US-China Education Review A, April 2026, Vol. 16, No. 4, 233-237
doi: 10.17265/2161-623X/2026.04.007

Enhancing Pre-service Teachers' Science Literacy Through Manaakitanga Pedagogy in the Context of Cultural Flows: A Sino-New Zealand Collaborative International Course

WANG Zhiling
Hangzhou Normal University, Hangzhou, China

Drawing on Appadurai's (1996) theory of cultural flows—specifically the concepts of disjunctureand recontextualization—this qualitative case study examined pathways to enhancing elementary pre-service teachers' science literacy through the Manaakitanga pedagogical framework. The study was situated in a co-taught Sino-New Zealand international course delivered across five cohorts (2019-2024), involving 250 pre-service teachers. All participants submitted written artifacts, and 30 completed pre- and post-course semi-structured interviews. Thematic analysis (Braun & Clarke, 2006) yielded three findings. First, localizing instructional content with Chinese cultural elements activated meaning-making through recontextualization. Second, the co-teaching model functioned as a "contact zone" enabling cross-field flow of theoretical and practical knowledge. Third, mathematical problem-posing served as a mediating mechanism connecting content and pedagogical localization, simultaneously fostering cultural consciousness and pedagogical imagination. The findings suggest that dual localization—of content and strategy—can mitigate pre-service teachers' "competence fracture" (i.e., high affect, moderate cognition, low ability). This study provides empirical operationalization of cultural flow theory within teacher education, extending its application from macro-societal to micro-classroom practices.

Keywords: cultural flows, science literacy, problem-solving

Background

Against the backdrop of accelerating global flows of educational knowledge, the localized appropriation of foreign pedagogical approaches has emerged as a pivotal strategy for enhancing teacher competence in China. However, cultural flow is not unidirectional transplantation but a complex process involving value conflicts, practical variation, and meaning (re)construction. Following Appadurai's (1996) theorization of cultural flows as characterized by disjuncture and unevenness, the cross-border transfer of educational knowledge entails context-specific recontextualization and power-laden negotiation. Existing research has largely focused on outcome validation following method introduction (e.g., Zhou, Cao, & Gao, 2023; Huang, Luo, & Bao, 2020), but has scarcely addressed the transformative mechanisms embedded in cultural flows, and even less so how such processes dynamically shape the structural configuration of teacher competence—i.e., the interrelationships

Acknowledgement: This paper is supported by the University-Level Teaching Reform Project of Hangzhou Normal University. Chinese Education Modernization Research Institute of Hangzhou Normal University.
WANG Zhiling, Ph.D., Assistant Professor, Jinghengyi School of Education, Hangzhou Normal University, Hangzhou, China.

among its cognitive, affective, and behavioral components. A key empirical question emerges: why do certain empirically validated foreign instructional approaches (e.g., problem-solving-based teaching) fail to systematically enhance pre-service teachers' professional competence after cross-cultural embedding, and instead relate to a decoupled pattern of high affect but moderate cognition and low ability (Liu, 2024)? Grounded in the theory of cultural flows, this study investigates the embedding practices of foreign pedagogical methods in cultivating elementary pre-service teachers' science literacy in China, aiming to uncover the generative mechanisms and optimization pathways of teacher competence under conditions of cultural flow.

Literature Review

The theory of cultural flows has evolved from a unidirectional model to a multidimensional and interactive framework. Gu (2003) proposed a unidirectional law whereby "high culture flows toward low culture". In contrast, Appadurai (1996) focused on the complexity and disjuncture of global cultural flows. Whereas Gu emphasizes directional hierarchy, Appadurai highlights fragmentation and multidirectionality. These two perspectives embody an inherent tension that has shaped the subsequent development of the field. Chinese studies (Hu, 2025; Wu et al., 2025; Han & Yang, 2025; Yang et al., 2020) have largely concentrated on the spatial representation of cultural flows, paying insufficient attention to power struggles and dynamic generative mechanisms.

In educational research, the application of cultural flow theory has largely centered on cultural capital and educational equity. However, most studies treat cultural capital as a static entity rather than a dynamic resource. Jiang (2018) distinguished between "cultural reproduction" and "cultural mobility" models, noting that both overlook the mediating role of habitus. Sun (2010) revealed the dual pathways through which families with different educational backgrounds achieve either upward mobility (for lower-educated families) or cultural reproduction (for higher-educated families) via cultural activities. Overall, Chinese research has emphasized the shaping role of cultural capital in educational equity while neglecting the micro-political dynamics embedded in knowledge transmission within schools.

Research methods in this field are predominantly qualitative (e.g., Huang & Zhang, 2025), quantitative with a spatial focus (e.g., Wu et al., 2025), or theoretical/conceptual (e.g., Hu, 2025). Each approach has its own limitations: qualitative studies often lack sufficient sample representativeness; quantitative studies tend to oversimplify the socio-cultural contexts in which cultural flows occur; and theoretical analyses remain empirically ungrounded. Collectively, these limitations have left a critical gap in understanding the micro-mechanisms of cultural flow within school education, and the combination of multiple approaches remains underutilized.

In China, existing research on science literacy among pre-service teachers has been approached from multiple dimensions. At the theoretical level, a"three-dimensional, five-level" model of science literacy (Liu, 2024) and an indicator system for professional literacy (Li, 2021) have been proposed. At the empirical level, studies have revealed a common predicament of unbalanced literacy development among pre-service teachers (Liu, 2024), characterized by a decoupling of cognition from ability and the coexistence of high affective engagement with low ability (Huang, Luo, & Bao, 2020). Research perspectives have expanded from science literacy to include STEM literacy, information literacy, and humanistic literacy. Methodologically, existing work has emphasized the integration of quantitative assessment with qualitative causal analysis (Fu, 2015). Overall, current research provides an empirical basis for the cultivation of pre-service science teachers, yet the cross-regional adaptability of literacy assessment tools and the specificity of cultivation pathways remain underexplored.

Despite these contributions, a critical theoretical perspective remains absent. Research on the cultivation of pre-service science teachers in China has yet to incorporate the theoretical lens of cultural flows. Consequently, it fails to reveal the dynamic contestations and generative mechanisms among different cultural forms—such as disciplinary knowledge, local traditions, and pedagogical norms—in the process of literacy development. Adopting a cultural flow perspective would illuminate how these cultural forms interact and shape pre-service teachers' literacy trajectories.

Research Question

This study, grounded in the Chinese local context, focuses on pathways to enhancing pre-service teachers' science literacy against the backdrop of cultural flows. Specifically, it investigates whether Manaakitanga—a Māori pedagogical concept from New Zealand—contributes to improving pre-service teachers' science literacy.

Methodology

This study employed a qualitative case study design to investigate pathways to enhancing elementary pre-service teachers' science literacy within the Manaakitanga pedagogical framework—a Māori concept emphasizing care and culturally responsive pedagogy. The study was situated in a "co-taught" international course for second-year undergraduates, delivered jointly by a university-based teacher educator and an experienced elementary school teacher. Across five consecutive cohorts, a total of 250 pre-service teachers participated. Data sources included classroom observations (40 hours), written artifacts (problem-posing task sheets and assignments), and pre- and post-course semi-structured interviews with a purposive sample of 30 participants. The pedagogical intervention encouraged participants to generate mathematical problems individually or in small groups and to present their problems to the whole class. Thematic analysis, following Braun and Clarke's (2006) six-phase framework, was employed with inductive coding; two researchers independently coded a 20% subsample (inter-coder agreement = 87%). The analysis focused on identifying patterns of change in pre-service teachers' science literacy across cognitive, affective, and ability dimensions. Ethical approval was obtained, and informed consent was secured from all participants.

Conclusion

First, the localization of instructional content significantly enhanced pre-service teachers' meaning-making of mathematical problems and their cultural identity.Integrating Chinese cultural elements—ancient mathematical classics, traditional measurement contexts, and folk numeracy logic—into the Manaakitangaframework reduced pre-service teachers' perceived abstractness of mathematical concepts. In written reflections, participants noted that cultural contexts enabled them to understand "the cultural logic behind the problems" rather than mechanically applying formulas. Classroom observations further confirmed that culturally embedded problems elicited higher originality and contextual relevance in students' problem-posing. These findings suggest that content localization operates not as decorative integration but as a recontextualization mechanism within cultural flows, activating pre-service teachers' meaning-making capacity and thereby alleviating the decoupled pattern of high affect, moderate cognition, and low ability (i.e., "competence fracture"; cf. Liu, 2024).

Second, the co-teaching model, as the core mechanism of pedagogical localization, facilitated the cross-field flow of theoretical knowledge and practical wisdom. The co-teaching configuration—involving a New Zealand expert in Manaakitanga pedagogy and a local university-based teacher educator—formed an iterative cycle of

"theoretical guidance, practical demonstration, and collaborative reflection." Interview data indicated that pre-service teachers widely perceived the co-teaching model as bridging "the practical void of university-only instruction and the theoretical fragmentation of purely school-based observations." Thematic analysis demonstrated that mathematical problems posed in co-taught classrooms were significantly superior to those in single-instructor classrooms in terms of situational authenticity and teaching transformation awareness. From a cultural flow perspective, the co-teaching model essentially constructs what Pratt (1991) termed a "contact zone", where knowledge from different educational fields undergoes negotiation, variation, and recombination, thereby shaping pre-service teachers' integrated understanding of science literacy.

Third, the mathematical problem-posing activity within the Manaakitangaframework functioned as a mediating mechanism connecting content localization and pedagogical localization. Under the guidance of the co-teaching team, pre-service teachers attempted to transform Chinese cultural elements into inquiry-based mathematical problems. This process simultaneously activated cultural consciousness (at the content level) and pedagogical imagination (at the strategic level). Classroom observations revealed that pre-service teachers who successfully integrated cultural contexts into their problem designs exhibited more balanced developmental trajectories across the cognitive, affective, and ability dimensions of science literacy, compared with their peers who did not.

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