

Proceedings of the Annual Meeting of the Georgia Association of Mathematics Teacher Educators

Volume 14
Issue 1 *14th Annual Proceedings*

Article 2

2023

Using Voting as a Lens to Teach Central Tendency and Impact K-8 Future Teachers

Ha Nguyen
California State University, hnnguyen@csudh.edu

Heidi Eisenreich
Georgia Southern University, heisenreich@georgiasouthern.edu

DOI
[10.20429/gamte.2022.140102](https://doi.org/10.20429/gamte.2022.140102)

Follow this and additional works at: <https://digitalcommons.georgiasouthern.edu/gamte-proceedings>

Recommended Citation

Nguyen, Ha and Eisenreich, Heidi (2023) "Using Voting as a Lens to Teach Central Tendency and Impact K-8 Future Teachers," *Proceedings of the Annual Meeting of the Georgia Association of Mathematics Teacher Educators*: Vol. 14: Iss. 1, Article 2.

DOI: [10.20429/gamte.2022.140102](https://doi.org/10.20429/gamte.2022.140102)

Available at: <https://digitalcommons.georgiasouthern.edu/gamte-proceedings/vol14/iss1/2>

This article is brought to you for free and open access by the Journals at Digital Commons@Georgia Southern. It has been accepted for inclusion in Proceedings of the Annual Meeting of the Georgia Association of Mathematics Teacher Educators by an authorized administrator of Digital Commons@Georgia Southern. For more information, please contact digitalcommons@georgiasouthern.edu.

Using Voting as a Lens to Teach Central Tendency and Impact K-8 Future Teachers

Ha Nguyen¹ and Heidi Eisenreich²

¹ Mathematics Department, California State University at Dominguez Hills

² Department of Mathematical Sciences, Georgia Southern University

Abstract

This study discusses how teaching K-8 preservice teachers (PSTs) about the measures of central tendency through the context of the voting process impacted their learning about mathematics as well as the voting process and issues that may arise. Being a well-informed citizen, especially for people who will be teaching in the next few years, is important as they will influence many children in the future. Findings show changes in the PSTs' perspectives on the voting process, voting issues, and learning center measures. Additionally, PSTs indicated they enjoyed learning about the measures of central tendency through context of the voting process and the issue of voter suppression. Furthermore, researchers found teaching through this context had long-term implications, as one PST reached out during the most recent election, which was more than a year after the course ended.

Keywords: Teacher preparation, measures of center, social justice

INTRODUCTION

Mathematics achievement, often measured by standardized tests, is used as a gatekeeper to sort students into “high” and “low” groups beginning in grade school (Spielhagen, 2011). Traditionally, mathematics has been taught by walking the whole class through examples on the board and practicing exercises from textbooks and worksheets (Wright, 2015). This approach in mathematics instruction led to lack of student participation in class and low scores on mathematical assessments, especially among the marginalized groups of students such as low social-economic status and non-white racial and ethnic (Gay, 2010). The gatekeeping role of mathematics costs future economic opportunities for these marginalized students. A social justice approach to mathematics education seeks to foster student mathematical abilities that transcend textbooks and promote quantitative reasoning skills and civic participation for all students (National Council of Supervisors of Mathematics [NCSM] & TODOS Mathematics for All [TODOS], 2016).

Teaching mathematics for social justice (TM4SJ) is an approach that uses mathematical knowledge to introduce students to unjust issues and empower them to make a difference in the world (Gutstein, 2006). When students are aware of social injustices that are relevant to their lives and interests, they begin to consider and investigate those issues and pose their own questions (Gutstein 2003, 2006). As students form their own thoughts on these issues through confronting unjust situations and inequalities, they develop their reasoning skills and see mathematics as a tool to enable them to understand, analyze, and transform injustices (Gonzalez, 2009; Gutstein, 2006).

TM4SJ has also been incorporated into mathematics content courses for preservice teachers (PSTs). Previous research indicated positive learning experiences for PSTs through

current events involving school choice voucher programs (Nguyen & Eisenreich, 2018) and shortage of teachers of color (Conway & Nguyen, 2020). Mathematics can be situated in so many real-world contexts. By connecting mathematics to the real world, students do not see mathematics as several unrelated, isolated topics (Peterson, 2012). Both the midterm elections and the governor race in Georgia occurred in Fall 2018, six months before the PSTs engaged in the project. Furthermore, the governor race in Georgia, where the PSTs and researchers reside, got national attention (McWhirter & Snow, 2018). Issues such as voter suppression were brought up in the media and news (Stein, 2018; Rannard, 2018). Two election events near the time when PSTs took this class occurred, which made this context relevant and timely. For these reasons, the researchers chose to spend instructional time discussing both current events (election process and voter suppression) and mathematics topics (mean, median, and mode).

LITERATURE REVIEW

Culturally Responsive Approaches

There are several frameworks for culturally responsive approaches (e.g., culturally responsive teaching, culturally relevant pedagogy). Ladson-Billings (1995) coined the term *culturally relevant pedagogy* (CRP) to describe an approach to teaching that recognizes the importance of incorporating students' cultures and experiences in all aspects of teaching and learning. Ladson-Billings (1995) presented three principles on culturally relevant pedagogy: (a) academic achievement, (b) cultural competence, and (c) development of sociopolitical consciousness (Ladson-Billings, 1994, 1995). Academic achievement involves supporting students to realize their full potential and acquire skills to be successful. Cultural competence requires teachers to understand students' cultures and help them maintain their cultural integrity. Sociopolitical consciousness requires teachers to actively educate themselves and their students

to “recognize, understand, and critique current and social inequalities” (Ladson-Billings, 1995, pg. 476). Thus, by implementing CRP, teachers “empower students intellectually, socially, emotionally, and politically” (Ladson-Billings, 1992, p. 382).

Building on Ladson-Billings’s work, Gay (2010) introduced *culturally responsive teaching* (CRT) as a form of teaching that uses “the cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them” (p. 31). Gay’s CRT framework focuses on instructional strategies and practices, particularly cultivating strong student-teacher relationships, while Ladson-Billings’ (1995) CRP framework calls attention to recognizing and honoring students’ cultures. Both Gay and Ladson-Billings emphasize offering students opportunities to think critically about their individual or their communities’ equity issues. Since both CRP and CRT approaches support students’ ability to understand and critique sociopolitical issues as well as empowering them to challenge the inequitable status quo (Ladson-Billings, 1995), implementation of either framework leads to examining social injustices.

Teaching Mathematics for Social Justice (TM4SJ)

Several definitions of *teaching mathematics for social justice* (TM4SJ) exist in the research literature. According to Gutstein (2003, 2006, 2009), TM4SJ has three goals to help students use mathematics to develop: (a) sociopolitical consciousness (Freire, 1992), (b) a sense of social agency; i.e., believing in themselves as people who can make a difference in the world, and (c) positive social and cultural identities (Murrell, 1997). In Gutstein (2002)’s study, his middle school students completed projects that used mathematics to make sense of and learn about issues people of color, low-income people, and immigrants are facing, which were relevant to their lives and communities. His students began to understand complex issues involving

justice and equity as well as develop mathematical power. For instance, they came up with their own strategies, solved problems in different ways, and reasoned mathematically. Furthermore, the students began to change their attitudes toward mathematics. Even though the students might not all love mathematics, they started to view mathematics as a tool to both solve real-world problems and examine society and understand inequalities.

Building off Gutstein's work, along with the work of several researchers, Gonzalez (2009) describes TM4SJ having four components: (a) access to high-quality mathematics instruction for all students; (b) curriculum re-centered around the experiences of marginalized students; (c) use of mathematics as a critical tool to understand social life, one's position in society, and issues of power, agency, and oppression; (d) use of mathematics to make society more just. The first component means that TM4SJ "works to transform mathematics from a gatekeeper to a gateway, democratizing participation and maximizing education advancement that equitably benefits all children rather than a select few" (NCSM & TODOS, 2016, p. 3). The second component says TM4SJ should draw on experiences of students from disadvantaged backgrounds when examining issues of fairness through mathematics (Gutstein, 2006). Previous research supports instruction focused on students' experiences because it broadens their participation and engagement in the classroom (Villegas & Lucas, 2002). The third component is commonly known as critical mathematics, whose two goals are to (1) develop political awareness that allows a learner to realize his or her place in society and (2) motivate learners to action (Gutiérrez, 2013). This way, mathematics becomes a tool for students to expose and analyze unjust issues and as a way to persuade others of a certain (often nondominant) perspective (Gutiérrez). The fourth component implies that TM4SJ should serve the purpose of

“liberation from oppression” (Gutstein, 2006, p. 22) and that students should be guided to understand the world and work toward making it more just (Michelli & Keiser, 2005).

RESEARCH FRAMEWORK

In addition to Gonzalez’s (2009) research on social justice, our research is grounded in Gutstein’s (2006) framework on the “three C’s,” community, critical, and classical knowledge bases. *Community knowledge* is the knowledge students bring to school that they may have learned outside of school; for example, knowledge about themselves, cultures, their communities, and society. *Critical knowledge* is being aware of the sociopolitical context of issues around them. *Classical knowledge* is the formal knowledge typically taught in textbooks and assessed in standardized tests. Gutstein (2007) encourages efforts to work on connecting all three parts of these knowledge bases. He suggests in some cases the three parts may already be connected. For example, students might have community and classical knowledge, but it is not yet critical. Whether or not it is critical depends on many factors such as their experiences and the strength of current social movements (Guistein, 2007). Teachers should be aware of these knowledge bases to help students formulate their understanding of different topics within each of the knowledge bases.

The researchers in this study are female; one is White while the other one is Asian. At the time, both were early career in a tenure-track position and open to implement current and best teaching practices to engage students in mathematics through sociopolitical issues. PSTs in the study were in their second mathematics content course, and the majority were elementary majors, female, and White. Most grew up in rural towns near the institution.

PSTs in this study might have similar blurred lines between these ideas. The PSTs may know how to calculate the mean, median, and mode (measures of central tendency) but may not

know yet how to relate those measures in a real-life context such as voting. They may have community knowledge about the election process from listening to their parents and other family members. At the time of the presidential election in 2016, their knowledge may not have been critical because some of them may not have been old enough to vote. However, when we discussed the electoral college and how it was connected to voting during summer 2019, it may have been critical knowledge because they could have voted in the upcoming presidential election 2020 and/or had already voted in the midterm election in 2018.

Purpose of the Study and the Research Questions. The research was designed to attempt to connect the three C's: Community knowledge about the election process, critical knowledge about voter suppression, and classical knowledge when learning about mean, median, and mode through voting process and issues. The research questions were:

1. How do the PSTs' perspectives about the election process (community knowledge) change after the TM4SJ activities?
2. How do the PSTs' perspectives about voter suppression (critical knowledge) change after the TM4SJ activities?
3. How do the PSTs' perspectives about learning mean, median, and mode (classical knowledge) change after the TM4SJ activities?

METHODOLOGY

Participants and Context

The participants in this qualitative study were 15 K-8 PSTs, mostly sophomores, who were enrolled in a *Foundation for Data and Geometry* course for K-8 Preservice Teachers (PSTs) during summer 2019 at a university in the Southeast United States. This is the second mathematics content course in a series of three required content courses for early childhood

majors. During the summer, the class met every day for five weeks, and each class meeting was one hour and 40 minutes long. Figure 1 displays topics for the course.

Figure 1

Topics (not necessarily in this order)

| |
|--|
| Statistics |
| Measures of Central Tendency (mean, median, mode) |
| Measures of Dispersion (range, quartiles, interquartile range, variance and standard deviation – recommend computing by hand, mean absolute deviation is optional) |
| Outliers |
| Statistical Graphs (pictograph, dot plot, stem and leaf plot, histogram, bar graph, circle graph, line graph, box and whisker plots) |
| Probability |
| Definition of Probability |
| Other Definitions (mutually exclusive, independent) |
| Probability Rules/Properties |
| Experimental and Theoretical |
| Single Stage and Multi-Stage Experiments (including tree diagrams) |
| Geometry |
| Undefined Terms |
| Two Dimensional Shapes |
| Three Dimensional Shapes |
| Measurement |

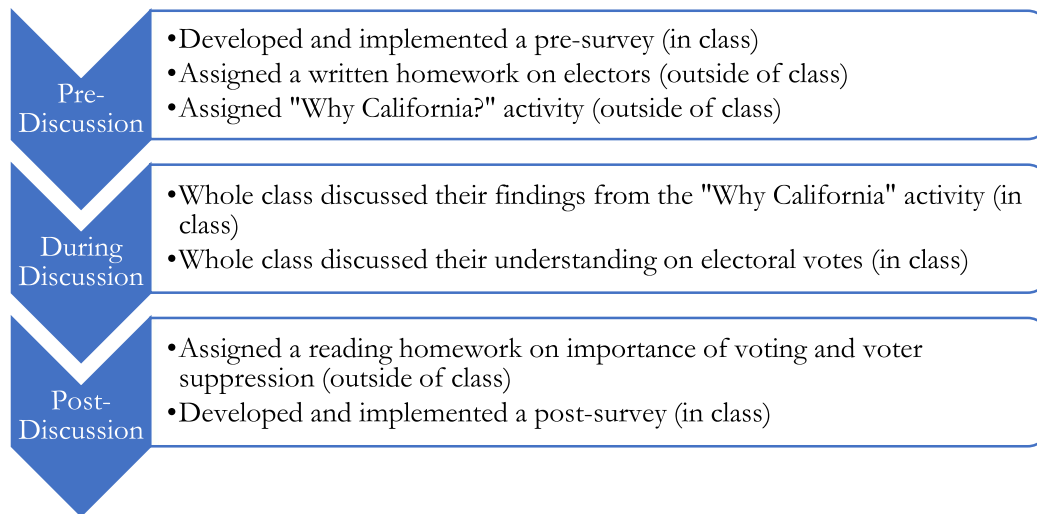
Procedures

To answer the research questions, the researchers monitored the PSTs’ changes in their perception in different stages of the study: Pre-class discussion, during the class discussion, and post-class discussion (see Figure 2). Before the class discussion on the voting process and “Why California?” (National Council of Teachers of Mathematics [NCTM], 2014) activity, the researchers developed a pre-survey to gauge the PSTs’ knowledge of the election process, opinions on the importance of voting, and awareness of voter suppression in order to develop appropriate class activities and assignments. During the class discussion on the voting process and “Why California?” (NCTM) activity, the researchers journaled the discourse between PSTs to PSTs and PSTs to the instructors. After the whole class discussion, the researchers noted the

PSTs' changes in perceptions through their responses in a reading homework assignment and the post-survey.

Figure 2

Research Protocol and Methodology. (Adopted from Conway & Nguyen, 2020)



Pre-Discussion

Before the class discussion on the voting process and “Why California?” (NCTM, 2014) activity, the PSTs first filled out a pre-survey in class and then completed an Electors assignment as well as the “Why California?” (NCTM) activity outside of class. The survey was created in Google Forms, containing questions about voting such as whether the PSTs voted in the 2016 presidential election and/or 2018 midterm election, their opinions on the importance of voting, their knowledge of electoral votes and awareness of voter suppression. The PSTs filled out the pre-survey at the beginning of class and used their phones or laptops to answer the pre-survey. Even though there was no time limit, most PSTs finished the pre-survey within 10 minutes.

After that, they were given an Electors assignment and the “Why California?” (NCTM) activity to complete outside of class. The Electors assignment asked the PSTs to collect data on the populations and electors for 50 states and the District of Columbia. On the “Why

California?” (NCTM) activity, the PSTs used the information from the Electors assignment to make their own observations of the data, answer questions involving the electoral votes, find the mean, median, and mode of electoral votes for all states, and choose the best measure of central tendency for the data.

During Discussion

On the day when the discussion on the voting process and “Why California?” (NCTM, 2014) activity took place in class, the PSTs were put in groups of three or four to discuss topics such as their observations about electors and states, the number of electoral votes the presidential candidate must have to win, and the mean, median, and mode of electoral votes for all states. Then they discussed findings as a whole class, and PSTs had the opportunities to ask questions that their group came up with when discussing. One question that arose was about the electoral votes and which candidate it goes to. For example, many students did not realize that if 51% of the state voted for Candidate A, all electoral votes for that state would go to Candidate A, not just a percentage of the votes. We then discussed that there were a few states where the percentage of votes corresponded to how many electoral votes that candidate got. However, this was not planned, but an important discussion to have. Students then understood how a candidate could win an election but not the popular vote.

The PSTs also determined which center measure best represents the data and explained their reasoning. For example, a possible response might be “median is the best measure because the electoral votes for California is an extreme value and greatly affects the mean.” Since the “Why California?” (NCTM, 2014) activity was a pre-assignment before formal discussion on measures of central tendency took place in class, students could make a case for either of the other measures (mean and mode), as long as they justified their choice. Additionally, they found

the number of electoral votes their own state has and compared to the median number of electors. Finally, the PSTs explained why California is an important campaign stop for presidential candidates, related this to their own state, and described how a presidential candidate might use electoral votes to plan a campaign.

Post-Discussion

At the end of the in-class discussion, the PSTs were given a reading assignment to complete outside of class, where they read at least two provided articles and responded to questions. The reading assignment was adopted from Public Broadcasting Service (PBS) LearningMedia (2016a, b), which included the following parts: (1) list reasons for voting that are encouraging and discouraging, and what value do you see in voting, (2) describe voter ID laws that have been enacted in Georgia, and name one reason to support voter ID laws in Georgia and one reason to oppose, and (3) how frequently voter fraud happens and why many states have enacted voter ID laws since 2010. The articles on the reading assignment were assigned to PSTs as a starting point, and they were encouraged to search for additional resources to broaden their understanding and worldview of others.

Following the in-class discussion and completion of the reading homework, the PSTs were given a post-survey to fill out in class, at the beginning of class. The survey was created in Google Forms, where the PSTs answered questions involving the election process, their opinions of voter suppression, how the in-class activities and assignments affected their initial thoughts on the importance of voting, and their opinions on learning measures of central tendency through voting issues. As with the pre-survey, even though the PSTs had no time limit on filling out the post-survey, most finished within 10 minutes.

Data Collection and Analysis

Data collection includes pre-survey, electors assignment, reading assignment, post-survey, field notes during the in-class discussion, and informal discussions during the following classes. Data from the pre- and post-surveys were first analyzed independently by the researchers and then reviewed and resolved any differences.

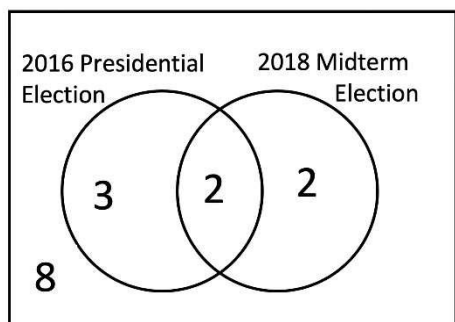
FINDINGS

Perspectives of the PSTs in this study showed changes in community, critical, and classical knowledge bases. The following sections use themes generated by the researchers when analyzing the pre- and post-surveys to observe changes in perception.

PSTs' Perspectives on Voting Process (Community Knowledge)

On the pre-survey, the PSTs indicated whether they voted in the 2016 presidential election and/or the 2018 midterm election. The results are summarized in Figure 3.

Figure 3
PSTs' Voting Records



The results revealed that five PSTs voted in the 2016 presidential election, four in the 2018 midterm election, two in both elections, while eight PSTs (more than 50% of the participants) did not vote in either election.

Also, on the pre-survey, the PSTs were asked whether they think voting is important and to explain their answers. Out of 15 PSTs, two did not think voting is important, while 13 said

voting is important. For the 13 responses with “yes,” their reasonings were grouped into two themes: focused on the voter and focused on the candidate. Table 1 shows the results of this question.

Table 1

Pre-Survey: Do you think voting is important? Why or why not?

| Voting Is Important or Not (<i>n</i> = 15) | Reasons Why or Why Not Voting Is Important | Common Responses | Frequency (%) |
|---|---|---|----------------------|
| No | 1 vote does not matter | “At the end of the day our votes don’t count that much” | 2 (13.3%) |
| Yes | Focus on voter | “I think that it is important to exercise your right to vote, because your opinion matters. I have been raised by the words of, ‘if you don’t vote and/or participate, then you shouldn’t complain about the outcome’.” | 8 (53.3%) |
| | Focus on candidate | “Yes. I believe is very important because you have the power to elect the candidate that have similar values.” | 5 (33.3%) |

Of the two PSTs who responded with “no,” the reasons they gave were, “At the end of the day our votes don’t count that much,” and “Electoral college votes are the only votes that decide.” A connection was not made between popular vote and electoral votes. Of the PSTs who responded with “yes” and focused on the voter, their responses typically fall into one of the following statements: We have the right as a citizen to vote; our opinion matters; we want our voice to be heard; and it is our right as a citizen. These PSTs focused on themselves as a part of the election process. Of the PSTs who responded with “yes” and focused on the candidate, they suggested it is their way to show support of a political party or candidate who has similar values to them and helps them identify what is going on in the country, to be more aware of platforms, and as part of a collective group to make decisions about our country. What we found interesting

about the findings from Figure 3 and Table 1 is that 13 PSTs out of 15 believe it is important to vote (in Table 1), but about half did not vote (in Figure 3). Furthermore, only four of the 15 voted in the most recent election (2018 midterm). The data indicated that all PSTs were at least 18 years old by November 2018, when the 2018 midterm elections took place.

On the post-survey, three (or 20%) PSTs indicated that the in-class activities and assignments regarding voting did not change their initial thoughts on the importance of voting, while 12 (or 80%) said “yes” to the change. Table 2 displays the results.

In Table 2, the three PSTs who responded with “no” said they already understood the importance of voting, and one of them even mentioned that they encouraged people to vote for this very reason. This is interesting because the two PSTs who initially did not think voting is important, as indicated on the pre-survey, said they changed their mind on the post-survey. One said it is important for us to vote because her ancestors fought for that right and went through a lot to get us to this point. The other said she did not know electoral votes were based on the state’s popular votes. This indicates that at the end of the TM4SJ activities all PSTs said voting was important.

Table 2
Post-Survey: Did In-Class Activities and Assignments Regarding Voting Change Your Initial Thought on the Importance of Voting? Explain.

| Changed Initial Thought or Not (<i>n</i> = 15) | Reasons to Change Initial Thought or Not | Common Responses | Frequency (%) |
|---|---|---|----------------------|
| No | Already thought voting was important | “I have always thought it was important to vote.” | 3 (20%) |
| Yes | Did not elaborate | “I will be voting in all elections.” | 3 (20%) |

Table 2 (continued)

| | | | |
|-----|------------------------------------|--|-----------|
| Yes | Voice heard | “I didn't really realize how important voting was until after class discussions. People in the population need to vote, because having their voice heard does matter. It is a right we have as US citizens.” | 6 (40%) |
| | Ancestors fought for our right | “Reading one of the articles reminded me of how my ancestors fought for the right to vote so it’s disrespectful not to vote considering how hard it was for them.” | 1 (6.7%) |
| | Learned more about electoral votes | “I was surprised about how the electors from one state all have to go to the same person. I feel like voting is more important to me after researching about it.” | 2 (13.3%) |

Of the 12 PSTs responding with “yes” to change in perception regarding voting, three PSTs did not elaborate stating that, “It is important” or “I will be voting.” Six PSTs said their initial thought on the importance of voting changed because they understood the importance of “having our voice heard” and voting is their civic duty as citizens. For instance, one PST from this group suggested, “Even though one vote is not going to change the world. Buy [sic] if everyone had that thought we would have no voters.” Another PST from this group commented, “Everyone’s vote matters.” Two PSTs learned more about the electoral votes. Before the TM4SJ activities they did not realize that all electoral votes for a specific state go to whichever presidential candidate received the majority of the popular vote for that state.

PSTs’ Perspectives on Voter Suppression (Critical Knowledge)

In the pre-survey, we asked PSTs if they heard of the term “voter suppression” before and their familiarity with it. The frequencies and percentages of PSTs’ responses are displayed in Table 3.

Table 3*Pre-Survey: Frequencies for Familiarity of the Term “Voter Suppression”*

| Response (n = 15) | Frequency (%) |
|--------------------------------------|----------------------|
| Never heard of it | 4 (26.7%) |
| Heard of it but not sure | 9 (60%) |
| Heard of it and confident to explain | 2 (13.3%) |

Of the 15 PSTs, 13 had either never heard the term, or heard the term but were not sure what it meant. Only two were confident they could correctly explain “voter suppression” to someone else.

After the pre-survey and before the post-survey, the PSTs were given articles that discussed issues regarding voting restrictions in Georgia and other states. In the post-survey, they were asked to express their opinions on voter suppression specifically for the state of Georgia, because this is the state they reside in, and hence makes it more relevant to them. Their responses were summarized in Table 4.

Table 4*Post-Survey: Do you Think Voter Suppression Currently Exists in Georgia? Explain.*

| Voter Suppression Exists or Not (n = 15) | Explanation | Common Responses | Frequency |
|---|-----------------------------|---|------------------|
| No | Everyone can choose to vote | “I dont [sic] think so because I feel that everyone has had the right to vote and i havent [sic] heard of miss treatment.” | 3 |
| | Did not elaborate | “They make it hard for people to vote.” | 3 |
| Yes | Obstacles to access | “There are people who can’t AFFORD to get photon [sic] IDs. Maybe they don’t have a car to take them, they can’t take off of work to go or they don’t have someone to keep their kids.” | 6 |

Table 4 (continued)

| | | | |
|-----|-------------------------|--|---|
| Yes | Media sways voters | “I think voter suppression exists everywhere in the US. People, especially the media, try and influence voters and how they vote so much. The media is so good at persuading people to vote one way with sneaky tactics they use.” | 2 |
| | Waiting in line to vote | “During the governer [sic] election here, voters had to wait hours and hours to vote and i heard a lot about weird stuff happening during the election.” | 2 |

* One person was in two categories because they commented on “obstacles to access” and “waiting in line to vote.”

Three PSTs did not think voter suppression exists in Georgia, stating “Everyone over 18 has the right to vote,” and no one has been mistreated. Six PSTs discussed obstacles that voters had to overcome to be able to vote. They indicated that some people may not be able to take off work, or get childcare, citing financial limitations. Others suggested there may be physical limitations (e.g., not being handicap accessible) and logistical limitations (e.g., not having identification, transportation to the polling center, or information about absentee voting in time to register for it). Two PSTs said suppression exists because the media encourages people to vote one way due to the way information is portrayed. This example shows that the PSTs may not have a clear understanding of voter suppression, even after the reading assignments and class discussions, but maybe they were trying to make a connection to their community knowledge and the media’s role in influencing elections. Two PSTs indicated that some voters waited in line for hours in prior elections, which again could impact the number of voters who participate in future elections. One PST was coded in two places because she cited long lines to vote and physical limitations in her response. The researchers separated the “obstacles to access” and “waiting in line to vote,” because in their opinion these were different ways suppression exists. Perhaps some voters can choose whether or not they want to wait in line, but there may be less

flexibility with financial, logistical, or physical limitations that prevent voters from coming to the poll stations.

PSTs’ Perspectives on Learning Central Tendency (Classical Knowledge) Through Context of Voting

Table 5

Post-Survey: Did you Enjoy Learning About Measures of Central Tendency Through the Context of Voting? Explain

| Enjoyed Learning or Not (n = 15) | Reasons | Common Responses | Frequency (%) |
|---|--|---|----------------------|
| No | Too much writing | “I hate having to write out all the numbers and go through all of that stuff.” | 2 (13.3%) |
| | Did not make a connection between assignments and the topics learned | “I didn't know that's what the voting worksheets were for so I didn't really understand why we were doing it.” | 1 (6.7%) |
| Yes | Awareness of sociopolitical issues | “its great to know what we are up against” “yes because it made me see how unaware i was of things.” “You learn about information that everyone need [sic] to be informed about.” | 4 (26.7%) |
| | Fun, interesting way of learning sociopolitical issues that affect their lives | “It made it more interesting to learn about this content in a different way than I am used too. It made it fun, and also gave me more knowledge on voting.” | 2 (13.3%) |
| | Real life connections | “I think it made the math concepts more applicable to real life.” | 3 (20%) |
| | Enjoyed math | “I enjoy math.” | 1 (6.7%) |
| | Learned new things | “I learned new things. “ | 1 (6.7%) |
| | Connections Among Mathematical Ideas | “I never really thought that a part of your data could affect the entire outcome, so it was cool to figure out that there is a better way to find the measure of center.” | 1 (6.7%) |

One of the benefits of implementing social justice lessons into the classroom is that students are able to relate the mathematics content they're learning about to the real world (Nguyen & Eisenreich, 2018). As such, we wanted to determine if PSTs in this class reported similarly. Frequencies of PSTs' responses to the question "Did you enjoy learning about measures of central tendency through the context of voting?" are reported in Table 5.

Three PSTs said they did not enjoy learning about central tendency using voting context. Two of these three indicated the tasks involved too much writing. In the future, the researchers plan to assign 10 states to each small group of PSTs to collect data so that gathering data is less overwhelming for the PSTs. One of those two also suggested there may be a better context than voting issues. The third PST did not see how the activity was connected to mathematics. Four PSTs made a specific comment about how they were more aware of sociopolitical issues that were applicable in our region. For example, they realized that these are important issues they need to be aware of as future teachers and as members of the community. One PST stated, "Its [sic] great to know what we are up against." Furthermore, two PSTs mentioned that it was fun and interesting to learn about the mathematics in our class using voting as a context so they were more aware of voting issues as well. For instance, one of them stated, "It made it more interesting to learn about this content in a different way than I am used too. It made it fun, and also gave me more knowledge on voting." Learning how topics are related to each other but through a different context (e.g., using voting in this mathematics lesson) helps students understand the relevance of mathematics by bringing in real-life examples. Three PSTs specifically mentioned they enjoyed learning about mathematics through voting context because of the real-life connections. One PST indicated she likes mathematics so she would enjoy learning mathematics regardless of any context. Another PST said it was interesting to learn new

things but did not clarify what those new things were and whether they related to mathematics or the social justice portion of the project. One PST was specific with her response and indicated how “part of your data” (e.g., extreme values) could impact the entire outcome, and in that case another “measure of center” (e.g., median) could be a better representation of the data’s center.

DISCUSSIONS, IMPLICATIONS, LIMITATIONS, AND CONCLUSION

Discussions

During our activity, an overview of elections was discussed. These were college students, and some had never voted before, so the researchers felt it was important for them to learn more about voting, especially since Georgia gained national attention from the issues that arose in the midterm elections in 2018. Furthermore, these PSTs would be voting in the 2020 election (with many voting for the first time), and the authors wanted them to be aware of some voting issues as they plan to vote in the presidential election in 2020. The researchers were excited when interesting conversations developed during their class discussions.

After the PSTs read the articles, a whole class meeting was held to clarify anything they wanted to discuss. PSTs were initially shocked when they realized how many electoral votes California had compared to how few some other states had. Using NCTM (2014) data to identify population per state, some PSTs calculated the number of people per electoral vote for a state and discovered that, despite having more electoral votes than other states, California has a higher population per elector than other states with fewer electors. For instance, California has approximately 677,345 people per electoral vote compared to Georgia having 605,478 people per electoral vote and North Dakota having 224,197 people per electoral vote. Some PSTs said our election should just be determined based on popular votes and not electoral colleges, while others argued that popular votes would mean that people in rural areas would not have their

voices heard. Some PSTs also indicated they had not heard about the long lines or not having handicap-accessible buildings when people were voting, even though it was prevalent in social media and news less than a year prior to the discussion (Haltiwanger, 2018). This indicates PSTs may not have had “critical knowledge” (Gutstein, 2006) yet, due to it not being relevant to them at the time.

During the discussion one PST said they did not realize all electoral votes in the state go to one candidate. This led to a discussion about how that is true for most states, but not for all. In most states, it is a winner-takes-all situation, which means if a candidate wins the state popular vote, all electoral votes for that state will go to that candidate. However, Maine and Nebraska do not follow this system. Electoral votes could be split between candidates depending on the popular vote in their districts. Informal discussion about the project and what PSTs were learning was built into the lesson plan for the day, which allowed PSTs to ask and respond to peers about these types of real-life situations. PSTs were invested in these informal conversations because it was relevant to their life at this point in time.

Implications

The majority (80%) of PSTs enjoyed learning about measures of central tendency through the context of the voting process because it showed them how mathematics was related to the real-world. One PST made a specific comment indicating she never realized before this class that there were different ways to measure the center (i.e., median versus mean) or that part of the data (outliers) could have such a large impact on the value of the mean. Additionally, the fact that California has so many electoral votes was interesting to many of the PSTs in addition to the “all or nothing” electoral votes for the majority of the states. Although this conversation was not focused on mathematics, it was important to being well-informed citizens, especially

since the PSTs will influence their K-8 students in the next few years. The TM4SJ lesson and discussions made them more interested in the voting process but also connected it to a mathematical concept. As researchers analyzed data, they were intrigued that by the end of the unit all PSTs noted voting was important. The two PSTs that initially stated voting was not important in the pre-survey, changed their mind. Even if the PSTs may not teach measures of central tendency in their future classrooms, they were able to engage in mathematics from a different lens. By giving these PSTs opportunities to learn content through real-world applications, they may see the benefit of situating mathematics learning in different contexts applicable to students.

During the discussion in class, a PST mentioned that he learned more about the election process in a few days during our class than he did in his introduction to political science class. Even though voting topics were likely discussed in that course (classical knowledge), this statement indicates it might not have been critical knowledge until this course. As this paper was being written, another PST that had been enrolled in the Summer 2019 class reached out to her instructor (the second author) one year later (during the 2020 presidential election) to say she used what she learned in class that summer to explain the electoral votes to her husband and father-in-law because they did not realize how it worked. This example indicates long-term implications for social justice projects. Furthermore, looking back at what was discussed from Figure 3 and Table 1, the majority of PSTs indicated they felt voting was important, but approximately half chose not to vote. This might imply they have community knowledge but not yet moved to critical knowledge. It would be interesting to see how many of them voted in the 2020 presidential election, which was the next major election they could vote in.

Limitations

As with any qualitative research, no generalizations can be made to larger populations. Findings are reported for only one class and because this was a summer class the size was about half as many as a typical semester class. Also, this course is normally designed for a 15-week semester, but was condensed into a five-week period, so we may not have gone as much in depth with the topics as we normally could. Furthermore, researcher bias comes into play when we identify themes. To lessen bias, the researchers created a theme specifically for when the PSTs did not elaborate on their responses, so they would not attempt to interpret what the PSTs meant or make assumptions when they did not have enough information.

Although the PSTs were asked how familiar they were with the term “voter suppression,” they self-identified their confidence level but did not elaborate on their choice. The next time this task is implemented, the researchers intend to ask their PSTs to explain “voter suppression” in their own words. In the future, the researchers also plan to design a study in a way to collect more longitudinal data (i.e., asking participants to include a personal email address to be contacted in the future). This way, there will be a way to follow up with the PSTs such as after the presidential (or next midterm) election to determine if they voted.

Conclusion

Overall, this was a positive experience for our PSTs. They learned more about situating mathematics content in a social justice context. They also applied what they learned from this lesson to determine the best measure of center in different situations such as calories in McDonald’s sandwiches. This idea of situating content within real-life experiences can also be extended to other content areas. For example, a lesson on history, economics, mathematics, and English language arts may analyze a plantation’s profits and losses with and without slaves in

order to examine the South's financial viewpoint on slavery and human rights violations suffered by slaves (Irvin et al., 2021). In English or foreign language, students can research a topic and write about an injustice they, or someone else they know, experienced. For sciences, they can raise awareness of environmental racism, such as contamination in water supplies due to factory waste in communities which are predominantly Black and Latinx (Foster, 2020). Our findings support previous research (Gay, 2010; Villegas & Lucas, 2002) that by incorporating social justice issues into different content areas, teachers of all disciplines can connect with their students from different cultural, ethnic, and socioeconomic backgrounds at a deeper level and increase student learning and engagement in both the content and social issues.

Research suggests PSTs may leave their credentialing programs with limited knowledge of how to integrate TM4SJ lessons in their future classrooms (Blanchett, 2006). Thus, beginning teachers who choose to incorporate culturally responsive approaches and TM4SJ should not be discouraged by their initial attempts (Leonard et al., 2010), as they are navigating to teach content in addition to finding pedagogical practices that work best for them and their students. As teacher educators, the researchers will continue to integrate social justice topics into their mathematics lessons, reflect on their practices, and help their PSTs gain experience infusing student culture and social justice issues into daily instruction so they in turn will create lessons with social justice aims for their future students. Future projects may include pre- and post-surveys with both social issues and mathematics content knowledge. As an extension, we could assign PSTs a group project where they integrate a mathematical concept learned in class with social justice issues and then present their ideas to the whole class.

REFERENCES

- Blanchett, W. (2006). Disproportionate representation of African American students in special education: Acknowledging the role of White privilege and racism. *Educational Researcher*, 35(6), 24-28.
- Boyer, E.L. (1990). *Scholarship reconsidered: Priorities of the professoriate*. San Francisco, CA: Jossey-Bass.
- Conway, B., & Nguyen, H. (2020). Incorporating Social Justice into Statistical Instruction: Using Action Research to Impact Pre-Service Teachers. *International Journal for the Scholarship of Teaching and Learning*, 14(1). Available at: <https://digitalcommons.georgiasouthern.edu/ij-sotl/vol14/iss1/13>
- Cross, K.P. (1986). A proposal to improve teaching: Or, what taking “teaching seriously” should mean. *AAHE Bulletin*, 39(1), 9-14.
- Foster, J. (2020, May 26). *Investigating Environmental Racism in the High School Biology Classroom*. National Science Teaching Association. <https://www.nsta.org/blog/investigating-environmental-racism-high-school-biology-classroom>
- Freire, P. (1992). *Pedagogy of the oppressed*. (M. B. Ramos, Trans.). New York: Seabury Press.
- Gay, G. (2010). *Culturally responsive teaching: Theory, research, and practice*. New York, NY: Teachers College Press.
- Gutiérrez, R. (2013). The sociopolitical turn in mathematics education. *Journal for Research in Mathematics Education*, 44(1), 37–68.
- Gutstein, E. (2003). Teaching and learning mathematics for social justice in an urban, Latino school. *Journal for Research in Mathematics Education*, 37-73.

- Gutstein, E. (2006). *Reading and writing the world with mathematics: Toward a pedagogy for social justice*. New York: Routledge.
- Gutstein, E. (2007). Connecting community, critical, and classical knowledge in teaching mathematics for social justice. *The Montana Mathematics Enthusiast*, Monograph 1, 109-118. Retrieved December 1, 2020 from <http://radicalmath.org/docs/Gutstein.pdf>
- Gutstein, E. (2009). Developing social justice mathematics curriculum from students' realities: A case of a Chicago public school. In W. Ayers, T. Quinn, & D. Stovall (Eds.), *The handbook of social justice in education* (pp. 690-698). Mahwah, NJ: Erlbaum.
- Haltiwanger, J. (2018, November 6). *Georgia voters face long lines, malfunctioning voter machines amid hotly contested governors race*. Business Insider. <https://www.businessinsider.com/georgia-governor-brian-kemp-stacey-abrams-long-lines-malfunctioning-voter-machines-midterms-2018-11>
- Hutchings, P., Huber, M.T., & Ciccone, A. (2011). Getting there: An integrative vision of the scholarship of teaching and learning. *International Journal for the Scholarship of Teaching and Learning*, 5(1). Retrieved May 1, 2018 from <https://digitalcommons.georgiasouthern.edu/ij-sotl/vol5/iss1/31/>
- Irvin, D., Brooks, S., Conway, B., & Nguyen, H. (2021). Teaching Statistics for Social Justice - An Autoethnographic Research Report. *Georgia Educational Researcher*, 18(1). DOI: 10.20429/ger.2021.180103
- Ladson-Billings, G. (1992). Liberatory consequences of literacy: A case of culturally relevant instruction of African American students. *Journal of Negro Education*, 61(3), 378-391.
- Ladson-Billings, G. (1994). *The dreamkeepers: Successful teaching for African-American students*. San Francisco: Jossey-Bass.

- Ladson-Billings, G. (1995). *Toward a theory of culturally relevant pedagogy*. *American Educational Research Journal*, 32(3), 465-491.
- Leonard, J., Brooks, W., Barnes-Johnson, J., & Berry III, R. Q. (2010). The Nuances and Complexities of Teaching Mathematics for Cultural Relevance and Social Justice. *Journal of Teacher Education*, 61(3): 261–270.
- McWhirter, C. & Snow, E. (2018, November 7). *Brian Kemp Says He Won Georgia Governor's Race, but Stacey Abrams Isn't Conceding*. *The Wall Street Journal*.
<https://www.wsj.com/articles/georgia-and-wisconsin-candidates-refuse-to-concede-governor-races-1541607485>
- Michelli, N. M., & Keiser, D. L. (Eds.). (2005). *Teacher education for democracy and social justice*. New York: Routledge.
- Murrell, P. C., Jr. (1997). Digging again the family wells: A Freirean literacy framework as emancipatory pedagogy for African American children. In P. Freire, (Ed.), *Mentoring the mentor: A critical dialogue with Paulo Freire* (pp. 19–58). New York: Peter Lang Publishing.
- National Council of Supervisors of Mathematics & TODOS Mathematics for All. (2016). *Mathematics education through the lens of social justice: Acknowledgment, actions, and accountability*. A joint position statement. Retrieved from
<https://www.mathedleadership.org/docs/resources/positionpapers/NCSMPositionPaper16.pdf>
- National Council of Teachers of Mathematics. (2014). *Why California?*. Illuminations.
<http://illuminations.nctm.org>

- Nguyen, H., & Eisenreich, H. (2018). Using School Choice to Connect to Mathematics Learning in a Statistics and Probability Course for K-8 Pre-service Teachers. *Georgia Educational Researcher*, 15(1).
- Peterson, B. (2012). Numbers count: Mathematics across the curriculum. In A. A. Wager & D. W. Stinson (Eds.), *Teaching mathematics for social justice: Conversations with educators* (pp. 147-159). Reston, VA: National Council of Teachers of Mathematics.
- Public Broadcasting Service LearningMedia. (2016a). *To Vote or Not to Vote | We The Voters*. PBS Education & We The Voters 2016. <https://gpb.pbslearningmedia.org/resource/to-vote-or-not-to-vote-lesson-plan/we-the-voters/>
- Public Broadcasting Service LearningMedia. (2016b). FRONTLINE | Why Voter ID Laws Aren't Really about Fraud. WGBH Educational Foundation. <http://www.pbslearningmedia.org/resource/fln33-soc-voterfraud/>
- Rannard, G. (2018, November 8). *Mid-terms 2018: When voting goes wrong*. BBC News. <https://www.bbc.com/news/world-us-canada-46132670>
- Spielhagen, F. (2011). *The algebra solution to mathematics reform: Completing the equation*. New York: Teachers College Press.
- Stein, L. (2018, November 27). *U.S. voting rights trampled in Georgia governor's race: lawsuit*. Reuters. <https://www.reuters.com/article/us-usa-election-georgia/u-s-voting-rights-trampled-in-georgia-governors-race-lawsuit-idUSKCN1NW2B8>
- Villegas, A. M., & Lucas, T. (2002). *Educating culturally responsive teachers: A coherent approach*. Albany, N State University of New York Press.

Wright, P. (2015). *Teaching Mathematics for social justice: translating theory into classroom practice* [Doctoral Thesis]. University of Sussex. Retrieved 02/11/2021 from http://sro.sussex.ac.uk/id/eprint/53984/1/Wright%2C_Pete.pdf