Science Teachers' Culturally Responsive Practices in the Context of Distance Education: A Qualitative Study

Michelle Maan, Memorial University of Newfoundland

Background, Context, and Problem

This study explores the implementation of Culturally Responsive Science Teaching (CRST) within rural, distance education in Newfoundland and Labrador (NL), Canada's easternmost province. While distance education was introduced in 1988 to address educational inequities in small, isolated communities, it often overlooks the cultural and rural identities of students. The province's Centre for Distance Learning and Innovation (CDLI) aimed to standardize curriculum access but challenges arise when addressing students' lived experiences and local ways of knowing as students from various rural locations merge for synchronous online learning. The research examines how science educators integrate rural culture into virtual teaching, identifying both challenges and opportunities. CRST is meant to promote equity by connecting science education to students' backgrounds, traditions, and communities. The study contributes to expanding frameworks that make distance science instruction more meaningful, inclusive, and relevant for diverse rural learners across NL.

Significance

For science to be meaningful, it must connect with students' lives, communities, and cultures. Traditional science instruction often forces students to assimilate into a Western scientific worldview, disregarding their cultural identities. In contrast, enculturation occurs when science education aligns with students' everyday experiences and worldviews, fostering deeper engagement. Distance education, while intended to promote equity, can reinforce cultural marginalization if it neglects local knowledge and identity. To ensure inclusivity, CRST must be embedded in distance education with attention to rural contexts.

Purpose and Research Questions

- To explore how NL science teachers are incorporating CRST in their teaching practices by distance.
- This study also aims to support a growing framework for CRST in distance education settings.
- The conceptualization and design for this research is guided by the following questions:

1. How are distance educators making science culturally relevant for students regarding their rural homelands and community cultural identities?
2. What challenges do distance science educators face when implementing CRT in the virtual classroom?

Methodology

The study used qualitative interview analysis with thematic coding for deeper insight. Focus was on science teachers' perceptions and use of CRST in distance learning. A grounded theory approach was employed to develop a theoretical framework for CRST in distance science education. Grounded theory allowed exploration of processes, actions, and interactions based on participants' [teachers'] views. The study followed Corbin and Strauss's (2007) methodology:

- Open coding: generating categories from data.
- Axial coding: selecting a category and fitting it into a theoretical model.
- Selective coding: developing a theory by connecting categories.

Participants

The study involved five high school science teachers from the NL public school system (current and former). All participants had experience teaching science through the CDLI. Teaching experience (both in-person and online) ranged from less than 1 year to over 30 years. Each participant taught one or more science courses (offered in grades 10-12) by distance, including:

- General Science: 1206, 1236, 2200, 3200
- Biology/Biologie: 2201, 3201, 3231
- Chemistry/Chimie: 2202, 3202, 2232, 3232
- Physics: 2204, 3204
- Earth Systems: 3209

Methods, Data Analysis, and Limitations

Data was collected through semi-structured, online interviews using WebEX. Consented audio recordings were transcribed for analysis. Interviews lasted 1–2 hours and followed a consistent question order but allowed space for participant insight and researcher flexibility. Epoché guided the process, balancing objectivity and existing assumptions. Questions covered knowledge of CRST, pedagogy, community inclusion, and challenges. Transcripts were analyzed using MAXQDA software with a grounded theory approach, involving open, axial, and selective coding. Themes emerged through constant comparison, and conceptual saturation was reached after five interviews. Both inductive and deductive reasoning informed theory development. A key limitation was reliance solely on teacher accounts; classroom observations and student input could have enhanced the study's reliability and depth.

CRT and CRST Frameworks

Previous frameworks for CRT and CRST emphasize integrating students' rural and cultural identities to enhance relevance and equity in education. Rurality is defined as a sense of place rooted in heritage and community, closely tied to cultural traditions. CRST encourages respect for cultural diversity through inclusive practices like using local language, traditions, and storytelling.

- Ladson-Billings' CRT model highlights three pillars: academic success, cultural competence, and critical consciousness.
- Extensions by scholars like Mackenzie and Raisinghani stress self-reflection, social justice, and holistic student development.
- CRST frameworks (e.g., Barron et al., Hernandez et al., Stephens) focus on student interaction, content integration, real-world relevance, differentiated instruction, and Indigenous knowledge.

These models promote science teaching that is context-specific, standards-aligned, and rooted in students' lived experiences. Together, these frameworks aim to make learning inclusive, empowering, and culturally meaningful—especially for rural and marginalized students in distance education settings.

Findings

<u>Key Findings Aligned with CRT/CRST Frameworks:</u>

- Teachers lacked CRST terminology but practiced related methods (e.g., authentic education, differentiated instruction).
- Concepts used by teachers included: Individualizing curriculum, Experiential learning, and Place-based education

<u>Authentic Education & Democratic Citizenship Education (DCE)</u>

- Teachers embraced student identity and diversity in learning.
- Practiced critical consciousness by recognizing cultural inequities.
- Reflected principles of DCE: bridging community and classroom, social justice, and equity.

<u>Differentiated Instruction</u>

Teachers' practices aligned with NL science curriculum's principles of:

- Differentiating content (individualization)
- Differentiating process (experiential learning)
- Differentiating environment (place-based education)

Supported CRST models from scholars like Barron et al., Hernandez et al., and Stephens.

Conclusion

<u>CRST Framework for Distance Science Education</u>

Using a grounded theory approach and inductive coding, the analyzed data was compared with existing CRT and CRST literature. This led to a new understanding of CRST in distance science education, organized into three key components:

1. Challenges – physical limitations, curriculum/pedagogical barriers
2. Affordances – fostering safe, respectful, inclusive online classrooms
3. Applications – implementing Culturally Responsive Project-Based Learning (CRPBL) and Culturally Responsive Subject Matter (CRSM) to bridge science with culture

<u>Challenges with CRST Implementation</u>

Lack of Physicality:

- Harder to build relationships, observe students, and conduct hands-on learning
- Poor internet connectivity in rural areas impeded engagement

Curriculum & Pedagogical Constraints:

- Rigid curriculum with limited flexibility
- Lack of CRST content and Indigenous Scientific Knowledge
- Few professional development opportunities

Suggestions for Overcoming Challenges

- Increase CRST content in curriculum guides
- Provide CRST-focused PL for distance educators
- Invest in reliable tech and online learning platforms
- Promote collaborative, culturally responsive teaching environments

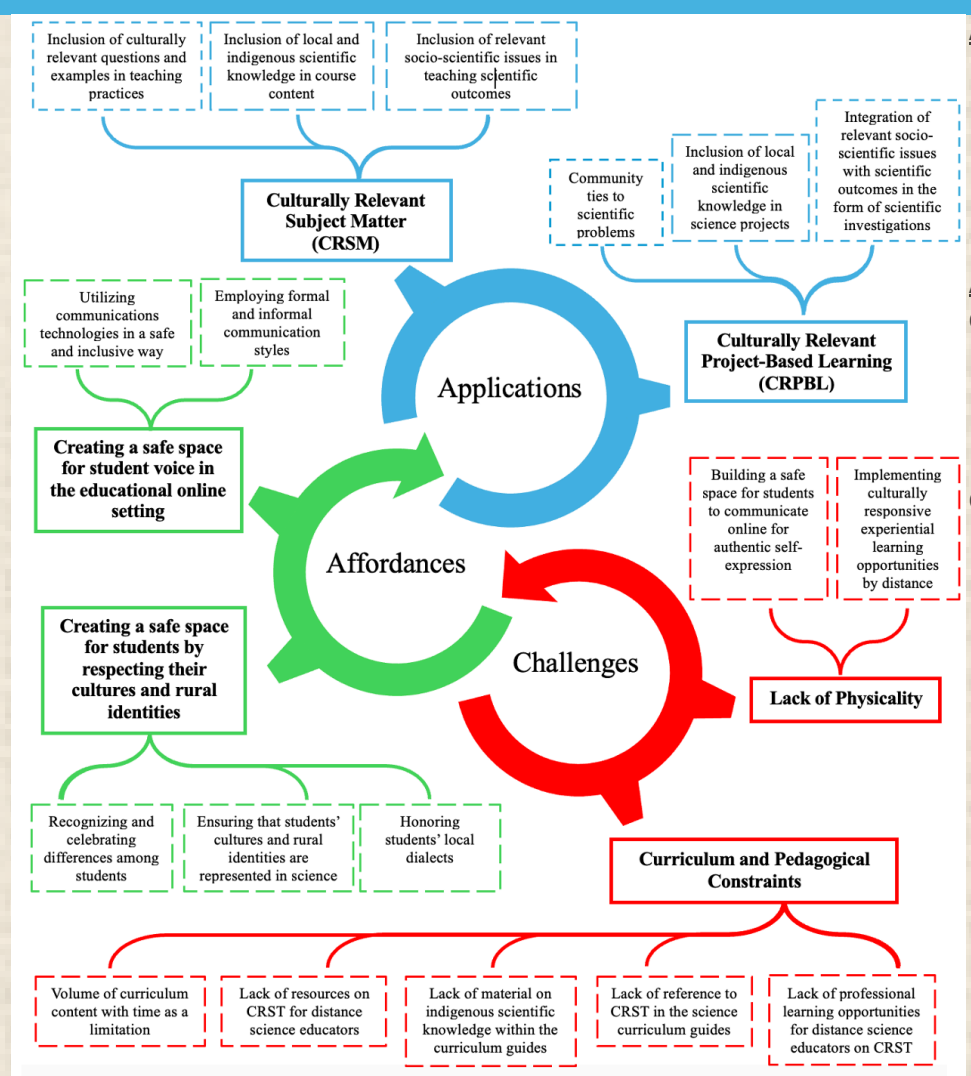

Figure 1. CRST Framework for Distance Science Education

<u>Affordances: Preconditions for CRST</u>

- Creating safe spaces online for:
- Student voice (e.g., informal chat, digital lockers)
- Respecting cultural identities (e.g., dialects, local customs)
- Aligned with CRT pillars: prejudice reduction, academic development, and social justice.

<u>Application of CRST</u>

CRPBL

- Student-led, place-based projects
- Included local issues (e.g., water quality, climate-impact on seal hunt)
- Integrated Indigenous knowledge and socio-scientific issues

CRSM

- Used local examples (e.g., ATVs, fishing)
- Validated community and Indigenous knowledge
- Emphasized culturally relevant content to support engagement

Scan for Full Thesis

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