Research Article https://doi.org/10.12973/eu-jer.12.3.1425

European Journal of Educational Research
Volume 12, Issue 3, 1425 - 1435.
ISSN: 2165-8714
https://www.eu-jer.com/

Embracing Multicultural Education: How Preservice Mathematics Teachers' Attitudes Towards Multicultural Pedagogies Differ From Their Non-Mathematics Peers

Matthew D. Gromlich[*]
Louisiana State University Shreveport, United States of America

Peter D. Wiens
University of Nevada Las Vegas, United States of America

Heather Whitesides
Louisiana State University Shreveport, United States of America

Received: January 25, 2023 ▪ Revised: April 1, 2023 ▪ Accepted: May 13, 2023

Abstract: Secondary subject subcultures, differing in status, perceived sequentiality, and scope, have been shown to form within departmental content areas. This study aimed to determine if preservice secondary teachers also exhibited attributes of secondary subcultures. Through the Teacher Multicultural Attitude Survey and the Culturally Responsive Teacher Self-Efficacy Scale, this study revealed that subcultures also occur within preservice teachers, specifically preservice mathematics teachers and preservice English teachers, with regards to multicultural awareness and attitudes. The results from this study support the need for purposeful and consistent focus on multicultural education and Ethnomathematics education in mathematics education programs. In doing so, secondary mathematics students can obtain a robust background in multicultural education before entering the PK-12 classroom. When they do enter the PK-12 classroom, they will be able to empower all students that they teach.

Keywords: *Ethnomathematics education, multicultural awareness, preservice teachers, secondary subject subcultures.*

To cite this article: Gromlich, M. D., Wiens, P. D., & Whitesides, H. (2023). Embracing multicultural education: How preservice mathematics teachers' attitudes towards multicultural pedagogies differ from their non-mathematics peers. *European Journal of Educational Research, 12*(3), 1425-1435. https://doi.org/10.12973/eu-jer.12.3.1425

Introduction

The process of teaching and learning in the United States has often been defined as a generic activity, leading research and policy to focus on schools as whole entities. In reality, schools are often a collection of subcultures with differing beliefs, norms, and practices (Guidi & Salvatore, 2013; Venuleo et al., 2016). These subcultures' beliefs and norms impact teachers' views of instruction, pedagogy, and even perceptions of educational policy and reform (Barth, 2002; Brady, 2008; John & La Velle, 2004; Todd, 2012).

While many lower-elementary schools are organized by grade level, many upper-elementary and secondary schools are organized by departmental content areas (Baroody, 2017; Eichhorn & Lacson, 2019; Jacob & Rockoff, 2011). Teacher subcultures that form within these departmental content areas are referred to as secondary subject subcultures (Brady, 2008; Todd, 2012). Secondary subject subcultures differ in status, perceived sequentiality, and scope (Brady, 2008; Grossman & Stodolsky, 1995; Todd, 2012). As these subcultures have become ingrained in the U.S. secondary school experience, there needs to be more investigation of the differences among teachers in these areas. Additionally, research needs to address if these disparities are beneficial or harmful to student success.

Research Question

Though attitudinal differences have been seen between secondary subject subcultures of in-service teachers (Grossman & Stodolsky, 1995; Stodolsky & Grossman, 1995), this study questioned whether the same differences can be observed in preservice secondary teachers early in their teacher training programs.

The main goal of this study was to determine if secondary subcultures existed amongst preservice secondary teachers and, if so, how preservice secondary teacher groups differed. Based on the relevant literature, the following guiding question emerged: Do preservice secondary teachers' attitudes towards multicultural education differ with regards to secondary endorsement area, as measured by the Teacher Multicultural Attitude Survey (TMAS) and/or the Culturally

[*] **Corresponding author:**
Matthew D. Gromlich, Louisiana State University Shreveport, United States. ✉ matthew.Gromlich@lsus.edu

Responsive Teacher Self-Efficacy Scale (CRTSE) inventories (Ponterotto et al., 1998; Siwatu, 2007)? Analyzing this research question will provide additional evidence to the field regarding the preservice secondary teacher subcultures and differences between subculture groups in regard to multicultural awareness and attitudes.

Research Design

The goal of this study was to determine if preservice secondary mathematics subcultures differed from other preservice secondary subject subcultures with regards to attitudes towards multicultural education and their perceived ability to meet the needs of culturally and linguistically diverse students. Previous literature identified the existence of subcultures in in-service teachers with regards to views of tracking, multi-level grouping, and curriculum sequentiality (Brady, 2008; Grossman & Stodolsky, 1995; Stodolsky & Grossman, 1995; Todd, 2012). This study focused specifically on preservice teachers' attitudes towards multicultural education and culturally responsive teaching self-efficacy using two valid and reliable measurement scales: the Teacher Multicultural Attitudes Survey (TMAS; Ponterotto et al., 1998) and the Culturally Responsive Teacher Self-Efficacy Scale (CRTSE; Siwatu, 2007). As the U.S. demographics change, it is important to understand how secondary teachers in different content areas differ in their attitudes towards diverse learners.

Theoretical Framework

This paper uses secondary subject subcultures as a theoretical framework through which research design and implementation is based (Brady, 2008; Grossman & Stodolsky, 1995; Todd, 2012). Secondary subject subcultures were identified by students' selected secondary education endorsement areas. This secondary subject subculture grouping allowed analysis of attitudes towards multiculturalism and culturally responsive teacher self-efficacy to determine if specific views and beliefs can be attributed to certain preservice secondary teacher subcultures.

In the United States, status has been assigned to core subjects for as long as there have been secondary schools (Ornstein & Hunkins, 2018). Mathematics and English courses are often required for college entrance and are highly tested subject areas, as evidenced by the No Child Left Behind (NCLB) Act which only tested mathematics and English (No Child Left Behind Act, 2002). In fact, some states continue to only administer state-wide standardized tests in mathematics and English, which are then used for school accountability determinations.

Besides there being differences in the perceived emphasis on certain content areas, secondary subjects also differ in their curricular approaches. For example, in regard to perceived sequentiality, each academic area may take different approaches. Specifically, in mathematics, teachers and students have come to accept that a certain sequence is required for knowledge and understanding (Brady, 2008; Stodolsky & Grossman, 1995; Todd, 2012). A mathematics course sequence typically consists of the following order: Pre-Algebra, Algebra I, Geometry, and then Algebra II. Students are not allowed to skip Algebra I and proceed to Geometry.

In English, however, course sequentiality is often less rigid (Grossman & Stodolsky, 1995). English courses often do not have sequentiality in subject material. While students use knowledge from previous courses, they do not necessarily have to know American literature to be able to take a Shakespeare course (Grossman & Stodolsky, 1995).

Scope of secondary courses also varies depending on the subject. English courses are broader in content and curriculum, with autonomy and flexibility in what to include or not include in the curriculum (Grossman & Stodolsky, 1995; Stodolsky, 1988). English teachers also have been encouraged for many years to include minority viewpoints in their courses, while mathematics teachers often view their content as strict and direct, with very little ability for autonomy or content choice (Baroody, 2017; Eichhorn & Lacson, 2019; Grossman & Stodolsky, 1995).

Due to these differences in scope and sequentiality, secondary teacher subcultures have developed individual identities. Siskin's (1994) study of secondary mathematics and English departments suggested that mathematics and English departments across schools were more alike than the mathematics and English department at the same school; that is, the subject subcultures are pervasively similar regardless of school (Siskin, 1994).

Literature Review

Secondary subject subcultures not only vary in their views of tracking, multi-level grouping, and curriculum sequentiality (Brady, 2008; Grossman & Stodolsky, 1995; Stodolsky & Grossman, 1995; Todd, 2012), but in their views of multicultural education as well. This literature review shows how teacher attitudes towards multiculturalism and culturally responsive teaching are important concepts to include when describing secondary subject subcultures.

Teacher Attitudes Towards Multicultural Education

Teacher attitudes towards multicultural education are an important aspect of teaching and learning (Abacioglu et al., 2020). Attitudes can be defined by a way of thinking or feeling about someone or something and are typically reflected in a person's behavior. Attitudes are developed through upbring, experiences, community, and culture. In our communities, these attitudes may be ever changing; however, teacher preparation programs have not enacted enough practices to prepare teachers for their ever-changing students (Cadenas et al., 2021).

Many factors influence teacher's attitudes, which may include lack of personal experience of working with students who have different cultural backgrounds than their own, lack of processional training, and bias (Adegbola, 2022; DeCuir-Gunby & Bindra, 2022).

With 52% of American students identifying as people of color (Hussar et al., 2020), there is a need for multicultural awareness and cultural competency amongst our PK-12 teachers (Hamdan & Coloma, 2022). Moreover, trends show racial and ethnic minorities comprising nearly half of all children in the United States and a majority of all immigrants in the United States (Federal Interagency Forum on Child and Family Statistics, 2018; Zong et al., 2019).

All teachers must be equipped with skills to meet the needs of culturally diverse learners (Phinney & Rotheram, 1987). It is only through a solid multicultural understanding and framework that all students have an equal opportunity to achieve success (Gay, 2005). Adegbola (2022) validated this need and additionally explored the practices for incorporation. This included culturally responsive teaching concepts such as utilizing student's culture as a vehicle of learning and field experiences to practice.

Multicultural teacher education is necessary in today's educational landscape (Beckett & Kobayashi, 2020; Cicchelli & Cho, 2007). The attitudes and expectations that teachers hold towards diverse learners are a vital component of student learning and achievement (Abacioglu et al., 2020; Lee et al., 2010; Loadman et al., 1999). Without proper training and support, teachers may develop negative perceptions of the children they teach or underestimate students' abilities (Aaronshon et al., 1995; Gallego, 2001). Negative or misguided perceptions often affect students' abilities to learn and succeed (Aaronshon et al., 1995). Understanding the attitudes towards multicultural education and pedagogy in secondary subcultures is necessary to continuously increase teaching and learning in schools (Abacioglu et al., 2020).

Teacher Multicultural Self-Efficacy

Self-efficacy, popularized by Albert Bandura (1997), is the belief in one's ability "to produce desired effects by their own actions" (p. vii). The greater one's self-efficacy, the more likely a person is to attempt difficult activities. When someone believes they can accomplish a goal, they are much more likely to try, even in the face of obstacles and adversity (Bandura, 1977; Maddux, 2002).

Multicultural self-efficacy applies the principles of self-efficacy to the topic of multiculturalism. Because teacher attitudes influence student achievement and outcomes, (Nye et al., 2004; Shields, 2004), it is necessary for teachers to embrace a multicultural pedagogy within their classrooms. Neglecting to incorporate multicultural pedagogy detracts from the overall learning environment for students whose cultures differ from the dominant culture (Yildirim & Tezci, 2016).

Teachers who have a high multicultural self-efficacy believe that multicultural education is necessary in their classrooms; only through the incorporation of multicultural education can all students achieve and succeed (Yildirim & Tezci, 2016). Highly multicultural self-efficacious teachers are able to design instruction based on differences in culture, language, religion, and nationality (Kaya, 2013) and will use various teaching methods and techniques to teach and evaluate learning of all students (Spanierman et al., 2011; Taylor & Sobel, 2001). As previously noted, through the review of relevant literature we identified the following research question: Are early-program preservice secondary mathematics teachers different from their peers with regards to attitudes towards multicultural education and culturally responsive teacher self-efficacy? In the following section, we provide elaboration on our methods used in investigating this research question.

Ethnomathematics

There are many terms that can be used to describe multicultural pedagogies in education. Each discipline over time has identified key terms and features that are unique to their subject subculture. Over the last decade, the term Ethnomathematics has become one of the central terms used to describe multicultural education in mathematics (Albanese et al., 2017; Barta & Shockey, 2006, 2016; Cimen, 2014; D'Ambrosio & Rosa, 2017; Orey & Rosa, 2007). The term Ethnomathematics is used, because it embraces "wider studies centered on the ways in which cultural and social context affects the process of generation, organization, and communication of knowledge" (Albanese et al., 2017, p. 307).

In traditional U.S. education, mathematics is not typically taught using connections to other cultures (Barta & Shockey, 2016). Teachers tend to teach mathematics using a "western-techno mathematics" framework perpetuating the 15th-century Cartesian worldview (National Council of Teachers of Mathematics, n.d.). For students whose culture does not match the Western, Eurocentric worldview, this creates cultural obstacles for student success in mathematics (Barta & Shockey, 2016). Additionally, because teachers tend to not be familiar with interdisciplinary mathematics and mathematics of other cultures, teaching professionals tend to not embrace Ethnomathematic principles in their teaching (Orey & Rosa, 2007).

With 52% of American students identifying as people of color, (Hussar et al., 2020), and with achievement gaps prevalent "between students of differing genders, cultures, ethnicities, and socio-economic backgrounds" (Johnson, 2009, p. 289), there is a need for multicultural awareness and education within teacher education programs (Cicchelli & Cho, 2007). It is, therefore, necessary to bring Ethnomathematics to the school setting.

Supporting and promoting Ethnomathematics restores cultural dignity, enhances creativity, and reinforces cultural self-respect (D'Ambrosio & Rosa, 2017). Recent studies have shown that students who are taught using Ethnomathematic lessons and principles have improved problem-solving abilities in mathematics (Irawan et al., 2018) and have connected more with their home cultures (Sharma & Orey, 2017).

Methodology

Overview

The main goal of this study was to determine if secondary subcultures existed amongst preservice secondary teachers and, if so, how preservice secondary teacher groups differed. The question guiding this study was: *Do preservice secondary teachers' attitudes towards multicultural education differ with regards to secondary endorsement area, as measured by the Teacher Multicultural Attitude Survey (TMAS) and/or the Culturally Responsive Teacher Self-Efficacy Scale (CRTSE) inventories (Ponterotto et al., 1998; Siwatu, 2007)?*

Context and Participants

The data used in this study come from a public university in a Mid-Atlantic State. This university houses both a five-year bachelors' plus masters' degree teacher preparation program (BAMT; n = 188) and a two-year postgraduate degree teacher preparation program (PGMT; n = 101). Data were collected every fall and spring semester for both programs beginning in the fall of 2009 and ending in the spring of 2015 and analyzed in the Spring 2018 using SPSS Version 24.

In total, all 289 preservice secondary teachers completed the surveys in the first year of their program. Secondary endorsement areas included social studies (n = 86), mathematics (n = 41), English (n = 68), foreign language (n = 47), science (n = 35), and health or physical education (n = 12). Of the participants, 57% identified as female, 24% identified as male, and 19% did not identify as either male or female; 79% of participants identified as Caucasian/white, 8% Asian, 4% African American, 3% Hispanic, and 6% "other."

Procedures

Preservice teachers at this university were required to complete the Teacher Multicultural Attitude Survey (TMAS) and the Culturally Responsive Teacher Self-Efficacy Scale (CRTSE) inventories online every year they were enrolled in the teacher education program (Wiens et al., 2013). Data for this study were taken from participant surveys completed in the spring semester in their first year in the teacher preparation program. At this point in their programs, preservice teachers had completed introductory coursework, had one brief field placement, and had taken classes with all the teaching areas together in general pedagogy courses.

Measure 1: Teacher Multicultural Attitude Survey (TMAS; Ponterotto et al., 1998)

The TMAS (Ponterotto et al., 1998) is a 20-item self-reporting inventory of teachers' multicultural awareness and sensitivity. All 20 items are Likert-scale items, with 1 = strongly disagree and 5 = strongly agree. Seven items are reverse-coded. The composite score for this inventory is the average of all 20 items. A high score indicates a high level of multicultural awareness and sensitivity, whereas a low score indicates a low level of multicultural awareness and sensitivity. The TMAS has been used in similar studies of preservice teacher candidates to measure changes in multicultural attitudes over time (Cicchelli & Cho, 2007). Self-reporting items on the TMAS include statements such as "I find teaching a culturally diverse student group rewarding" and "To be an effective teacher, one needs to be aware of cultural differences present in the classroom" (Ponterotto et al., 1998).

The origins of the TMAS (Ponterotto et al., 1998) are rooted in multicultural sensitivity and competence (Manning & Baruth, 1996; Sue et al., 1995). Items were written, rewritten, and discarded based on feedback from focus groups and factor analysis. The final 20 items showed high levels of internal consistency and content validity. The TMAS was positively correlated to the Quick Discrimination Index racial equity subscale (r = .45) and the Multigroup Ethnic Identity Measure, Other Group Orientation subscale (r = .31). Reliability for the TMAS was $\alpha = .77$ (Ponterotto et al., 1998).

Measure 2: Culturally Responsive Teaching Self-Efficacy Scale (CRTSE; Siwatu, 2007)

The CRTSE (Siwatu, 2007) examines the beliefs of teachers with regards to teaching self-efficacy and outcome expectancy beliefs. In this 41-item inventory, participants rate how confident they are in accomplishing specific tasks on a scale from 0 to 100 (0 = no confidence, 50 = moderately confident, and 100 = completely confident). The final score is the sum of each item, resulting in a total possible score from 0 to 4,100. The CRTSE has been used in similar studies of preservice teachers to study preservice teacher self-efficacy as it pertains to culturally responsive teaching. Self-reporting items on the CRTSE include statements such as "I am able to develop a community of learners when my class consists of students from diverse backgrounds" and "I am able to critically examine the curriculum to determine whether it reinforces negative cultural stereotypes" (Siwatu, 2007). Internal reliability of the CRTSE is $\alpha = .96$ (Siwatu, 2007).

Analyzing of Data

To understand if secondary mathematics teachers differed from their peers in terms of multicultural attitudes and self-efficacy, we determined that a multivariate analysis of variance (MANOVA: Tabachnick & Fidell, 2001) was the best analytic choice. Conceptually these constructs should be similar enough to be analyzed as a combined dependent variable. However, prior to conducting this analysis, we first ran assumption tests to determine if this analytic decision was also empirically supported.

The first step we conducted in the process was running a correlational analysis on the data. We wanted to see if TMAS and CRTSE scores were correlated. In MANOVA analysis, variables should be moderately correlated. High correlations result in multicollinearity and low correlations determine that the variables are not related enough to analyze together. Correlational analysis yielded a correlation of .400 between TMAS and CRTSE, $p<.001$, indicating sufficiently high correlation between these two measures. This moderate correlation was in the acceptable range for MANOVA analysis to continue (Tabachnick & Fidell, 2001). See Table 1 for CRTSE and TMAS correlations data. These analyses supported our theoretical decision to combine these measures into one dependent variable.

Table 1. CRTSE and TMAS Correlations Table

		CRTSE	**TMAS**
1.	**CRTSE**		
	Pearson Correlation	1.000	0.400**
	Sig. (2-tailed)		0.000
	N	286	286
2.	**TMAS**		
	Pearson Correlation	0.400**	1.000
	Sig. (2-tailed)	0.000	
	N	286	286

** Correlation is significant at the 0.01 level (2-tailed).

In the next step of assumption testing, we ran a linear regression using Mahalanobis' Distance to determine if outliers existed within the data (Mahalanobis, 1936). Two data points had a Mahalanobis Distance greater than the recommended 13.82. Deletion has been suggested as a viable option if the cases represent 5% or less of the sample size (Tabachnick & Fidell, 2001), so we removed these two data points from our sample.

With assumption testing complete, we continued with the MANOVA analysis to determine if TMAS and CRTSE scores varied across secondary endorsement groups. That is, we ran a MANOVA to see if one secondary endorsement group was statistically significantly different than other in terms of TMAS and CRTSE scores. However, a MANOVA test only reveals if any differences exist between groups; it does not reveal which groups are different.

Our MANOVA analyses focused on secondary endorsement area as the grouping variables and a combined dependent variable that included the TMAS and CRTSE data. Because the data did not follow normal distribution assumptions, we looked at the Pillai's Trace value. See Table 2 for MANOVA data.

Table 2. Multivariate Tests

	Endorsement Area
Pillai's Trace	
Value	.175
F	5.378
df	10.000
Error df	560.000
Sig.	.000
Partial Eta Squared	.088
Noncent. Parameter	53.783
Observed Power	1.000

Findings/Results

Tests of between-subject variables showed that scores for the TMAS were significant at the $p < .001$ level, with effect sizes (partial n^2) of .135., we concluded that there was a statistically significant difference between at least two secondary endorsement area groups on the TMAS instrument. The data did not reveal any statistical differences between endorsement area groups on the CRTSE instrument, as seen in Table 3.

Table 3. Test of Between-Subjects Effects

		Endorsement Area
	CRTSE	
	Type III Sum of Squares	1738950.397
	df	5
1.	Mean Square	347790.079
	F	1.276
	Sig.	.275
	Partial Eta Squared	.022
	TMAS	
	Type III Sum of Squares	7.354
	df	5
2.	Mean Square	1.471
	F	8.726
	Sig.	.000
	Partial Eta Squared	.135

Our MANOVA test on TMAS scores only revealed that groups were different, so we ran a post-hoc test to determine which groups were different. The mean TMAS score for preservice mathematics teachers was 3.6695, while the mean TMAS score for preservice English teachers was 4.0940, resulting in a mean difference of .4245. See Table 4 for descriptive statistics of TMAS scores.

Table 4. Descriptive Statistics of TMAS Scores

		TMAS		
		Mean	**Std. Deviation**	**N**
1.	Social Studies	3.8012	.43477	86
2.	Mathematics	3.6695	.39193	41
3.	English	4.0940	.39730	67
4.	Foreign Language	3.9326	.45998	46
5.	Science	3.8365	.33873	34
6.	Health/PE	3.4901	.33826	12
7.	Total	3.8632	.43749	286

A post hoc Scheffe test showed that this difference in mean TMAS scores was significant at $p < .001$. Therefore, we concluded that there was a significant difference between preservice mathematics and preservice English teachers with regards to multicultural attitudes in the classroom. Although we did not find significant differences between mathematics and other subject endorsement areas, this difference between preservice mathematics and preservice English teachers echoes similar findings between mathematics in-service teachers and in-service humanities teachers (Grossman & Stodolsky, 1995; Stodolsky & Grossman, 1995). See Table 5 for the Scheffe post hoc test of multiple comparisons.

Table 5. Scheffe Post Hoc Test of Multiple Comparisons

		TMAS Mathematics				
		Mean Difference	**Std. Error**	**Sig.**	**95% CI Lower Bound**	**95% CI Upper Bound**
1.	**Social Studies**	-.1317	.07792	.722	-.3928	.1295
3.	**English**	**-.4245***	.08141	.000	-.6973	-.1517
4.	**Foreign Language**	-.2631	.08818	.117	-.5586	.0324
5.	**Science**	-.1670	.09523	.688	-.4862	.1521
7.	**Health/PE**	.1794	.13475	.879	-.2722	.6310

* The mean difference is significant at the .05 level.

Discussion

Secondary subject subcultures, differing in status, perceived sequentiality, and scope, have been shown to form within departmental content areas (Brady, 2008; Grossman & Stodolsky, 1995; Todd, 2012). While attitudinal differences are seen in between subcultures of in-service teachers (Grossman & Stodolsky, 1995; Stodolsky & Grossman, 1995), this study revealed that attitudinal differences also occur between subcultures of preservice teachers, specifically preservice mathematics teachers and preservice English teachers, with regards to multicultural awareness.

Preservice teachers training to become secondary English teachers have a statistically higher score on the Teacher Multicultural Attitude Survey (TMAS) than preservice teachers training to become secondary mathematics teachers, raising the important consideration that certain personalities and attitudes are potentially drawn to certain secondary endorsement areas before ever entering the classroom.

Looking at these data, it is evident that preservice mathematics teachers are lagging behind their English peers in regard to multicultural attitudes. This is significant, as students feel more valued, more capable of learning, and more engaged when a teacher is culturally responsive (Abacioglu et al., 2020; Gay, 2010).

Multicultural attitudes are correlated with multicultural teaching efficacy (Kim & Connelly, 2019). Low scores on TMAS and other multicultural attitudes instruments indicate the need for additional support for preservice secondary mathematics students.

Higher education institutions are charged to continuously evaluate the effectiveness of their teacher preparation programs (Feuer et al., 2013; Wiens & Gromlich, 2018). Teacher preparatory programs must understand that all preservice teachers are not equal in their incoming knowledge or attitudes. Therefore, additional or supplemental materials and courses should be provided to preservice teachers depending on their individual needs and needs of their subculture. In this case, the results from this study indicate that more multicultural and Ethnomathematics education courses should be provided for preservice secondary mathematics students.

Conclusion

Preservice secondary mathematics subcultures do not necessarily enter the higher education environment with a high level of multicultural awareness. Oftentimes, they lack experiences and formal training in multicultural education (Doucette et al., 2021). Therefore, it may be necessary to provide additional content and courses specifically for preservice secondary mathematics students.

One method to provide multicultural content is to teach Ethnomathematic principles. There is evidence that Ethnomathematic principles can be practiced and learned by preservice teachers. Harding (2016) reviewed 47 preservice elementary teachers who taught elementary mathematics by using Ethnomathematic techniques. Lessons included: Fractions, doubling, decimals, multiplication, integers, factorials, addition, area, perimeter, subtraction, patterns, measurement, counting, data analysis, graphing, money, mental math, geometry, estimation, even/odd, and symmetry. Examples of multicultural children's literature taught from include: *One Grain of Rice: A Mathematical Folktale* by Demi, *If America Were a Village: A Book About the People of the United States* by D.J. Smith, *The Patchwork Path: A Quilt Map to Freedom* by B. Stroud, *Islamic Art: Recognizing Geometric Ideas in Art* by J. Levy, *The Tortoise Who Bragged: A Chinese Tale with Trigrams* by B. Franco, *Lucky Beans* by B. Birtha, *Emeka's Gift* by I. Onyefulu, and *Can You Count Ten Toes?: Count to 10 in 10 Different Languages* by L. Evans and D. Roche. (p. 96)

All 47 preservice teachers found Ethnomathematic teaching valuable and beneficial. Additionally, students also seemed to benefit from these lessons as they were more able to relate to the stories and see themselves as mathematicians.

Implementing Ethnomathematic teaching principles in secondary mathematics education programs could increase preservice teacher multicultural attitudes which, in turn, would positively impact secondary students (Abacioglu et al., 2020). Secondary mathematics subcultures must facilitate learning settings that "employ open dialogues, which equally respect all participants' contributions," and "models for students the importance of considering various perspectives to develop broad views of social issues" (Tanase & Lucey, 2015, p. 109). By implementing Ethnomathematic pedagogy in the American mathematics classroom, we can provide an environment where all students can learn.

Recommendations

It is important to know that in-service and preservice secondary teachers tend to identify with specific subcultures. Each subculture is unique in their beliefs, norms, and practices. Therefore, each subculture may require a different type of support.

For preservice secondary mathematics students, additional content is required in the area of multicultural attitudes. Secondary mathematics education curricula must teach cultural competency and multicultural awareness by incorporating Ehnomathematic principles and pedagogy into the secondary classroom. To view issues of equity, access, empowerment, and multicultural pedagogy as separate from content is not only in stark contrast to the Association of Mathematics Teacher Educators Standards (AMTE; Association of Mathematics Teacher Educators, 2017), but is a

disservice to preservice and in-service teachers who, we believe, are truly expecting to be well-prepared to teach in diverse settings.

While this study identified an area of opportunity for secondary mathematics education programs, future studies should be conducted to identify areas in which other secondary subcultures could use additional support. With this information, higher education programs could best tailor their courses and content to support their preservice teacher subcultures.

Limitations

The TMAS and CRTSE are self-reported surveys. While the reliability of the surveys supports their usefulness in multicultural attitudes data collection, there is inherent bias within self-reported surveys. Ponterotto et al. (1998) noted this limitation when creating the TMAS. The TMAS is a negatively skewed survey, with means across the two original survey populations being 4.0 and 4.1, respectively.

Although there is a negative skew in the self-reporting data, Ponterotto et al. (1998) still believe the survey accurately discriminates between teachers with high and low multicultural awareness for three reasons: the coefficient of variation, 9.3%, was in the ideal 5% to 15% range (Dawis, 1987), a criterion validity test showed that the TMAS scores could distinguish between subjects who had and had not completed focused multicultural workshop training, and teaching, being a human service occupation, tends to attract people who support multicultural education (Ponterotto et al., 1998).

Ethics Statements

The studies involving human participants were reviewed and approved by The University of Virginia. The participants provided their written informed consent to participate in this study.

Authorship Contribution Statement

Gromlich: Concept and design, drafting manuscript, supervision. Wiens: Data acquisition, data analysis/interpretation, statistical analysis. Whitesides: Critical revision of manuscript.

References

Aaronshon, E., Carter, C. J., & Howell, M. (1995). Preparing monocultural teachers for a multicultural world: Attitudes toward inner-city schools. *Equity and Excellence in Education, 28*(1), 5-9. https://doi.org/10.1080/1066568950280102

Abacioglu, C. S., Volman, M., & Fischer, A. H. (2020). Teachers' multicultural attitudes and perspective taking abilities as factors in culturally responsive teaching. *British Journal of Educational Psychology, 90*(3), 736-752. https://doi.org/10.1111/bjep.12328

Adegbola, B. (2022). Pre-Service teachers' perceptions of preparedness and self-efficacy in instructing students from diverse cultural and linguistic backgrounds. *Administrative Issues Journal: Connecting Education, Practice, and Research, 12*(1), 13-24. https://doi.org/10.5929/2022.12.1.2

Albanese, V., Adamuz-Povedano, N., & Bracho-López, R. (2017). The evolution of ethnomathematics: Two theoretical views and two approaches to education. In M. Rosa, L. Shirley, M. E. Gavarrete, & W. F. Alangui (Eds.), *Ethnomathematics and its diverse approaches for mathematics education* (pp. 307-328). Springer International Publishing. https://doi.org/10.1007/978-3-319-59220-6_13

Association of Mathematics Teacher Educators. (2017). *Standards for preparing teachers of mathematics*. http://amte.net/standards

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215. https://doi.org/10.1037/0033-295X.84.2.191

Bandura, A. (1997). *Self-efficacy: The exercise of control.* Freeman.

Baroody, A. E. (2017). Exploring the contribution of classroom formats on teaching effectiveness and achievement in upper elementary classrooms. *School Effectiveness and School Improvement, 28*(2), 314-335. https://doi.org/10.1080/09243453.2017.1298629

Barta, J., & Shockey, T. (2006). The mathematical ways of an Aboriginal people: The Northern Ute. *Journal of Mathematics and Culture, 1*(1), 79-89. https://bit.ly/3HGY0sn

Barta, J., & Shockey, T. (2016). Finding the 'space between' in developing mathematical curriculum and pedagogy across cultures: The mathematical ways of the Northern Ute. *Journal of Mathematics & Culture, 10*(3), 16-31. https://bit.ly/42NIqU3

Barth, R. S. (2002). The culture builder. *Educational Leadership, 59*(8), 6-11. https://bit.ly/41Zq29F

Beckett, G. H., & Kobayashi, M. (2020). A meta-study of an ethnographic research in a multicultural and multilingual community: Negotiations, resources, and dilemmas. *American Journal of Qualitative Research, 4*(1), 85-106. https://doi.org/10.29333/ajqr/8267

Brady, P. (2008). Working towards a model of secondary school culture. *Canadian Journal of Educational Administration and Policy, 73,* 1-16. https://bit.ly/3OkkZgM

Cadenas, G. A., Cisneros, J., Spanierman, L. B., Yi, J., & Todd, N. R. (2021). Detrimental effects of color-blind racial attitudes in preparing a culturally responsive teaching workforce for immigrants. *Journal of Career Development, 48*(6), 926-941. https://doi.org/10.1177/0894845320903380

Cicchelli, T., & Cho, S.–J. (2007). Teacher multicultural attitudes: Intern/teaching fellows in New York City. *Education and Urban Society, 39*(3), 370-381. https://doi.org/10.1177/0013124506298061

Cimen, O. A. (2014). Discussing ethnomathematics: Is mathematics culturally dependent? *Procedia – Social and Behavioral Sciences, 152,* 523-528. https://doi.org/10.1016/j.sbspro.2014.09.215

D'Ambrosio, U., & Rosa, M. (2017). Ethnomathematics and its pedagogical action in mathematics education. In M. Rosa, L. Shirley, M. E. Gavarrete, & W. F. Alangui (Eds.), *Ethnomathematics and its diverse approaches for mathematics education* (pp. 285-305). Springer. https://doi.org/10.1007/978-3-319-59220-6_12

Dawis, R. V. (1987). Scale construction. *Journal of Counseling Psychology, 34*(4), 481-489. https://doi.org/10.1037/0022-0167.34.4.481

DeCuir-Gunby, J. T., & Bindra, V. G. (2022). How does teacher bias influence students?: An introduction to the special issue on teachers' implicit attitudes, instructional practices, and student outcomes. *Learning and Instruction, 78*, Article 101523. https://doi.org/10.1016/j.learninstruc.2021.101523

Doucette, B., Sanabria, A., Sheplak, A., & Aydin, H. (2021). The perceptions of culturally diverse graduate students on multicultural education: Implication for inclusion and diversity awareness in higher education. *European Journal of Educational Research, 10*(3), 1259-1273. https://doi.org/10.12973/eu-jer.10.3.1259

Eichhorn, M. S., & Lacson, C. (2019). Departmentalization for mathematics: Is it beneficial for the teacher, students, and teacher candidates? *Journal of Educational Research and Practice, 9*(1), 124-131. https://doi.org/10.5590/JERAP.2019.09.1.09

Federal Interagency Forum on Child and Family Statistics. (2018). *America's children in brief: Key national indicators of well-being, 2018.* https://bit.ly/421nAjs

Feuer, M. J., Floden, R. E., Chudowsky, N., & Ahn, J. (2013). *Evaluation of teacher preparation programs: Purposes, methods, and policy options.* National Academy of Education. https://bit.ly/3MCc9cS

Gallego, M. (2001). Is experience the best teacher? *Journal of Teacher Education, 52*(4), 312-320. https://doi.org/10.1177/0022487101052004005

Gay, G. (2005). Politics of multicultural teacher education. *Journal of Teacher Education, 56*(3), 221-228. https://doi.org/10.1177/0022487105275913

Gay, G. (2010). *Culturally responsive teaching: Theory, research, and practice* (2nd ed.). Teachers College Press.

Grossman, P. L., & Stodolsky, S. S. (1995). Content as context: The role of school subjects in secondary school teaching. *American Educational Research Association, 24*(8), 5-23. https://doi.org/10.3102/0013189X024008005

Guidi, M., & Salvatore, S. (2013). Parents' images of their children's school system. In P. Marsico, K. Komatsu, & A. Iannaccone (Eds.), *Crossing boundaries: Intercontextual dynamics between family and school* (pp. 271-300). Information Age Publication.

Hamdan, S., & Coloma, R. S. (2022). Assessing teachers' cultural competency. *The Journal of Educational Foundations, 35*(1), 108-128.

Harding, J. L. (2016). Reflection within mathematics methods: Prospective teachers develop a classroom diversity teaching assignment. *Journal of Mathematics and Culture*, *10*(2), 86-103. https://bit.ly/3naqO5i

Hussar, B., Zhang, J., Hein, S., Wang, K., Roberts, A., Cui, J., Smith, M., Mann, F. B., Barmer, A., & Dilig, R. (2020). *The Condition of Education 2020.* National Center for Education Statistics. https://bit.ly/3HjID94

Irawan, A., Kencanawaty, G., & Febriyanti, C. (2018). Realistic mathematics and ethnomathematics in improving problem solving abilities. *Journal of Physics Conference Series*, *1114*, Article 012208. https://doi.org/10.1088/1742-6596/1114/1/012108

Jacob, B. A., & Rockoff, J. E. (2011). *Organizing schools to improve student achievement: Start times, grade configurations, and teacher assignments.* Brookings Institution, Hamilton Project. https://bit.ly/3NfICGT

John, P. D., & La Velle, L. B. (2004). Devices and desires: Subject subcultures, pedagogical identity and the challenge of information and communications technology. *Technology, Pedagogy and Education, 13*(3), 307-326. https://www.learntechlib.org/p/69617

Johnson, C. C. (2009). An examination of effective practice: Moving toward elimination of achievement gaps in science. *Journal Science Teacher Educator, 20*(3), 287-306. https://doi.org/10.1007/s10972-009-9134-y

Kaya, A. (2013). Multiculturalism: The culturalisation of what is social and political. *Perceptions: Journal of International Affairs, 18*(3), 63-91. https://bit.ly/3LBPflJ

Kim, H., & Connelly, J. (2019). Preservice teachers' multicultural attitudes, intercultural sensitivity, and their multicultural teaching efficacy. *Educational Research Quarterly, 42*(4), 3-20.

Lee, R. E., Eckrich, L. T., Lackey, C., & Showalter, B. D. (2010). Pre-service teacher pathways to urban teaching: A partnership model for nurturing community-based urban teacher preparation. *Teacher Education Quarterly, 37*(3), 101-122.

Loadman, W. E., Freeman, D. J., Brookhart, S. M., Rahman, M. A., & McCague, G. J. (1999). Development of a national survey of teacher education program graduates. *Journal of Educational Research, 93*(2), 76-89. https://doi.org/10.1080/00220679909597632

Maddux, J. E. (2002). Self-efficacy: The power of believing you can. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of positive psychology* (pp. 335-344). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780195187243.013.0031

Mahalanobis, P. C. (1936). On the generalized distance in statistics. *Journal of Genetics, 41*, 159-193.

Manning, M. L., & Baruth, L. G. (1996). *Multicultural education of children and adolescents* (2nd ed.). Allyn & Bacon.

National Council of Teachers of Mathematics. (n.d.). *Principles and standards*. https://bit.ly/3IoOudv

No Child Left Behind Act of 2001, P.L. 107-110, 20 U.S.C. § 6319. (2002). https://bit.ly/3BAvcxU

Nye, B., Konstantopoulos, S., & Hedges, L. V. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis, 26*(3), 237-257. https://doi.org/10.3102/01623737026003237

Orey, D. C., & Rosa, M. (2007). Cultural assertions and challenges towards pedagogical action of an ethnomathematics program. *For the Learning of Mathematics, 27*(1), 10-16. https://bit.ly/3MQHOaA

Ornstein, A. C., & Hunkins, F. P. (2018). *Curriculum: Foundations, principles, and issues* (7th ed.). Pearson.

Phinney, J. S., & Rotheram, M. J. (1987). Children's ethnic socialization: Themes and implications. In J. S. Phinney & M. J. Rotheram (Eds.), *Children's ethnic socialization: Pluralism and development* (pp. 274-292). Sage.

Ponterotto, J. G., Baluch, S., Greig, T., & Rivera, L. (1998). Development and initial score validation of the teacher multicultural attitude survey. *Educational and Psychological Measurement, 58*(6), 1002-1016. https://doi.org/10.1177/0013164498058006009

Sharma, T., & Orey, D. C. (2017). Meaningful mathematics through the use of cultural artifacts. In M. Rosa, L. Shirley, M. E. Gavarrete, & W. F. Alangui (Eds.), *Ethnomathematics and its diverse approaches for mathematics education* (pp. 153-179). Springer. https://doi.org/10.1007/978-3-319-59220-6_7

Shields, C. M. (2004). Dialogic leadership for social justice: Overcoming pathologies of silence. *Educational Administration Quarterly, 40*(1), 109-132. https://doi.org/10.1177/0013161X03258963

Siskin, L. S. (1994). *Realms of knowledge: Academic departments in secondary schools.* Routledge. https://doi.org/10.4324/9781315821887

Siwatu, K. O. (2007). Preservice teachers' culturally responsive teaching self-efficacy and outcome expectancy beliefs. *Teaching and Teacher Education, 23*(7), 1086-1101. https://doi.org/10.1016/j.tate.2006.07.011

Spanierman, L. B., Oh, E., Heppner, P. P., Neville, H. A., Mobley, M., Wright, C. V., Dillon, F. R., & Navarro, R. (2011). The multicultural teaching competency scale: Development and initial validation. *Urban Education, 46*(3), 440-464. https://doi.org/10.1177/0042085910377442

Stodolsky, S. S. (1988). *The subject matters.* University of Chicago Press.

Stodolsky, S. S., & Grossman, P. L. (1995). The impact of subject matter on curricular activity: An analysis of five academic subjects. *American Educational Research Journal, 32*(2), 227-249. https://doi.org/10.3102/00028312032002227

Sue, D. W., Arredondo, P., & McDavis, R. J. (1995). Multicultural counseling competencies and standards: A call to the profession. In J. G. Ponterotto, J. M. Casas, L. A. Suzuki, & C. M. Alexander (Eds.), *Handbook of multicultural counseling* (p. 624-644). Sage.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Allyn and Bacon.

Tanase, M., & Lucey, T. A. (2015). Interdisciplinary connections: Teaching mathematics for social justice and financial literacy. *Journal of Mathematics and Culture*, *9*(1), 81-118. https://bit.ly/42N2JB8

Taylor, S. V., & Sobel, D. (2001). Addressing the discontinuity of students' and teachers' diversity: A preliminary study of preservice teachers' beliefs and perceived skills. *Teaching and Teacher Education, 17*(4), 487-503. https://doi.org/10.1016/S0742-051X(01)00008-7

Todd, N. A. (2012). Assisting secondary support teachers to work in the recommended service delivery model: Introducing the concept of a subculture of learning support. *Support for Learning, 27*(4), 177-183. https://doi.org/10.1111/1467-9604.12005

Venuleo, C., Mossi, P., & Salvatore, S. (2016). Educational subculture and dropping out in higher education: A longitudinal case study. *Studies in Higher Education, 41*(2), 321-342. https://doi.org/10.1080/03075079.2014.927847

Wiens, P. D., & Gromlich, M. D. (2018). Five years of video-based assessment data: Lessons from a teacher education program. *Research & Practice in Assessment, 13*, 51-61. https://bit.ly/3MANWUw

Wiens, P. D., Hessberg, K., LoCasale-Crouch, J., & DeCoster, J. (2013). Using a standardized video-based assessment in a university teacher education program to examine preservice teachers' knowledge related to effective teaching. *Teaching and Teacher Education, 33,* 24-33. https://doi.org/10.1016/j.tate.2013.01.010

Yildirim, S., & Tezci, E. (2016). Teachers' attitudes, beliefs and self-efficacy about multicultural education: A scale development. *Universal Journal of Education Research, 4*(12A), 196-204. https://doi.org/10.13189/ujer.2016.041325

Zong, J., Batalova, J., & Burrows, M. (2019). *Frequently requested statistics on immigrants and immigration in the United States.* Migration Policy Institute. https://bit.ly/451uo2Q