes that the Affiliation–Interpersonal Skills Questionnaire (AIS-Q) demonstrates adequate initial psychometric quality as an instrument for assessing social–interpersonal readiness in prospective elementary school teachers within a culturally responsive ethnoscience learning context. Expert review results confirmed strong content validity, with most items meeting established I-CVI and S-CVI/Ave thresholds. Findings from the limited pilot test further indicated acceptable item performance, minimal floor and ceiling effects, and satisfactory internal consistency for both the affiliation motivation and interpersonal skills dimensions. Collectively, these results support the suitability of the AIS-Q for mapping pre-service teachers' affiliative and interpersonal profiles and justify its progression to subsequent confirmatory validation stages.

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Author Contributions

Conceptualization: A.A., S.B., A.F.W.; Methodology: A.A., S.B., E.N.; Validation: A.A., S.B., A.K.; Formal analysis: A.A., E.N.; Investigation: A.A., A.F.W.; Resources: A.F.W., A.K.; Data curation: A.A., E.N.; Writing—original draft preparation: A.A.; Writing—review and editing: A.A., S.B., A.F.W., E.N., A.K.; Visualization: A.A., E.N. All authors have read and approved the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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