

Students' Identities and Collaboration in Mathematics Group Work

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In this study, we examined how students' different identities, especially gender and students' relationship with mathematics, influenced leadership and group work in math classrooms. This study took place in two linguistically and racially diverse middle schools in Canada. We collected student surveys, video-recorded group work interactions, and individual video-mediated interviews. We analyzed four mixed-gender groups and 12 interviews. Our analysis revealed that girls took on leadership roles equally as boys. Instead, we found that those who demonstrated a positive math identity tended to take on leadership roles in the group and those who demonstrated a negative math identity did not. We also identified how culturally-constituted gender norms can influence collaboration. Two girls expressed their preference to work with girls. Their preference influenced the way in which they interacted in the group with a boy. Our results complicated the role of gender identities in math by examining its intersection with other identities. We highlight the importance for educators and parents to collectively develop positive math identities among all students to in turn foster leadership and agency in math learning. We also question the common school practice where students are socialized into the unsustainable norm that boys and girls work separately.

(a) Purpose and (b) Perspectives and Theoretical Framework

The benefits of group work are well documented in educational literature (Blumenfeld, Marx, Soloway, & Krajcik, 1996; Ryve, Nilsson, & Pettersson, 2013). However, research has also noted an unequal distribution of learning opportunities within these groups. Often, this inequality emerges because of students' social identities (e.g., race, ethnicity, gender, etc.) (Esmonde & Langer-Osuna, 2013; Langer-Osuna, 2011; Takeuchi, 2016). Therefore, the present study examines how students' different identities influence leadership and group work in math classrooms. Within their groups, students can take on different roles. Group leaders are defined as those individuals who determine the course of the group's problem solving by directing the other group members and offering help (Langer-Osuna, 2011). To strive for equity, Langer-

Osuna suggests we attend to how students' engagement with math can be influenced by students' positioning as group leaders and by their gender identities.

To conceptualize gender in the present study, we drew from Butler (1990) and queer theory. According to Butler, gender is characterized as performative: "*stylized repetition of acts*" (p. 140). In this conceptualization, gender is a dynamic act rather than stable attributes.

Furthermore, as recommended by Leyva (2017), to achieve a more complete analysis of gender in math, we consider how different aspects of identity and different levels of school practices influence students' math success. Students' math identities, who they believe themselves to be in math, play a critical role in how they engage with and feel about the discipline (Bishop, 2012). Additionally, math identities are dynamic, contextualized within a given community and are therefore, both individually and collectively determined. Thus, the influence from significant community members (e.g., parents) can shape students' identities or attitudes towards math as well (Heyd-Metzuyanim, 2015).

(c) Methods and (d) Data Sources

We collected the data for this study from two linguistically and racially diverse middle schools in Canada. We collected three different types of data: student surveys regarding group work experiences ($n=236$), 11 video-recorded group work interactions, and individual video-mediated interviews ($n=39$). In the interviews, we asked students questions regarding their preference for group work, their relationship with math, and their parents' expectations. We analyzed the survey data using chi-square analyses to reveal any associations between students' group work experiences and gender. For the analysis of group work interactions and interviews, we selected four mixed-gender groups and 12 interviews. Group 1 was made up of four students: one student self-identified as a boy; three students self-identified as girls. Group 2, Group 4, and

Group 6 were each made up of three students. In each group, two students self-identified as girls and one student self-identified as a boy.

(e) Results

We first examined whether and how students' gender identities influenced leadership. Our analysis revealed no gender bias influencing which student took the leadership role in the group. We then considered the role of math identities in group leadership. We found that those who had developed a positive math identity tended to take on leadership roles in the group and those who had developed a negative math identity did not. For example, Dhann, the Group 1 leader, demonstrated a positive math identity as evidenced by such statements as, "I always take a step ahead for some reason" and "it only took a genius to figure that out." Sana, the leader of Group 4, also expressed a positive math identity. She then explained to us that at home her dad encourages her to be a leader and helps her complete math problems and that her mom is a math teacher in Pakistan. Jeet, the Group 6 leader, also expressed a positive math identity. She said that math in Canada was "very easy" (compared to in India). However, in Group 2, all three students had negative math identities. In their interviews, they all expressed the same identity of "not good at math" and in this group, there was no one consistently positioned as a leader.

While we did not find a clear connection between gender and leadership, we found more nuanced ways in which the gender norms affect group dynamics. In our data, 32.7% of boys strongly agreed with the statement "I am good at math," whereas only 8.4% of girls strongly agreed with the same statement ($\chi^2(1)=14.37, p<0.01$). We examined how culturally-constituted ideas of gender can also influence collaboration. In Group 4, both Sana and Rue (the girls of the group), expressed a preference to work with girls. This was evident in Group 4's video-recorded interactions in a couple of different ways. At the small table the group was working at, Sana and

Rue sat close together at one end, whereas Zain was separated from the two girls at the other end. Sana and Rue communicated almost exclusively with each other. In her interview Sana, elaborated that she does not like to speak in front of boy. This discomfort working with boys could have influenced the poor collaboration among the group members.

(f) Educational Importance

Previous research has found a relationship between gender and leadership within group work (Esmonde, Bradie, Dookie, & Takeuchi, 2009; Langer-Osuna, 2011). Our analysis further examines this and we found no clear pattern between gender and leadership. Girls took on leadership roles equally as boys. However, our results also indicate that gender norms shaped students' ways of collaborating and positive math identities were associated with taking on leadership roles. Thus, our results complicated the role of gender identities in math by examining its intersection with other identities (Leyva, 2017). Our study shows how gender, math identities, and messages from parents, interact to shape math learning. Therefore, our analysis highlights the importance for educators to develop positive math identities among all students to in turn foster leadership and agency in math learning.

Our findings reveal more nuanced ways in which heteronormative classroom practices affect group dynamics (McWilliams, 2016). The girls in Group 4 expressed a preference for working with girls because they feel uncomfortable speaking in front of boys. Generally, schools continue to form groups using the gender binary. As such, students are socialized into the unsustainable norm that boys and girls work separately. It is important that educators become aware of the heteronormative practices they are perpetuating in their classrooms and how this can influence math learning.

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