PRESERVICE TEACHERS KNOWLEDGE AND APPLICATION OF CULTURALLY RESPONSIVE TEACHING TECHNIQUES IN MATHEMATICS INSTRUCTION

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Abstract
Preservice teachers should be able to identify culturally responsive teaching (CRT) techniques and discuss the use of those techniques in future classrooms. It is challenging to infuse these techniques into typical preservice courses, especially concerning mathematics. The researchers focused on information and activities in one course with the intention to increase knowledge of techniques for application in their field placements and future classrooms. Level of knowledge was measured by performance on graphic organizers, a family and community research assignment and group writing assignments. Results indicate that a majority improved knowledge and appropriate statements about applying CRT techniques during mathematics instruction.

1 INTRODUCTION
Culturally responsive teaching is integrated in teacher education program and many teacher educators and researchers advocate culturally responsive teaching practices ([1] Gay, 2010; [2] Ladson-Billings, 2001). Even though the importance of culturally responsive teaching is discussed for more than two decades (e.g., [3] Ladson-Billings 1994), limited research has been conducted and only few examples are evident in mathematics classrooms. This study intended to introduce CRT to preservice teachers and prepare them to understand CRT strategies and use CRT techniques in practice, especially in teaching mathematics.


Approaches that are considered culturally responsive include, developing materials that are culturally relevant, modifying instruction to meet students’ prior knowledge, providing context for instruction that is familiar, using cooperative learning strategies, using model-based approaches, and encouraging instructor reflections about how students are progressing ([11] Bransford, 2000; [12] Eglash, Bennett, O’Donnell, Jennings, Cintorino, 2006; [13] Villegas & Lucas, 2002).

In the mathematics classroom, ‘making sense of problems’ and ‘constructing viable arguments and critique the reasoning of others’ are particularly important practice standards in 21st century education ([14] CCSS, 2010). These standards can be implemented through social interactions, and teacher’s knowledge and skills for social construction play a critical role in student’s success in learning mathematics. Also, “constructs of mathematical knowledge and an individual’s relationship to mathematics are highly interpretive and are influenced greatly by the individual’s experiences with mathematics, many of which have been framed by teachers.” ([4] Bonner, 2014, 380) Therefore, it is important for the researchers to investigate the ways in which preservice teachers define CRT and assign meaning to effective ways to use CRT to teach mathematics.

2 METHODOLOGY
The objectives of this study are to investigate preservice teachers’ knowledge and use of culturally responsive teaching (CRT) techniques in the teaching of mathematics. The study focused on the impact of information and activities presented in the major level course, Introduction to Exceptional
Children in terms of students’ perceived knowledge and use of culturally responsive teaching techniques in P-9 mathematics instruction.

The following research questions guide the study:

1. What are effective ways to improve preservice teachers' knowledge of culturally responsive teaching for mathematics?

2. To what extent do learning about culturally responsive teaching in a college course prepare preservice teachers identify the CRT techniques used in P-9 math classroom?

The researchers anticipated that preservice teachers should be able to identify culturally responsive teaching techniques and discuss the use of those techniques with currently practicing P-9 teachers after taking the course.

An explanatory sequential mixed methods design were used ([15]Creswell, 2015). Quantitative data were analyzed first using statistical methods, and qualitative data were used to validate the quantitative results. This mixed methods design integrates both data types and draws interpretations using the strengths of both sets to understand the research problem.

Quantitative Data: Preservice teachers were asked to respond to questions regarding perceived knowledge and the use of CRT. Questions include how cultural and linguistic diversity affect classrooms; and define key concepts associated with CRT such as culture, multiculturalism, multicultural education, and bilingual education. For the purpose of this study, we defined the key CRT concepts as follows and measured the preservice teacher’s knowledge of CRT using these definitions:

- **Culture**: attitudes, values, belief systems, norms, and traditions shared by a particular group of people that collectively form their heritage.
- **Multiculturalism**: more than one culture; acknowledges basic commonalities among groups of people while appreciating their differences.
- **Multicultural Education**: ambiguous concept that deals with issues of race, language, social class, and culture as well as disability and gender. Bilingual Education: educational approach whereby students whose first language is not English are instructed primarily through their native language while developing competency and proficiency in English.
- **Bilingual**: an educational approach whereby students whose first language in not English are instructed primarily thought their native language while developing competency and proficiency in English.

Also, preservice teachers were asked to list at least 4 guidelines for selecting and evaluating instructional materials. The following criteria were used to measure their knowledge:

- Are members of diverse racial/cultural groups, men and women, and people with disabilities shown engaged in a broad range of social and professional activities?
- Are members of a particular culture or group depicted as having a range of physical features (hair color, hair texture, variations in facial characteristics and body build)?
- Will students from different ethnic and cultural backgrounds find the materials personally meaningful to their life experiences?
- Are the materials free of ethnocentric or sexist language patterns that may make implications about persons or groups based solely on their culture, race, gender, or disability?

Each item was analyzed to evaluate the degree of agreement among students regarding that issue or topic. Descriptive statistics and frequency distributions were examined to determine the mean responses, standard deviation, and assumptions of normality.

Qualitative Data: In-class activities and assignments including graphic organizers detailing important points from the readings and answers to group discussion questions were analyzed to investigate how their understanding of instructional strategies progress. Students were also asked to interview their cooperating teacher (CT) as part of a Family and Communities assignment. This assignment asked them to research the culture of the community where they were doing field placement. They were to determine ways to learn about the culture of the community and why that would lead to better success during instruction.
Students’ graphic organizers, discussions, reflections, and interview data analysis were coded thematically by using standard qualitative analysis techniques. Content analysis and analytic induction were employed in analysis ([16]Berg, 1989).

3 RESULTS

Knowledge of culturally responsive teaching

The students responded to questions regarding the information from the textbook and readings. The number represents the number of students who successfully stated the basic knowledge.

How does cultural and linguistic diversity affect US classrooms? 53

Define culture 53, multiculturalism 53, multicultural education 53, and bilingual education 52.

List at least 4 guidelines for selecting and evaluating instructional materials.53

Students were then asked to apply the information from their readings into graphic organizers and how this information applied to instruction during mathematics. Ten students completed the organizers on a basic level. Twenty students completed the organizers in more detail, but not enough link to mathematics instruction and 13 students completed the organizer with application of the information clearly evident.

Example of a basic organizer- Minimal information.

1 Math makes students think and requires student engagement and attention.
2 Math is used in all cultures and can be used as a structure and basic foundation of the classroom.

Example of an organizer with adequate CRT information but no obvious connection to mathematics instruction is shown in Figure 1. Figure 2 shows the CRT information with a connection to mathematics instruction.

![Figure 1. Adequate CRT information-Lacks Connection](image-url)
4 CONCLUSIONS

The preservice teachers in this study did improve their knowledge of CRT, but not all were clear on application to the field and some failed to ask their cooperating teachers in depth questions about what techniques they were observing during mathematics instruction. The researchers intend to make some changes to instruction and pacing based on these results. Consistent use of graphic organizers appear to increase comprehension and should be used more consistently in this course. Research articles to support the text chapters lead to better comprehension than reading the text alone, so this will be applied to more subjects in this course. The timing of the cooperating teacher interview was late in the semester for the first group and the time between introducing the topic and the interview was spread so far apart that some students didn't ask all the questions. The second semester the time between introducing the topic and the interview was shorter and lead to better interviews. The due date of the Family and Community paper was moved to mid semester, so students had more time to focus on the assignment, rather than it being one of the many assignments due at semester’s end. Finally seeking cooperating teachers that have a strong knowledge of CRT is a future goal of our teacher preparation program. Preservice teachers need models of CRT in mathematics to underscore the theory they are learning at the university.

REFERENCES


