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Students' Attitudes towards Mathematics during Math Walks

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Abstract: Math walks are informal learning activities where students create mathematical meaning from their everyday surroundings. In this qualitative study, we observed 5th–8th-grade students (N = 52) across three urban informal learning sites (a community center, a zoo, and an aviation museum) as they created their own math walks exploring geometric concepts. In a post-survey questionnaire, students described their attitudes toward math using affective language motivated by three psychological factors: autonomy, competence, and relatedness. Implications for informal math learning are discussed.

Conceptual framework

Recent informal learning science literature (Guzey et al., 2016) maintained that situated learning has been used to broadly study students' attitudes toward STEM (science, technology, engineering, and mathematics) as they participate in authentic learning activities (Brown et al., 1989). The construct of attitudes toward math has been extensively studied in formal schooling scenarios, revealing that students typically express their attitudes toward math using affective descriptive language (Chew et al., 2019; Russo & Minas, 2020). Those studies showed that students' attitudes toward math can range from being "positive" to "ambivalent" to "negative" and usually vary in strength along that spectrum. But, how do students express their attitudes toward math in informal learning environments? Math walks, or informal learning activities where students walk around their communities and form math connections with the art, nature, etc. within their surroundings, are being used as a way to improve students' attitudes towards mathematics (e.g., Wang et al., 2021). We used self-determination theory (Deci & Ryan, 2012) to examine how students expressed their attitudes toward mathematics based on three psychological factors that motivate behavior: autonomy, competence, and relatedness (Russo & Minas, 2020). As such, our research question was: How do students describe their attitudes toward mathematics after participating in and creating a series of math walks?

Methods

Over 3–4 sessions, we examined a diverse group of learners in grades 5–8 (N = 52) at three informal learning sites (a community center, a zoo, and an aviation museum) in a large urban city in the southwestern U.S.A. Across the sites, learners were mostly female (71%), Black (49%), and Hispanic/Latinx (27%). Grade level breakdown was 33% (5th grade), 37% (6th grade), 19% (7th grade), and 11% (8th grade). Students self-organized into groups of 3–4 paired with one researcher who video-recorded the group's daily interactions. After they finished the math walk activities, they took a paper-based survey, which included two open-ended questions: (1) What did you like about your experience creating your math walk? and (2) What do you wish had gone differently? In isolating students' attitudes toward math, we used thematic analysis (Braun & Clark, 2006) to contextualize students' written feedback on their experiences and iteratively coded responses as either positive, ambivalent, or negative. Then, like Russo and Minas (2020), we categorized the statements into three themes representing the psychological motivators: autonomy (choice over how they approached the task), competence (feeling they have the necessary success skill), and relatedness (collaboration with their peers during the task).

Results

Students' affective attitudes toward math walks

Analysis of the data revealed that affective attitudes (how they felt) toward mathematics after the math walk experience (see Table 1) were predominantly positive across all sites, with 69% (*n* = 27) of students reporting positive sentiments. Positivity language included phrases such as "I liked...," "I enjoyed...," or "It was fun...." For instance, a 5th-grade female community center participant expressed her satisfaction by saying, "What I liked about creating my own math walk is when I got to go and find an area that was math related." Students who expressed ambivalent or negative feelings were evenly split at 15.4% (*n* = 6). For example, a female 8th-grader at the aviation museum reported mixed feelings, saying, "It was okay. It really doesn't matter to me. It was boring sometimes, and then it wasn't boring." Meanwhile, a male 8th-grader at the zoo expressed a desire for "things being more related to math." We coded this as a negative feeling because a specific learning need was unmet. Unanswered questions were excluded from the analysis.

Table 1
Summary of Students' Affective Attitudes toward Mathematics during Math Walks

Positive	Ambivalent	Negative
27 (69.2%)	6 (15.4%)	6 (15.4%)

Psychological motivators for students' positive attitudes toward math

Next, we described the student attitudes and found that they primarily attributed positive attitudes due to their perceived ability to demonstrate *competency* in math (n = 23). For instance, one fourth-grader at the zoo wrote, "I liked finding similarities between math and animals." Other students used language that emphasized *relatedness* (n = 11) when expressing their attitudes toward math during the math walks at their sites. Two documented responses were:

> *"I like that we got to be in a group and express our ideas in math."* –4th-grade male zoo participant
>
> *"I also enjoyed how we worked in a group because groups make me feel more comfortable."* –5th-grade female student community center participant

Finally, eight students (n = 8) discussed the importance of *autonomy* when completing their math walks. "Being able to pick our stop was my favorite part," explained one 8th-grade male who attributed his positive attitude toward the math he was learning to his enjoyment of autonomy during the tasks.

Conclusion

Our analysis revealed that student-created math walks are promising tools for practitioners to gauge students' affective attitudes toward mathematics and the possible reasons behind those attitudes. Although most students expressed positive attitudes toward mathematics, some reported negative or ambivalent feelings. The impact of math walks on students' perceived competence requires further exploration to inform the development of math walk activities and theories of change for informal math learning. These preliminary findings are based on data collected in the first year of our five-year study. Future implications include students' transferability of positive attitudes towards mathematics developed in informal learning environments to formal learning environments (i.e., schools) and teachers' experimentation with math walks to improve students' attitudes toward mathematics.

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