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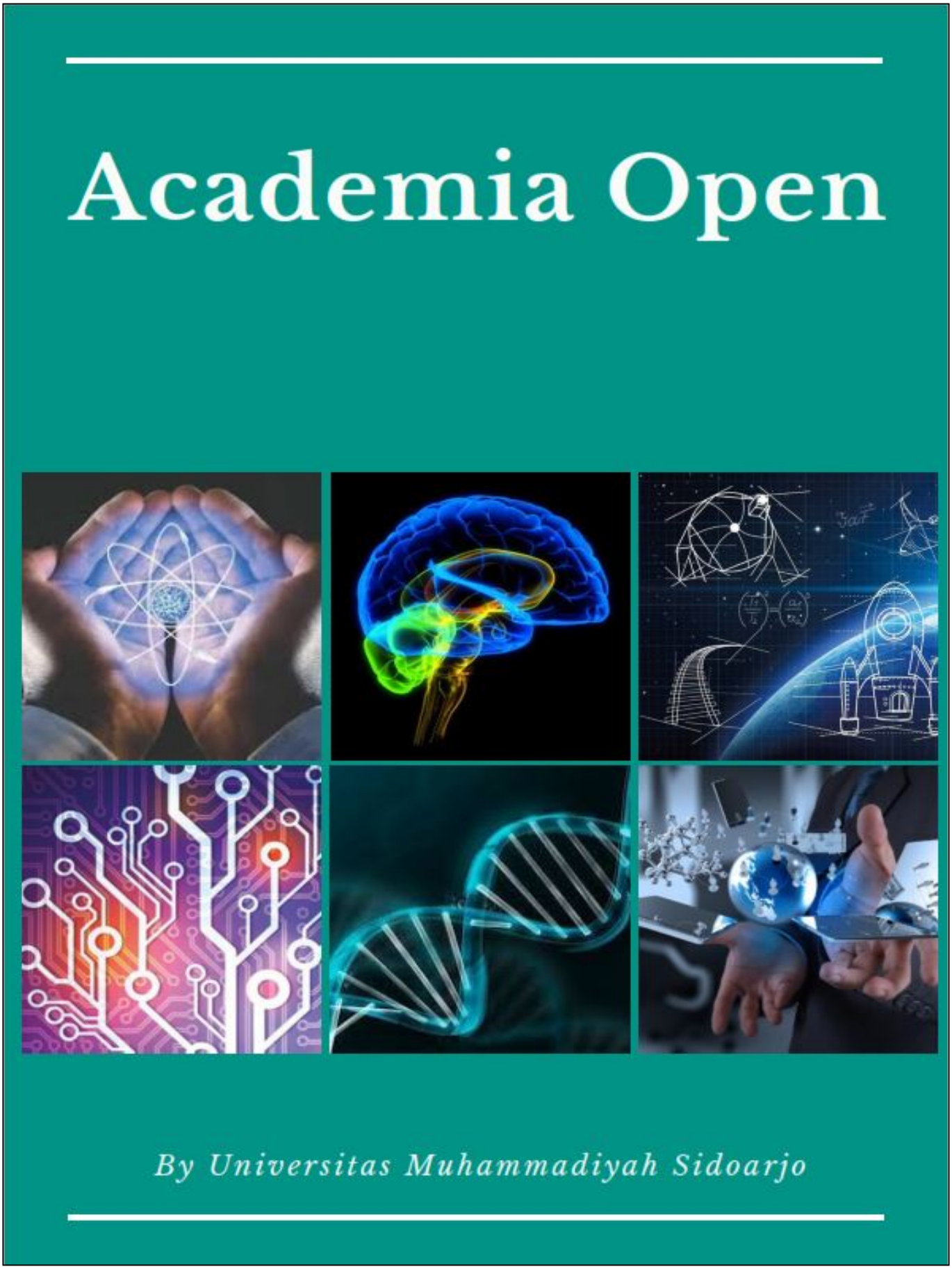

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Culturally Responsive Science Instruction and Preservice Teachers' Affiliation Motivation

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Abstract

General Background: Teacher education in multicultural settings like Papua demands pedagogies that integrate cultural, linguistic, and communal values to foster inclusive learning. **Specific Background:** Culturally Responsive Science Instruction (PRB) operationalizes Culturally Responsive Teaching through the Hem Re Yegokhe practice, embedding local Indigenous knowledge into science instruction. **Knowledge Gap:** While prior research highlights cognitive benefits of culturally responsive pedagogy, the socio-affective dimension, particularly affiliation motivation among preservice teachers in frontier Indonesian regions, remains underexplored. **Aims:** This study investigates the effects of PRB on preservice teachers' affiliation motivation and examines the mediating role of Cultural Exploration Experience (PEB). **Results:** Using a pretest–posttest design with 173 participants and structural equation modeling, PRB significantly enhanced PEB ($\beta = 0.681$, $p < .001$) and affiliation motivation ($\beta = 0.436$, $p = .018$), with PEB providing a significant partial mediation ($\beta\_indirect = 0.130$, $p = .025$). **Novelty:** By situating culturally grounded science instruction within a Papuan context, this study integrates Self-Determination Theory and culturally sustaining pedagogy to reveal affective mechanisms underlying multicultural teacher education. **Implications:** Findings urge teacher-training institutes to embed local cultural practices into curricula, strengthening social cohesion and motivational readiness of preservice teachers in diverse and underdeveloped regions.

Highlights:

- PRB significantly boosts preservice teachers' cultural exploration and social motivation.
- Cultural exploration experience acts as a partial mediator between PRB and affiliation motivation.
- Embedding local practices like Hem Re Yegokhe enhances multicultural teacher education impact.

Keywords: Culturally Responsive Instruction, Affiliation Motivation, Cultural Exploration, Teacher

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Introduction

Teacher education in multicultural contexts such as Papua requires pedagogical strategies that are both effective and sensitive to the cultural, linguistic, and communal values of students' home communities. Within this framework, Culturally Responsive Teaching (CRT; Pembelajaran Responsif Budaya) is positioned as a key approach for creating culturally relevant, equitable, and empowering learning experiences, emphasizing identity recognition and the integration of local knowledge into instructional practice [1],[2],[3]. In Indonesia's teacher education institutes (Lembaga Pendidikan Tenaga Kependidikan, LPTK), the preservice phase shapes pedagogical orientations and professional values, including the capacity to build cross-cultural relationships; however, the implementation of CRT in higher education remains relatively underexamined empirically [4][5].

In the socio-affective domain, affiliation motivation—namelyz the drive to establish and maintain warm social relationships constitutes a critical prerequisite for collaboration and for positive cultural exploration experiences in learning. Classical and contemporary literature indicates that affiliation motivation is associated with the need for social acceptance, cooperation, and adaptive regulation of social emotions [6], [7], [8]. Meeting these relational needs becomes increasingly crucial in diverse learning environments where students negotiate their own and others' cultural identities in everyday academic situations. The Papuan context provides an authentic foundation for applying CRT because ethnic, linguistic, and value-system diversity presents both pedagogical challenges and opportunities. This study situates the Hem Re Yegokhe practice a system of collective sago-forest management among the Sentani Indigenous community as a local cultural context integrated into science instruction. Such integration is expected to strengthen cognitive relevance while facilitating the internalization of collectivist values, solidarity, and ecological responsibility that are meaningful to local students [9].

Within this framework, Culturally Responsive Science Instruction (Pembelajaran Sains Responsif Budaya, PRB) is positioned as a concrete and contextualized form of CRT in Indonesia's education system. PRB adopts CRT's core principles cultural identity recognition, participatory justice, and the integration of community values and applies them in practice through locally grounded, community-based learning such as Hem Re Yegokhe. PRB is not a term separate from CRT; rather, it serves as an operational translation within the local context of Papua and other frontier, outermost, and underdeveloped regions (3T) of Indonesia.

Theoretically, the relationship between PRB and affiliation motivation can be understood through the fulfillment of relatedness needs in Self-Determination Theory, which predicts enhanced social motivation when learning environments acknowledge identity, provide meaningful participation, and cultivate a sense of belonging [10]. In addition, the culturally sustaining pedagogy perspective emphasizes that culture is not merely inserted content but an experience sustained and developed through curricular practice; when cultural experiences are explicitly embedded in instructional design, students receive identity affirmation alongside bridges that strengthen social attachment [11]. In line with this view, cultural exploration experiencecomprising field/artefact observation, engagement with Indigenous practitioners, and identity reflection is positioned as a mediator that channels the effect of PRB toward affiliation motivation. Nevertheless, in practice, students from 3T regions often face obstacles in building social affiliation due to differences in values and norms within diverse classrooms. When instruction draws on cultural contexts they have personally experienced such as customary practices they understand first-hand pre-existing cultural exploration experiences become an important internal resource. These prior experiences can facilitate the internalization of values transmitted through PRB and strengthen students' affective readiness to engage with multicultural learning contexts.

Prior CRT scholarship has largely focused on urban contexts in high-income countries and on cognitive outcomes or professional identity, while socio-affective dimensions such as affiliation motivation in multicultural higher education remain underexplored and often descriptive [12], [13]. This gap indicates the need for quasi-experimental studies that link locally grounded cultural interventions with the psychopedagogical mechanisms underlying motivational and social change. By positioning Cultural Exploration Experience as a mediator between PRB and affiliation motivation, the present study seeks to expand the evidence base regarding how Indigenous community–based instructional designs operate among preservice teacher populations in 3T regions and to enrich the discourse on multicultural education in Indonesia. Methodologically, the study employs partial least squares–based structural equation modeling (SEM-PLS) to test the proposed conceptual model. The measurement model is evaluated using common indicators (outer loadings, AVE, composite reliability, alpha, rho_A), while discriminant validity is examined using HTMT, which is recommended for assessing construct distinctiveness [14], [15].

Grounded in this conceptual foundation, empirical gap, and methodological design, the study addresses the following questions: (1) To what extent does Hem Re Yegokhe–based PRB affect preservice teachers' affiliation motivation in Papua's multicultural context? (2) To what extent does PRB influence students' cultural exploration experience as an intermediary that links scientific concepts with local cultural practices? (3) Does cultural exploration experience mediate the effect of PRB on affiliation motivation in accordance with the referenced mediation framework? (4) How do these findings inform the development of culturally responsive curricula in Indonesia's LPTKs for populations from 3T (underdeveloped, frontier, and outermost) regions?

Method

A. Research Design

This study employed a pretest–posttest control-group design to assess the effect of Hem Re Yegokhe–based Culturally

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Responsive Science Instruction (Pembelajaran Sains Responsif Budaya, PRB) on two primary variables: Cultural Exploration Experience (Pengalaman Eksplorasi Budaya, PEB) and Affiliation Motivation (Motivasi Afiliasi, MA). Two student groups experimental and control completed pretest and posttest measurements to evaluate changes following the intervention. The pretest assessed both variables prior to the intervention, and the posttest reassessed them afterward to determine changes within and between groups.

B. Participants and Setting

The sample comprised 173 students enrolled in the Elementary Teacher Education Program (Pendidikan Guru Sekolah Dasar, PGSD) at Universitas Cenderawasih, Papua. Students were divided into two groups via simple random assignment across parallel classes. The experimental group (n = 88) received Hem Re Yegokhe–based instruction, whereas the control group (n = 85) received conventional instruction without local cultural integration. Gender distribution differed across groups, with a higher proportion of female students in the experimental group (77.3%) than in the control group (62.4%). This imbalance was addressed by including gender as a covariate in subsequent analyses.

C. Intervention

The experimental group received science instruction that integrated the local cultural practice of Hem Re Yegokhe and involved field observation, engagement with Indigenous practitioners, and guided reflection on students' cultural identities. This approach was designed to strengthen social connectedness and deepen understanding of scientific concepts through contextually relevant cultural experiences. The control group received conventional science instruction without local cultural elements. Both groups were facilitated using evidence-based, active-learning approaches; however, only the experimental group engaged directly in local cultural exploration.

D. Variables and Instruments

Three latent constructs were measured:

1. Culturally Responsive Science Instruction (PRB/X).

Assessed using a Culturally Responsive Science Teaching perception inventory adapted from CRT (Culturally Responsive Teaching; Gay; Ladson-Billings; Siwatu) frameworks/instruments through a translate–back-translate procedure and expert review for content validity (Content Validity Index, CVI). Subscales captured cultural relevance, identity recognition/affirmation, evidence-based inquiry, and cross-cultural collaboration; several negatively keyed items were included for reverse coding. Scores were computed as subscale means and a total mean. Reliability (Cronbach's α/McDonald's ω) and factor structure (EFA/CFA: AVE, CR, HTMT) are reported in the Results.

2. Cultural Exploration Experience (M/PEB)

Measured with a ~12-item Cultural Exploration Experience Scale developed for the Papuan context and content-validated by experts. Indicators included interaction with Indigenous practitioners, analysis of cultural artifacts, field observations, and identity reflection. Scoring used item means (with reverse coding where applicable). Reliability (α/ω), convergent validity (AVE/CR), and discriminant validity (HTMT) are reported in the Results.

3. Affiliation Motivation (Y/MA)

Measured using the Affiliation Motivation Scale (Mehrabian; ~26 items, including reverse-keyed items) adapted to multicultural classroom settings in Papua; for convergent validity, the Relatedness subscale from the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS, 8–12 items) was also included. The total score was calculated as the mean after reverse coding.

All variables were measured on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) at pretest and posttest. The primary analysis employed partial least squares–based structural equation modeling (SEM-PLS) for the measurement and structural models; pre–post statistics were reported descriptively as supporting information (no gain tests/ANCOVA).

E. Measurement Procedures and Data Analysis

Data were analyzed using partial least squares–based structural equation modeling (SEM-PLS) to examine relationships among Culturally Responsive Science Instruction (Pembelajaran Sains Responsif Budaya, PRB), Cultural Exploration Experience (Pengalaman Eksplorasi Budaya, PEB), and Affiliation Motivation (Motivasi Afiliasi, MA).

1. Pretest and posttest

Pretest and posttest were administered to quantify change within each group.

2. Reliability and validity

Measurement quality was established by evaluating outer loadings, Cronbach's alpha, rho_A, and Average Variance

Extracted (AVE) to assess construct reliability and convergent validity; discriminant validity was examined using HTMT.

3. Path analysis and mediation

Direct and indirect (mediated) effects were tested via bootstrapping with 5,000 subsamples to obtain path coefficients and significance levels.

To depict interconstruct relationships, a path diagram was used to display the strength of associations, including path coefficients and R^2 values. This visualization facilitates interpretation of how the variables interact within the tested model. The path diagram of the model showing the strength of the relationships between variables, including path coefficients and R^2 values as shown in the diagram below.

[Figure 1 . about here]

F. Research Ethics

This study received approval from the Research Ethics Committee of Universitas Cenderawasih. All participants were clearly informed about the study's purpose, procedures, and their rights as respondents, and they provided voluntary informed consent. Collected data were kept confidential, and no financial incentives were offered to participants.

Results and Discussion

A. Results

1. Measurement Model Evaluation

The measurement model evaluation indicated that all construct indicators had outer loadings above the minimum threshold, satisfying convergent validity criteria. Composite reliability and Cronbach's alpha values were in the acceptable range, demonstrating strong internal consistency. In addition, the Average Variance Extracted (AVE) values exceeded 0.50, further supporting convergent validity. The HTMT assessment also confirmed adequate discriminant validity among constructs. Accordingly, the measurement model was deemed suitable for subsequent structural analysis.

Direct Path Analysis

The structural path analysis revealed that Culturally Responsive Science Instruction (PRB) exerted a strong positive effect on students' Cultural Exploration Experience. This path was the most dominant, underscoring the effectiveness of integrating local cultural practices into science instruction. PRB also showed a direct effect on Affiliation Motivation, indicating that culturally responsive instruction can strengthen preservice teachers' social connectedness. On the contrary, the direct relationship between Cultural Exploration Experience and Affiliation Motivation is not significant, indicating that cultural exploration operates more strongly as a mediating mechanism rather than as a direct predictor, as explained in the table below.

[Table 1. about here]

2. Mediation Effects

The tests indicated that the direct effect of Cultural Exploration Experience (Pengalaman Eksplorasi Budaya, PEB) on Affiliation Motivation (Motivasi Afiliasi) was not supported; however, the indirect effect of Culturally Responsive Science Instruction (Pembelajaran Sains Responsif Budaya, PRB) via PEB remained significant. At the same time, the direct effect of PRB on Affiliation Motivation was confirmed. This pattern signifies partial mediation through PEB: PRB elevates affiliation motivation directly while also transmitting part of its influence by first fostering students' engagement in cultural exploration. Accordingly, PEB functions as an intermediary that amplifies the impact of PRB on the formation of social connectedness in multicultural classrooms, consistent with the classification of partial mediation proposed[16].

3. Structural Model Visualization

To clarify the directionality among latent variables, the SEM-PLS results are visualized in the structural model presented in Figure 2. The visualization displays direct and indirect paths, path coefficients, and R^2 values that indicate the proportion of variance explained in each construct.

[Figure 2 . about here]

4. Structural Model: Summary of Visualized Effects

The visualization indicates that Culturally Responsive Science Instruction (PRB) exerts a significant influence on Affiliation Motivation both directly and indirectly through the mediation of Cultural Exploration Experience. The PRB → Cultural Exploration path is the strongest, contributing substantially to the variance in Cultural Exploration Experience ($R^2 = 0.464$). Although the Cultural Exploration Experience → Affiliation Motivation path is not significant, the indirect effect of PRB via

Cultural Exploration Experience remains significant, supporting partial mediation. Overall, the model explains 22.7% of the variance in Affiliation Motivation, indicating that PRB and Cultural Exploration Experience play important roles in shaping students' social connectedness in multicultural classrooms.

5. Distribution of Affiliation Motivation by Prior Experience

A follow-up analysis compared students based on their prior cultural exploration experience. Results showed that the group with prior experience reported consistently higher levels of Affiliation Motivation than the group without such experience. These findings underscore students' cultural background as a salient contextual factor that amplifies the effectiveness of PRB. The higher mean Affiliation Motivation scores among the experienced group are depicted in Figure 2, highlighting the function of prior cultural experience as an internal resource that strengthens students' social connectedness in multicultural learning contexts.

[Figure 3 . about here]

B. Discussion

1. Direct Effect of PRB on Affiliation Motivation

The findings confirm that Culturally Responsive Science Instruction (PRB; Pembelajaran Sains Responsif Budaya) exerts a direct effect on students' affiliation motivation. This result aligns with Self-Determination Theory, which emphasizes the importance of the relatedness need for social connectedness [10], [17]. PRB creates space for students to feel accepted and have their identities recognized, thereby increasing their desire to build social relationships in multicultural classrooms. Prior scholarship similarly indicates that culturally responsive instruction effectively enhances social participation. [18], [19] This finding is consistent with the CRT framework, which highlights the centrality of identity recognition and local knowledge [20], [21]. In the Indonesian context,[22] report that integrating CRT in higher education improves cross-cultural social connectedness among students. From the perspective of Social Identity Theory (Tajfel & Turner), recognition of students' cultural identities strengthens their social attachment in academic settings [23], [24].

PRB has also been shown to significantly increase social participation among diverse student populations. By integrating students' cultural backgrounds into instruction, educators can foster inclusive environments that support engagement and socioemotional well-being. This approach not only promotes academic success but also encourages students to participate actively in their communities. Culturally responsive pedagogy bridges gaps between students' cultural identities and educational settings, improving student–teacher relationships [25]. Through a culturally relevant curriculum, educators can empower students to reflect on their identities and experiences, cultivating a sense of belonging and community engagement.

2. Mediating Role of Cultural Exploration Experience

Although the direct path from cultural exploration experience to affiliation motivation was not significant, its mediating role proved consequential. This indicates that cultural exploration experience strengthens the pathway from PRB to affiliation motivation. In line with culturally sustaining pedagogy [11], students' cultural experiences are not merely supplementary content but a critical factor for building stronger social connectedness. Cultural exploration experience functions as a bridge between PRB and affiliation motivation. Consistent with this perspective [20], PRB enhances students' emotional competencies, enabling them to navigate social situations more effectively [26], increase engagement [25], and mitigate achievement gaps, particularly for students from diverse backgrounds [27], [28]. Within an identity-theoretical frame, cultural exploration helps students align their personal and social identities. Consistent with Ausubel's anchoring theory [29], such experiences also act as advance organizers that link new knowledge to existing cognitive structures [30].

3. Students' Prior Experience in 3T Regions

The distribution of affiliation motivation scores shows that students from 3T regions who possess prior cultural experience are better prepared to build social affiliation than those without such experience. This finding underscores prior experience as valuable affective capital and supports the view that affective readiness is a key factor in the effectiveness of multicultural instruction. The pattern in Figure 2 highlights prior cultural experience as affective capital. These results resonate with perspectives on multicultural education in Indonesia, which stress the importance of locally grounded pedagogical strategies to support students from marginalized regions [9]. PRB also operates as a buffer against culture shock that often arises when students encounter differing norms and values in multicultural classrooms[31]. The psychosocial mechanisms at work include identity recognition, reduced social anxiety, strengthened cross-cultural empathy, and self-reflection.

4. Comparison with Previous Studies

This study extends a literature base that has largely focused on urban contexts in high-income countries [12], [13]. As an operationalization of CRT in Papua, PRB demonstrates that integrating local culture can address the distinctive social and pedagogical challenges of 3T regions, thereby enriching global CRT discourse with contextualized evidence from Indonesia. The Zone of Proximal Development perspective (Vygotsky) is also relevant: PRB can be viewed as sociocultural scaffolding that accelerates students' cognitive development as they navigate multicultural environments [32].

5. Theoretical and Practical Implications

Theoretically, this study integrates CRT, Self-Determination Theory, identity theories, cognitive learning theories (Vygotsky's ZPD; Ausubel's anchoring), and social theories (Social Interdependence and Social Identity) within a single empirical framework. Practically, the findings encourage LPTKs to embed local cultural practices in their curricula so that preservice teachers gain culturally relevant learning experiences while strengthening social cohesion in multicultural classrooms. In practice, the results also underscore the need for more culturally responsive curricula in LPTKs.[33] emphasize the effectiveness of CRT approaches in science teaching,[34] highlight the importance of multicultural competence for preservice teachers in their professional development [35]. Accordingly, this study offers a conceptual contribution by integrating cognitive learning theory and social identity theory within the context of multicultural education.

6. Limitations and Future Directions

This study is limited by its geographic scope and reliance on self-report data. Future research should employ longitudinal designs and mixed-methods approaches to deepen understanding of the long-term dynamics of cultural value internalization.

Conclusion

This study demonstrated that Culturally Responsive Science Instruction (Pembelajaran Sains Responsif Budaya, PRB) grounded in the Hem Re Yegokhe practice had a significant effect on preservice teachers' affiliation motivation in Papua's multicultural context. The effect operated not only directly but also through Cultural Exploration Experience, which functioned as a partial mediator. Supplemental analyses confirmed that students with prior cultural experience were better prepared to build social affiliation than peers without comparable experience. Theoretically, the study enriches the literature by integrating Culturally Responsive Teaching, Self-Determination Theory, identity theory, cognitive learning theories (Vygotsky's Zone of Proximal Development; Ausubel's anchoring), and social theories (Social Interdependence; Social Identity) within a single empirical framework. This integration underscores that affiliation motivation in multicultural instruction is shaped not only by pedagogical strategies but also by psychosocial mechanisms and students' cultural experiences.

Practically, the findings highlight the urgency for teacher education institutes (Lembaga Pendidikan Tenaga Kependidikan, LPTK) to embed local cultural practices as core curricular elements to strengthen social connectedness and classroom cohesion. This strategy is especially pertinent for students from 3T regions who are vulnerable to affiliation barriers in multicultural academic settings. The study's contribution lies in providing empirical evidence that locally grounded cultural instruction can bridge multicultural pedagogy and educational practice in marginalized regions. Nevertheless, limitations include the geographically bounded context and reliance on self-report data. Future research should adopt longitudinal and mixed-methods designs and examine additional cultural contexts across Indonesia to broaden generalizability. In sum, PRB functions not only as a pedagogical strategy but also as a sociocultural mechanism that can strengthen students' affiliation motivation and contribute tangibly to the development of multicultural education in Indonesia.

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