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Exploring Teacher Candidates' Reflection on Equity-Oriented 5E Lessons from Culturally Responsive Perspectives

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Abstract: This study aims to explore how an equity-focused 5E instruction approach can be aligned with Culturally Responsive Teaching (CRT). We analyzed eight teacher candidates' interviews, focusing on their experiences of planning inquiry-based 5E lessons. Our findings propose that 5E instruction has potential to help teacher candidates make sense of how to create a learning environment to teach science content using students' cultural background knowledge.

Introduction

Research has shown that culturally responsive teacher preparation curricula enhance science teacher candidates' (TCs) confidence in teaching science and improves skills in developing lessons that incorporate multiple perspectives (Yoon & Martin, 2019). However, TCs have limited practice in making sense of Culturally Responsive Teaching (CRT; Gay, 2000). Researchers note that TCs doubt their ability to enact CRT practices and have low confidence in implementing CRT strategies due to lack of knowledge about student diversity and CRT implementations in diverse educational environments (Siwatu et al., 2016).

We designed methods courses to support TCs to plan equity-focused lessons implemented within a caring learning environment to support diverse students' achievement using a 5E lesson planning approach. The 5E model supports students' exploration of and engagement with science phenomena to extend their understanding of new concepts using their background knowledge. Therefore, it can make a space for TCs to consider culturally responsive approaches. In this vein, we asked: How do experiences of reflecting on planning 5E lessons impact TCs' perspectives on science teaching?

Theoretical framework

CRT recognizes that when knowledge and skills are situated within students' lived experiences, students become more interested, learn more thoroughly, and take the new content more meaningfully (Gay, 2000). In turn, the achievement of diverse students improves when they learn through their cultural and lived experiences (Ladson-Billings, 1994; 1995). This study focuses specifically on the CRT approach which addresses how TCs consider how to demonstrate caring and build learning communities.

5E instruction offers a potential space aligned with CRT where TCs can consider how to design learning environments for diverse students that draw on students' backgrounds to understand science concepts and share ideas with others. The 5E instructional model focuses on interactions between academic content and how students process content based on their prior understandings (Bybee, 2006). 5E is inquiry-based and consists of 5 phases: Engagement, Exploration, Explanation, Elaboration, and Evaluation. Each E guides teacher to invite students' prior knowledge (Engagement), bridge with new ideas (Exploration), share their understanding (Explanation), elaborate and extend the understandings (Elaboration), and to evaluate students' achievement (Evaluation). Building on previous research that has demonstrated how the 5E lesson approach supports cultural responsivity (Watson, 2021; Yoon & Martin, 2019), we examined how TCs experiences of planning the 5E model within equity objectives align with CRT outlined by Gay (2002).

Methods and analysis

We focused on TCs' responses to post-course interviews to understand how their experiences reflecting on the equity-oriented 5E lessons impacted their perspectives on science teaching. Then, we considered how their reflections aligned with CRT. Data for this study comes from methods courses that prepared TCs to teach PreK-5 science and supported TCs' development of equity-focused orientations toward science teaching. As part of the course, TCs were assigned to create unit plans using the 5E instructional model. In order to support TCs to take up equitable science teaching approaches, we asked TCs to include equity objectives in their unit plan using the

four equity-driven approaches identified by NASEM (2022): access, identity, agency, and social justice. We focused on eight TCs' interviews in which TCs reflected on their experience of planning equity-focused 5E instruction. We used pseudonyms chosen by the TCs. We conducted inductive coding (Charmaz, 2006) and analyzed the data with the constant comparative method (Strauss & Corbin, 1990).

Results

Our analysis presents three themes where TCs discussed equity-oriented 5E instruction in ways that align with CRT principles: bridging science with students' background knowledge, considering students' multiple ways of learning, and elevating students' motivation and participation.

Bridging science with students' background knowledge

All the TCs described that the equity-oriented 5E instructional model was different from their educational experiences in science, especially emphasizing how exploring phenomenon can bridge science content and students' background knowledge. Two TCs, Ella and Solomon Gatsby, emphasized how the 5E instructional model has potential to allow students to understand scientific concepts by connecting to and expanding their background knowledge while students explore the science phenomenon. Riley's reflection built on this observation, noting that "students might be considering things in a different light or based on their own experiences." The TCs also emphasized that the *Exploration* phase in particular invites students to explore new ideas using their background knowledge and extends their understanding of the concepts, which can encourage students to connect their daily experiences to scientific content. This connects to the CRT approach because it supported TCs to realize the 5E's potential for building culturally responsive learning environments that make spaces for students to learn new knowledge by using their experiences and knowledge as a cultural scaffold.

Considering students' multiple ways of learning

Six of the eight TCs' reflections emphasized that every student has a different way of learning. TCs attended to how the *Exploration* and *Engagement* phases enabled them to invite students' approaches to scientific concepts, allowing students to make sense of scientific concepts in their own ways. TCs described their awareness of individual students' way of sensemaking as students' smartness. Lucy mentioned, "every student has their way of being smart and finding that out for each student is really important." Solomon Gatsby noted that students' multiple ways of learning "can't be narrow because every child is different." Riley elaborated that considering students' approaches and perspectives made the TCs more prepared for different ways of understanding scientific concepts. TCs observed how equity-oriented 5E lessons have potential to elicit students' ways of sensemaking. This awareness can also be aligned with the CRT approach of demonstrating caring. TCs learned how to observe individual students to build a learning environment that cares for students' different cultures, acknowledges their cultural characteristics, experiences, and perspectives, and understands students' own ways of learning.

Elevating students' motivation and participation

Reflections of four TCs emphasized that the *Exploration* phase of 5E instruction can make science class "more interactive and student-centered" (Allie Meehan). TCs emphasized that allowing students to explore a phenomenon can support students to "slowly take on a task" (Skylar). The TCs also recognized that students' participation and interaction can lead to students sharing prior knowledge rooted in their cultures. Lucy pushed this awareness even further, noting that students can share different perspectives by "getting to know those [phenomenon] and then bringing them [cultural knowledge] into the classroom or finding different [ideas from] each other." Overall, TCs emphasized that 5E lessons support students to explore the given science content. This enables connections with the CRT approach of building learning communities. TCs recognized that exploration during the 5E lessons became a space for students to increase their motivation and participation by using their own experiences in learning activities and also a space for cross-cultural communication among students as they share understandings that stem from different cultures.

Discussion

This study explored how the 5E instruction designed toward equitable science teaching can make space for TCs to connect to a CRT approach. Phenomenon-centered instruction helps TCs learn how to invite students' knowledge into learning environments, develop a community of caring, and teach students through their cultural background knowledge. This study also contributes to the teacher education field by providing insights into TCs' sensemaking toward more expansive and culturally responsive approaches to teaching.

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