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WOMEN LEADERS IN MATHEMATICS EDUCATION: AN ANALYSIS OF GENDER IN LEADERSHIP ROLES IN PROFESSIONAL ORGANIZATIONS

Article by Brianna Kurtz and Farshid Safi

Abstract

Professional organizations within mathematics education have been a source of development, connection, pedagogical direction, and policy for decades. With gender and equity discussions reaching the forefront of the mathematics education conversation, one must consider the gender representation of those leading the organizations upon which we rely. The authors analyzed historical presidential data from four major mathematics education professional organizations in the United States. Women were found to be in presidential roles at a statistically significantly less proportion ($p < 0.001$) in three of the four organizations. When the organizations were considered aggregately since the enactment of Title IX, a trend to a plateau at 40% female leadership was seen. Future analysis beyond the presidential role and breakdowns by other factors are advisable.

Introduction

The underrepresentation of females in mathematics has been widely studied and analyzed. However, once women are retained in STEM fields including mathematics, further disparities are seen in their representation in leadership roles, especially in professional organizations (Welch, Parker, & Welch, 2013). Although efforts have been made to encourage the qualities necessary to hold leadership roles, this has been a more recent development (Dugan, Faith, Howes, Lavelle, & Polanin, 2013). This begged the question as to if the disparities experienced by women in mathematical organizations in leadership roles was also experienced by women in the major mathematics education organizations in the United States. By taking a historical approach and analyzing publically available information, the goal is to see if the underrepresentation does occur and if it does so in a statistically significant way.

Literature Review

The importance of female leadership in mathematics education

Direct correlations have been seen between students' views on the appropriateness of mathematics for his or her binary gender and the continued pursuit of the field and that which surrounds it. Additionally, teachers and administrators are essential keys in the promotion of positive gender roles in mathematics, and often the administrators especially are relying on current research coming from the field when making their decisions (Wilson & Hart, 2001). Often, to promote non-sexist teaching and the recognition of sexism in mathematics education, teachers and administrators will be looking to research and development coming out of professional organizations in mathematics education (Jacobs, 1978). Therefore, we look to the current leadership in mathematics education and the changes in leadership by gender to see if legitimacy is truly being provided in context.

American Mathematical Society

The American Mathematical Society (AMS) was formed in 1894 as a derivative of the New York Mathematical Society. Although established to work primarily in research with pure and applied mathematical problems, some of the early members, including E. H. Moore, saw it that some attention was given to issues in mathematics education, primarily in secondary schools. Furthermore, the 1894 publication entitled the *Report of the Committee of Ten on Secondary School Studies* saw the push for national committees to spark reform in mathematics education (Jones & Coxford, 1970b). From here, it could not be denied that mathematics education and its outcomes could be widely influenced by the formation of a society specific to this cause, rather than a simple sect of like-minded people within the AMS.

National Council of Teachers of Mathematics

Founded in 1920, the National Council of Teachers of Mathematics (NCTM) was created as a response to educational reformers who were, in the opinions of many educators focused on mathematics, diluting mathematical content in favor of a more holistic approach to teaching. C. M. Austin was the first president and stated that, among other goals, that the council itself would be a place where solid pedagogy and curriculum reform could be presented in a constructive way, as compared to some of what he felt were loftier and abstract decrees related to the profession (Osborne & Crosswhite, 1970).

Today, NCTM remains influential in mathematics education throughout the United States and Canada, promoting a membership of over 60,000 educators with 230 affiliate groups (NCTM, 2017). While pedagogical practices and the teaching and learning of mathematics are still at the forefront of the organization's goals, equity has additionally made its way into the strategic framework of NCTM. In its initial founding, one of the reasons for formation given by C. M. Austin himself was to, "help the progressive teacher to be more progressive...[and] also arouse the conservative teacher from his satisfaction" (Osborne & Crosswhite, 1970, p. 195). Now the shift has certainly been

seen from the proverbial *his* to *his and hers*, with the strategic plan stating, “NCTM advances a culture of equity where each and every person has access to high-quality teaching empowered by the opportunities mathematics affords” (NCTM, 2017, para. 4).

NCTM did start its female leadership early with the election of Dr. Eula Weeks to the vice presidency from 1922-1923. Dr. Weeks had received her PhD in mathematics in 1915 from the University of Missouri and went on to teach at Grover Cleveland High School in St. Louis. In 1919, one year before women obtained the right to vote, she was appointed to the National Committee on Mathematical Requirements as one of only three representatives from secondary schools, and she was also a charter member of the Mathematical Association of America (MAA) (Green & LaDuke, 2009). Marie Gugle became the first female president in 1927 and, although sporadic through its history, female presidents have consistently appeared through the organization (NCTM, 2018).

School Science and Mathematics Association

Founded nineteen years before NCTM in 1901, the School Science and Mathematics Association (SSMA) began as the Central Association of Physics Teachers. It was reimagined the following year as the Central Association of Science and Mathematics Teachers and kept close ties to its founding location of Chicago. SSMA advertises itself as a sounding board for multiple organizations, including NCTM, and boasts a monthly journal (SSMA, 2018). Indeed, some of the findings of the National Committee of Fifteen on the Geometry Syllabus, one of the reform committees referred to by C.M. Austin, published its findings in a 1911 *School Science and Mathematics Journal* (Jones & Coxford, 1970a). This, however, was not the only item shared by the two organizations. Marie Gugle, the first female president of NCTM, also served as the first president of SSMA from 1916 – 1917, a full three years before the founding of NCTM (SSMA, 2018).

Association of Mathematics Teacher Educators

One of the newer and smaller prominent professional associations for mathematics educators in the United States, the Association of Mathematics Teacher Educators (AMTE) was founded in 1991 and currently holds a membership of over 1,000. While both NCTM and SSMA tend to focus more on pedagogical techniques and practices dealing with the primary and secondary sector, AMTE focuses more on the education of future and current mathematics teachers. With Judith Jacobs presiding as the first female president just four years after the initial formation of the organization in 1991, AMTE has been ahead of its time in many ways in terms of focusing on issues of equity in mathematics education (Breyfogle & McGatha, 2011).

Alongside the aforementioned NCTM and AMS and in conjunction with the NCSM and MAA, AMTE is a member of the Conference Board of Mathematical Sciences (AMTE, 2018). Together, these societies truly are shaping what it means to be a mathematics educator in the United States and Canada. Keeping this in mind, it makes it proper to analyze these to the fullest to determine how women are influencing the landscape of the profession.

Methodology

Historical lists of presidents were obtained from organizational websites for the prominent national mathematics education organizations in the United States. These were identified based on size of membership, age, and relative influence in the field in terms of pedagogy and publication. The chosen organizations were: The National Council of Teachers of Mathematics (NCTM), the Association of Mathematics Teacher Educators (AMTE), and the School Science and Mathematics Association (SSMA).

Once each leadership list was obtained, the number of males and females who served in presidential roles in each organization was recorded and the proportions calculated. In the case that an individual served as president of the same organization more than once, he or she was only counted as one data value. However, if the same individual served as president of two different organizations, this was considered as a unique data value for each of the organizations. For each organization, a two-proportion z-test was conducted to determine the statistical significance between the proportion of male and female leaders. Additionally, leadership information about the American Mathematical Society (AMS) was gathered as this as the largest membership of any American organization solely focused on mathematics as a whole. The leadership proportions of this organization were then compared to the combination of unique of NCTM, AMTE, and SSMA presidents to determine significance in gendered leadership differentials in mathematics versus mathematics education.

Results

Table 1 displays the raw gender numbers for each organization’s presidential leadership and the corresponding p -values for their individual significance tests.

Table 1
Presidential Leadership by Gender

ORGANIZATION	MALE PRESIDENTS	FEMALE PRESIDENTS	TOTAL	P-VALUE
NCTM	35	14	49	$p < 0.001$

AMTE	5	9	14	$\rho=0.131$
SSMA	70	19	89	$\rho<0.001$
AMS	62	2	64	$\rho<0.001$

When considering mathematics education organizations, it was found that both the National Council of Teachers of Mathematics and the School Science and Mathematics Association that there was a lower proportion of female presidents than male presidents in a way that was statistically significant, $\rho < 0.001$. The Association of Mathematics Teacher Educators did not have a significant difference in the gender of its presidents at the $\alpha = 0.05$ significance level ($\rho = 0.131$).

The American Mathematical Society also had a statistically significantly lower proportion of female presidents than male presidents ($\rho < 0.001$). When compared to the combined total of unique mathematics education presidents by gender, eliminating the five repeated females and three repeated males, it was found that there was a statistically significantly less proportion of female presidents for mathematics societies when compared to math education societies in the United States ($\rho < 0.001$).

A further look was taken at the changing proportion in the gender of leadership within the three prominent mathematics education societies in the United States since 1973, seen in Figure 1 below. A fifth-order polynomial trendline was fitted to the data with a Pearson correlation coefficient of $r=0.9269$.

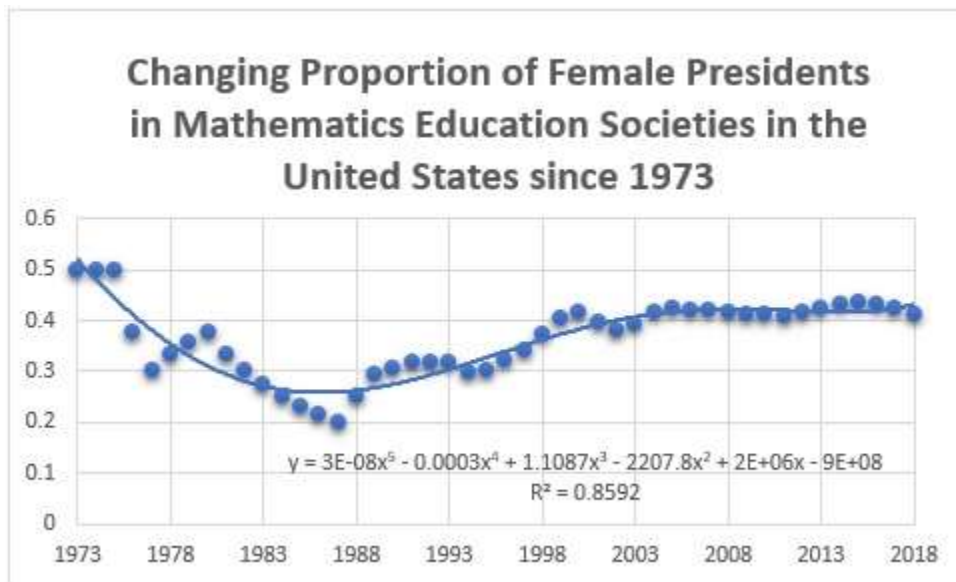


Figure 1: Changing proportion of female presidents, 1973 – 2018.

Discussion

According to the Schools and Staffing Survey, between 44 and 65% of middle school and high school math and science teachers in the United States are female. Considering as a whole that 75% of United States public school teachers in K-12 are female, one would expect leadership representation in the professional organizations dedicated to this profession to be at least 50/50, as elementary, secondary, and post-secondary teachers are included in the membership (National Center for Education Statistics, 2015). However, NCTM, the largest organization by the numbers dedicated to the profession in the United States, boasts only a 28.57% female leadership in its history. Likewise, SSMA has had only a 21.35% female leadership in its history. Both of these showed statistical significance in a difference in proportion to expectation of gender split for the leadership roles.

The only mathematics education organization whose numbers seem in line with expectation is AMTE, which comes in at 64.29%. It is important to note, however, that AMTE has only been in existence since 1991, a full 71 years longer than NCTM and 90 years longer than SSMA. If we consider historical changes in leadership and look at NCTM and SSMA from the years 1991 onwards, NCTM has had an exact fifty-fifty split between males and females in its past 14 presidents, and SSMA has had five of the last 14 presidents (35.71%) being females. While these organizations are becoming more in line in leadership when compared to what is expected, they still are seeing lower percentages than AMTE. One should note, however, that this particularly organization is more focused on teacher educators' membership than in-field teachers. However, this makes the results even more surprising. Only 44% of higher education faculty in the United States are women (National Center for Education Statistics, 2017). While the proportions may be different in just the educational field and should be considered in

future study, AMTE certainly seems to be an anomaly in the field, though statistically there is no difference in proportion between genders in leadership, mainly due to the small sample size attributed to the youth of the organization itself.

The data was further analyzed to consider the female leadership presence in NCTM and SSMA, and then combined with AMTE when it was founded, from the year 1973 onward. As the women's rights movement in the United States of the 1960's and 1970's saw an increase across the country in ideals associated with women's prominence and role in the workforce, this time period was chosen for further analysis. The year 1973 was chosen based on the passing of Title IX on June 23, 1972, which amended several acts, including the Higher Education Act of 1965, to include the illegality of gender-based discrimination (Mellis, 2017). What seems to be in line with Title IX, as well as the advent of gender-specific mathematics and mathematics education organizations such as the Joint Committee for Women in Mathematical Sciences in 1971, is that there was an initial spike in women's leadership followed by a decline after the novelty and initial push for Title IX's enactment had faded from the public eye.

The organizations themselves have various term lengths and starting times so, for the purposes of analysis, every year was treated as a separate accumulation point. Proportions instead of raw numbers were chosen for the data in order to maintain the integrity of the accumulation and provide a method by which to more readily handle the differing term lengths and starts of the leadership roles. As can be seen in Figure 1, the leadership proportion faced a general decline again until 1987, after which time there is been an upward trend in the growing historical proportion of women in the presidential roles of the three societies. This trend, however, has not grown as rapidly in the past 10 years, and now some overall stagnation is seen in the 40% range of proportion of female presidents over time.

When compared to the American Mathematical Society, the strongest representation of mathematicians in the United States, it was seen that the gender disparity in leadership was statistically significantly better in mathematics education than in mathematics. However, this can also be said for the representation of women in mathematics education when compared to pure and applied mathematics. The fact that the NCTM was a split from AMS itself may have indeed led not only to a focus on educational issues in mathematics but also gave a chance for females to take on leadership roles that may have come about more quickly than they would have had the groups stayed permanently merged.

Conclusions and Future Study

Women are slowly increasing their presence in leadership roles in mathematics education as with professional organizations in many fields but, as in these aforementioned fields, the changes are still slow to catch up with percentages who are members of the fields. Although the past 25 years has seen significant changes toward an equal balance of genders in leadership roles, there is still an imbalance to overcome before the percentages in leadership positions more closely matches the gender

percentages of the field itself. Furthermore, it would be very intriguing to determine how these proportions of leaders do or do not line up with the gendered membership of the organizations themselves, as well as what was occurring in 1987 that could have sparked the upturn seen in Figure 1.

Racial representation among the leadership in the organizations also deserves to be studied and evaluated further. Dr. Christine Thomas of Georgia State University, president of AMTE from 2015 – 2017, stepped into significant prominence as an African-American female president in mathematics education. As African-Americans and non-Caucasians in general have been poorly represented in leadership roles in mathematics and mathematics education, further analysis can be done about how the advent of organizations specific to equity issues in mathematics such as the Benjamin Banneker Association and TODOS: Mathematics for All have contributed to the promotion of gender diversity in leadership, even beyond the presidential roles.

As this study was limited to the United States, further analyses could include leadership in mathematics education throughout the world and investigate key organizations in Europe, East Asia, the Pacific, and South Africa that have a large presence in the mathematics education research community. Additionally, it would be desirable to obtain data on the percentages of women specifically in mathematics education in the primary and secondary sectors as a separation from science education. Then further, the science education numbers could be compared to mathematics and further disparities could possibly be witnessed.

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