Running Head: STUDENT PERSPECTIVES ON INSTRUCTIONAL STRATEGIES

Marginalized Students' Perspectives on Instructional Strategies in Middle-School Mathematics Classrooms

Bethany Rittle-Johnson, Vanderbilt University

Dale C. Farran, Vanderbilt University

Kelley L. Durkin, Vanderbilt University

Published 2020 in The Journal of Experimental Education
https://doi.org/10.1080/00220973.2020.1728513

Author Note

Bethany Rittle-Johnson, Department of Psychology and Human Development, Dale C. Farran, Department of Teaching and Learning, Kelley L. Durkin, Department of Teaching and Learning, Vanderbilt University.

Research supported by the Heising-Simons Foundation (#2013-26) to Dale Farran and the Institute of Education Sciences, U.S. Department of Education, through grant R305K050157 to Dale C. Farran and Mark Lipsey and grant R305A140126 to Dale Farran. The opinions expressed are those of the authors and do not represent views of the funders. The authors thank the staff, teachers, and children in the Metro Nashville Public Schools for participating in this research, Megan Franke for her input on our methodology, and Claudell Haymond, Luke Rainey and Jessica Sommer for their help in designing and implementing the interview protocol and coding system.

Address correspondence to Bethany Rittle-Johnson, 230 Appleton Place, Peabody 552, Vanderbilt University, Nashville, TN 37203. Email: bethany.rittle-johnson@vanderbilt.edu. Phone: 615-322-8301.

Abstract

Marginalized students face a range of gaps in experience, highlighting the importance of understanding these students' perspectives on their opportunities to learn. The current study contributes to this effort by reporting on marginalized students' experiences and liking of mathematics instructional strategies in middle-school mathematics classrooms in a large metropolitan school district in the Southern U.S. Middle-school students (N = 466), many of whom attended racially segregated schools, sorted instructional strategies and discussed their experiences with the strategies in small groups or interviews. Most students reported that traditional and student-focused instructional strategies happened in their mathematics class, but fewer student-focused strategies were experienced in racially segregated schools than in racially balanced schools. Most students reported liking all but one of the student-focused strategies and not liking the traditional strategies. Common reasons that emerged during discussions of why students liked particular instructional strategies were that it provided opportunities to learn, built their confidence or increased their interest. Overall, marginalized students' experiences and views should inform efforts to increase the instructional opportunities for all students.

KEYWORDS: Opportunity gap; instructional practices; mathematics education; student attitudes; urban education; segregated schools

Marginalized Students' Perspectives on Instructional Strategies in Middle-School Mathematics Classrooms

Students of color and those from low-income homes are often marginalized in schools, facing a range of gaps in experience, including an education gap, opportunity gap, expectation gap, resource gap, teacher quality gap, and funding gap (Darling-Hammond, 2000; Ford, 2016; Ladson-Billings, 2006). For example, these students often have less access to qualified mathematics and science teachers (Akiba, LeTendre, & Scribner, 2007). Further, teachers often have deficit views of marginalized students. For example, they attribute students' difficulties with mathematics to traits of the students and/or deficits in their families and communities, rather than to factors under the teachers' control, such as instructional quality (K. Jackson, Gibbons, & Sharpe, 2017). Given these structural inequities and potentially harmful teacher beliefs, what are marginalized students' own perspectives on their instructional opportunities? Students' perspectives, such as whether and why they like different instructional strategies, have important implications for their motivation, learning and identity (Joseph, Hailu, & Boston, 2017; Lubienski, 2002; Stodolsky, Salk, & Glaessner, 1991). The current study reports on marginalized students' experiences and attitudes toward different instructional strategies in middle-school mathematics classrooms in a large metropolitan school district in the Southern United States. Students sorted instructional strategies and then discussed their experiences with the strategies. The current study focused on instructional quality because this factor is under the teachers' control, so our results have the potential to disrupt teachers' and policy-makers' deficit views of marginalized students.

In the introduction, we first discuss instructional strategies in mathematics teaching and potential differences in exposure to varied instructional strategies in segregated schools compared to racially or economically balanced schools. Next, we discuss students' views of different instructional strategies, such as whether they like them and why they like them. Then, we outline the goals and design of the current study.

Instructional Strategies in Mathematics Teaching

Students' classroom experiences are one driver of their learning, attitudes and persistence (Boaler & Staples, 2008). Broader factors, such as at home experiences, community resources, and barriers created by systematic racism are also critical. We focus here on opportunities to learn in classrooms given their core role, while acknowledging that improving classroom experiences alone will not be sufficient (Berry, 2005; C. D. Lee, 2017). We focus on mathematics classrooms because they can be particularly exclusionary (McGee, 2014) and because poor performance and limited course work in mathematics is a barrier to college education and numerous career paths, especially for marginalized students (J. Lee, 2012; Moses & Cobb, 2001). In particular, we focus on marginalized students' experiences with common instructional strategies, such as lecturing and group work, in middle-school mathematics classrooms.

Traditional, teacher-centered, instructional strategies still dominate mathematics instruction around the world (Hiebert et al., 2003). Traditional instruction is primarily teachers lecturing and students individually completing worksheets and textbook problems. It is the most frequent form of instruction in the U.S. across grade levels (Jacobs et al., 2006; McKinney & Frazier, 2008; Wenglinsky, 2002). Although well-designed lectures and worksheets can provide useful opportunities for learning, heavy reliance on these traditional instructional strategies is not very effective in supporting student understanding or motivation, especially among marginalized students (Boaler & Staples, 2008; Lubienski, 2006; NCTM, 2014) and is associated with inequitable participation in mathematic classrooms (Boaler & Staples, 2008).

Recommendations for more effective and equitable mathematics instruction include instructional strategies that are more student focused (i.e., in which students play a more active role), with a greater focus on opportunities for students' mathematical thinking and for collaboration (Boaler & Staples, 2008; NCTM, 2014). For example, Ford (2016) claims "Cooperative learning is essential for Hispanic and African American students relative to building a sense of community and addressing culturally based ways of learning" (p. 372). Collaborative problem solving opportunities, including small group work and sharing solutions to mathematics problems with other students, is also associated with greater student engagement and learning (Lubienski, 2006; Webb et al., 2014). Similarly, students comparing solution methods with peers improves student learning (Rittle-Johnson & Star, 2007). Such comparison requires that teachers support the use of multiple solution methods for solving a problem, which in itself is also associated with better learning (Woodward et al., 2012). Other student-focused instructional strategies are used in classrooms, such as playing mathematics games and conducting projects in small groups, but have less evidence for consistently being related to better student learning or motivation (Lubienski, 2006; McKinney & Frazier, 2008). The first goal of this study was to identify which instructional strategies marginalized students reported occurring in their middle-school mathematics classrooms.

There may be an opportunity gap in marginalized students' exposure to student-focused instructional strategies. There is general concern of a "pedagogy of poverty" in urban, often segregated, schools, including concerns that there is less use of high-quality curriculum and instructional practices (Darling-Hammond, 2000; Haberman, 1991). This concern is based in part because of a gap in teacher quality. Teachers are typically less qualified (e.g., more likely to be new teachers) and turn over more in schools with a majority of students who are Black or who are from low-income homes compared to schools with a majority of students who are White (Akiba et al., 2007; Aud, Fox, & KewalRamani, 2010). In addition, teachers may have deficit views of marginalized students, tending to simplify tasks rather than continue to challenge the students to engage in rigorous mathematics (K. Jackson et al., 2017). Further, teachers may make subtle variations in the instructional strategies they use with students of different races. For example, teachers may provide instruction with more emphasis on basic skills with their Black students compared to their White students (Lubienski, 2002, 2006; Oakes, 1990), and Black female college students majoring in STEM fields reported they were less likely to have been pushed to think critically in their high-school mathematics classes than their White peers (Joseph, 2017).

School segregation may exacerbate differences in opportunities to learn for marginalized students. There are consistent negative effects of attending racially imbalanced, segregated schools on student achievement and teacher qualifications (see Mickelson, 2015 for a review). For example, the re-segregation of schools since the ending of court-ordered desegregation in one school district was associated with there being less-qualified teachers in the segregated schools (e.g., more teachers with 0-3 years of experience, fewer teachers scoring well on their certification exams) (C. K. Jackson, 2009). One goal of the current study was to test for an opportunity gap in students' exposure to varied student-focused instructional strategies in segregated schools compared to racially or economically balanced schools

Marginalized Students' Views of Instructional Strategies

Another goal of the current study was to explore marginalized students' own perspectives of their instructional opportunities in math classrooms. Students' perspectives, such as whether and why they like different instructional strategies, have important implications for their motivation, learning and identity (Joseph et al., 2017; Lubienski, 2002; Stodolsky et al., 1991). As Carol Lee (2017) noted, "the design of robust learning environments (whether in families, in schools, in informal community-based settings) ignores the perceptions and as a consequence, the emotional experience of learners at their peril" (p. 93).

Illustrating the importance of attending to students' perceptions, when a teacher-researcher taught a new seventh-grade mathematics course using open-ended problems and extended student exploration, students who reported not liking the new instructional practices were less motivated to engage in the mathematics work and tended to learn less than students who liked the practices (Lubienski, 2000). Further, among these predominantly White students, the social class of students' families was related to students' liking of the new instructional practices, with students from lower-SES homes liking the practices less than students from higher-SES homes.

We could not identify a previous study that focused on students' perceptions of mathematics instructional strategies among a large number of marginalized students. Too often, research is conducted with primarily White participants from middle-to-upper-middle-class families, with the implied assumption that this is the normative perspective (Lee, 2017), or with a representative sample that does not consider potential differences by race or social class. Mathematics classrooms are often white-male dominated spaces and experienced as unwelcoming and exclusionary environments by students of color (Joseph et al., 2017; McGee, 2014). Clearly, research on students' perceptions of mathematics instruction conducted with primarily White participants cannot be assumed to generalize to students of color. We centered marginalized students' perspectives to better understand what instructional strategies they like and why in mathematics classrooms.

Some scholars suggest students from some racial and ethnic groups will favor collaboration-based instructional strategies, which are a key component of student-focused instruction. For example, Ford (2016) claims "Cooperative learning is essential for Hispanic and African American students relative to building a sense of community and addressing culturally based ways of learning" (p. 372). Collaboration-based instructional strategies are considered more compatible with a more collectivist, interdependent framework of these cultures (Markus & Kitayama, 1991). Similarly, adolescents' preference for working as part of a team was higher among students from low-SES families than those from high-SES families in countries around the world (OECD, 2017). Thus, developmental and cultural characteristics of marginalized middle-school students led us to expect a majority of our participants would like student-focused instructional strategies, particularly collaboration-based instructional strategies (e.g., small group work and group projects) and would dislike traditional instructional strategies.

We also identified common reasons students gave for why they liked particular instructional strategies. For example, which instructional strategies did they consider to provide opportunities to learn? We should not assume that students' perceptions will match the views of teachers or experts in education, especially White teachers and experts. Students' perceptions are important for understanding their educational experiences and perceived opportunities.

Current Study

The purpose of this study was to give marginalized students attending middle schools an opportunity to report on various instructional strategies that occurred in their mathematics classrooms, which of these strategies they liked and why. This study asked and answered the following research questions:

1. What instructional strategies do marginalized students in a large metropolitan school district report occur in their middle-school mathematics classrooms? Is there an opportunity gap, with differences in exposure to student-focused instructional strategies in segregated schools compared to racially or economically balanced schools?
2. Of the instructional strategies that occur in their mathematics classrooms, which ones do students report liking?
3. What are some common reasons for why students like particular instructional strategies in their mathematics classes? For example, which instructional strategies did they consider to provide opportunities to learn?

Students all attended schools in a Southern metropolitan school district that continues to have a substantial number of segregated schools, with many schools having a high concentration of students of color and students living in poverty.

First, students individually identified which instructional strategies they had experienced in their mathematics class and which of those strategies they liked via card sorts. Then, students discussed why they liked the strategies they had selected. When possible, these discussions were held in small groups because young people tend to feel more comfortable and share more about their attitudes in small groups than in individual interviews (Punch, 2002; Ruffell, Mason, & Allen, 1998). We identified common reasons for liking strategies that arose in the discussions to address our third question.

Method

Participants

Participants were 466 middle-school students (56% female) from a large metropolitan school district in the South who were part of a larger longitudinal study focused on mathematics knowledge development. Students had initially been recruited from 57 pre-kindergarten classes at 20 public schools and 4 Head Start sites, all of which served children who qualified for free or reduced priced lunch (family income less than 1.85 times the U.S. Federal income poverty guideline). The larger study included middle-school students who were not available to be interviewed because they attended schools outside of the district (n = 31), were homeschooled (n = 1) or who were not available to be interviewed for other reasons (n = 3), as well as a student who had skipped a grade and was in high school.

Most students were in eighth grade, but 18% (*n* = 85) had been retained a grade at some point and were in seventh grade, and the average age was 13.6 years (*SD* = .31). Most students were from marginalized racial groups, with 80% Black, 8% Hispanic, 8% White, non-Hispanic, and 4% other race students, which was very similar to the original sample. A large majority of students continued to be classified as economically disadvantaged (90%), with missing income data for many of the remaining 10% of students. These students were largely struggling in mathematics, with 55% classified as below basic, 29% as approaching expectations, 15% as on-track and only 1% as mastered expectations on the state mathematics test. About 16% of students received special education services, with specific learning disability (8% of students) and health impairments (4% of students) the most common reasons. Despite their low levels of achievement, most students reported liking mathematics, feeling comfortable with mathematics and as having teachers who would help them (Farran, Durkin, & Ziegler, 2017). The disparity between student ratings and their achievement helped motivate the present study, part of an attempt to understand student perceptions in more depth.

The students attended 46 different middle schools, with an average of 10 students per school (range = 1 to 25). Distribution of students across schools in the district is not equal by student race or family income. At the school-level, students of color comprised 39.5% to 98.6% of the student body at schools attended by participating students. About three-quarters of the students (74.7%) attended *a racially-segregated* school, defined as above the district average that school year of 70.5% students of color. The remaining quarter of students attended more *racially balanced* schools, with White, non-Hispanic students accounting for 32.3 to 60.5% of students, Black students accounting for 20.1 to 53.8% of students, and Hispanic students accounting for 5.4 – 37.9% of students. At the school-level, students from economically disadvantaged families comprised 10.1 to 89.6% of the student body at schools attended by participating students. Over half of students (61.4%) attended a *high-poverty school* (defined as above the district average of 50.6% economically disadvantaged), and remaining students attended more *economically balanced schools* (with economically disadvantaged students accounting for 10.1 to 50.5% of students). Many schools (52%) were both racially segregated and high-poverty schools; three of the high-poverty schools were not racially segregated, six of the racially-segregated schools were not high-poverty schools and 12 schools were neither. At the student level, 58.2% of students attended a school that was both high-poverty and racially segregated.

Teaching background was reported by 88% of students' teachers and is summarized in Table 1. About a third of teachers (37%) had majored or minored in mathematics while in college. A majority (64%) had at least 5 years of teaching experience and 52% had at least 5 years of experience teaching middle-school mathematics. Only 9% were first-year teachers and 16% were teaching middle-school mathematics for the first time. Teaching backgrounds were similar across school types, except teachers at high-poverty schools were less likely to have majored or minored in math than teachers at economically-balanced schools, (49% vs. 27%), χ^2 (1, 97) = 4.829, p = .028 (see Table 1).

Materials

Cards were created that contained both photographs and brief descriptions of 8 instructional strategies in mathematics classrooms, as shown in Table 2 and described in the Appendix, along with 4 distractor activities (e.g., watch movies; read books). We selected 6 student-focused instructional activities that are common in mathematics classrooms and that ranged in opportunities for collaboration and for student-generated ideas.

Procedure

Most students met in small groups of 2-6 students at their schools with a facilitator, with a group of 3 students the most typical size. Most groups (76%) had a mix of male and female students. When meeting with a small group was not possible (e.g., student was the only participating student at their school), students met individually with a facilitator. Of the 170 sessions, 133 were focus groups and 37 were interviews.

All materials, including the scripts, are posted on Open Science Framework (osf.io). The session began with a card-sorting activity completed individually, in line with recommendations to incorporate physical activities and concrete stimulus materials when interviewing young people (McHugh, Horner, Colditz, & Wallace, 2013; Punch, 2002). Each student was asked to sort the cards into two piles, one for what happens in your mathematics class and the other for what does not happen in your mathematics class. Cards for instructional activities that did not happen were placed in a marked envelope, and then a facilitator asked the students to briefly discuss the instructional activities that did happen, prompting them to share their experiences and examples.

Next, for cards in the “happens” pile, each student was asked to select which cards within that pile reflected things that they liked to do. Each student placed cards of instructional activities not like in a marked envelope, and then a facilitator prompted students to discuss what they liked about the instructional strategies in their “Like” pile, using prompts such as, “What do you like about them?” “Does anyone have similar or different experiences?” encouraging students to build on one another’s ideas. There was no push for students to come to a consensus. At some point in the discussion, the facilitator also asked, “In your mathematics class, is there just one way to solve a problem? Or does your teacher let you use different ways?” Students were then asked to do and discuss two additional sorts that are beyond the scope of this paper. Sessions were audiotaped and a note taker recorded students’ responses in real time. After the session, the note taker reviewed the audio file and revised and expanded the notes.

Coding of Discussion

Students’ discussions of what they liked about selected instructional strategies were coded through an iterative process. First, two people reviewed the session notes for themes in the discussions and identified a set of potential codes for common reasons for why students liked particular instructional strategies that emerged across strategies. The codes were: (a) *helps learning*, (b) *builds confidence*, (c) *improves enjoyment*, (d) *allows them to interact with peers,* (e) *includes rewards* like candy or teacher praise, (f) *other reasons (*“Writing on the board because I don’t like to sit all the time.”) A code was applied if at least one student mentioned the reason. These codes were not mutually exclusive, and a few additional codes were used for a particular instructional strategy. However, codes d) and e) occurred very infrequently (less than 3% of groups mentioned the theme for a particular strategy) and code f) did not match our goal of identifying common reasons, so we report on the first three codes. More information and detailed descriptions and examples are provided in the Results section. To establish inter-rater reliability, a team of people independently coded four sessions and then met to come to consensus on the presence of each code, creating master codes for the sessions. New coders needed to match at least 80% of the master codes for these lessons before they began coding new sessions. A total of 4 people coded the discussions.

Results

Instructional Strategies Students Experienced

As shown in Table 2, almost all students reported experiencing both of the traditional instructional strategies in their mathematics class. Almost all students also experienced some student-focused instructional strategies. Small-group work without a teacher was experienced by almost all students, and a large majority of students also reported showing work on the board, small group work with a teacher, and students comparing solutions with peers. Small group projects and games were experienced by about half of students. Students reported experiencing an average of 4.4 of the 6 student-focused instructional strategies (*SD* = 1.3; range 0 to 6).

Student-focused instruction should allow students to solve problems using a variety of strategies, not only teacher-taught strategies. In response to the question: “In your mathematics class, is there just one way to solve a problem? Or does your teacher let you use different ways?” we were able to tally how many individual students said their teacher let them use different ways, at least some of the time. A vast majority (89%) said multiple ways were allowed. Their discussions, however, suggested variability in what it meant to allow multiple strategies, ranging from tolerating students using solution strategies that were not instructed (e.g., “She teaches one way but lets you solve other ways.”) to intentional consideration of alternative solution strategies (e.g., “Some people solve in the regular way like they know how to do it, and some people find out ways to do it a different way and they raise their hand and go up and do it on the board.”). Overall, students in this study were exposed to a variety of instructional strategies, including a variety of more student-focused instructional strategies.

Differences In Strategy Experience by School Segregation Level

We explored whether experiencing the different instructional strategies differed by school segregation level, both racially and economically. As shown in Table 2, students in racially-imbalanced schools tended to report that fewer of the student-focused instructional strategies occurred in their mathematics classes compared to students in racially balanced schools. Such a difference did not emerge when we classified schools as high-poverty alone.

Multi-level regression models were used to test for school-level differences by segregation type. Models had two levels: (1) the individual level and (2) the school level to account for the nesting within school, with racial-segregation type and economic-segregation type dummy coded as school-level independent variables. The Variance Inflation Factor (VIF) value between racial- and economic-segregation type was 1.51, indicating that collinearity between the two variables was sufficiently low to include both variables in the same model. A preliminary model included a racial-segregation x economic-segregation interaction term, but the interaction term was not significant, so it was not included in the final model. Whether students were White was included as a control variable at the individual level, with being a student of color as the referent category; inclusion of this variable did not alter the effects of the school-level variables. A two-level linear regression model tested for differences in the number of student-focused strategies experienced.

Attending a racially-imbalanced school predicted experiencing fewer student-focused instructional strategies than at racially balanced schools (M = 4.28, SD = 1.38 vs. M = 4.66, SD =

1.10, respectively; β = -.60, *SE* = .25, $t(54) = -2.35$, $p = .02$). In contrast, the number was similar in both high-poverty and economically balanced schools (*M* = 4.40, *SD* = 1.34 vs. *M* = 4.34, *SD* = 1.30, respectively; β = .33, *SE* = .24, $t(47) = 1.38$, $p = .18$). We also conducted a parallel model with the school-level variables as continuous, rather than categorical predictors (e.g., percent students of color at the school), with similar, but marginal results. As the proportion of students of color at a school increased, there was a marginal decrease in the number of student centered strategies reported, β = -.016, *SE* = .008, $t(41) = -1.91$, $p = .06$, but there was no effect for the percent of economically disadvantaged students, β = .005, *SE* = .007, $t(43) = .71$, $p = .48$.

To identify which instructional strategies were less common based on school-segregation type, two-level nested logistic regression models tested for differences in the number of students who experienced each student-focused instructional strategy. These models indicated that students comparing solutions (β = -.94, *SE* = .41, $p = .02$, *OR* = 0.39, 95% CI: -1.75, -0.13), small-group work with a teacher (β = -1.0, *SE* = .45, $p = .03$, *OR* = 0.38, 95% CI: -1.89, -0.11), and showing work at the board (β = -1.79, *SE* = .73, $p = .01$, *OR* = 0.17, 95% CI: -3.21, -0.37) were less likely to be reported by students in racially-imbalanced schools. For example, for students at racially-imbalanced schools there was a 62% decrease in the odds of experiencing small-group work with a teacher relative to students attending racially balanced schools. There were no significant differences for school poverty status (β's < .50, p's > 0.26). We also verified there were no significant differences for racial or economic segregation for teacher lecture (β's = -.39 & -.64, p's > .33); statistical tests for worksheet use could not be conducted because it was 100% for some groups. The pattern of findings was the same when the variables were treated as continuous rather than categorical variables, except the percent of students of color at a school did not predict whether students comparing solutions was reported, $\beta = -.01$, *SE* = .01, $p = .30$, *OR* = 0.99, 95% CI: -0.03, 0.01), unlike when the variable was treated categorically.

Which Instructional Strategies Students Liked and Why

As shown in Figure 1, a minority of students liked traditional instructional strategies and a majority liked all but one of the student-focused instructional strategies. Binomial tests confirmed that fewer than 50% of students liked completing worksheets independently or teacher lecture (p's $< .01$) and more than 50% liked small group work with or without a teacher, showing work on the board, small group projects and playing games (p's $\leq .001$). Liking of comparing solutions was not significantly different from 50%.

Student discussions. Discussions during the focus groups or interviews helped illuminate common reasons for why students liked particular instructional strategies. Note that students were not prompted to discuss why they disliked particular instructional strategies, and this rarely came up. Because many students used terms like "working in a group," the small-group work without a teacher and small-group project instructional strategies could not be distinguished and were coded as a single instructional strategy. Students had to specifically reference the teacher being in the group for small-group work with teacher to be considered the strategy being discussed. Too few groups discussed why they liked teacher lecture for this strategy to be coded. Students were not prompted to share what they liked about each strategy one strategy at a time, and students had to explicitly mention a strategy for the theme to be coded for that strategy. This means not all strategies were discussed by each group. Finally, a group received a code even if only one student shared that opinion, so the codes indicated the themes brought up by any student and not consensus among the group.

The three most common reasons that students mentioned were (a) helps learning (e.g., have a better understanding; shown how to get the right answer), (b) builds confidences (e.g., makes you feel good about what you know; shows the class or teacher what you know), and (c) improves enjoyment (e.g., because it is fun, interesting, not boring). The proportion of groups that mentioned each of these codes for each instructional strategy is in Table 3.

We were particularly interested in students' reasons for liking students comparing solutions, as only about half of students reported liking it. As shown in Table 3, about a quarter of groups discussed the strategy. A majority that discussed it (56%) mentioned that it helped them learn. Students' descriptions of the activities and justification for why they liked comparing solutions suggested that many students interpreted the instructional strategy as we had intended and had good insights into why it provided opportunities for learning. For example, students mentioned:

1. I like comparing my problems because if we both got the answers right, but we solved it in different ways, it shows me a different way that I can solve it, and sometimes it might be easier for me to do it that way.
2. 'Cause it's a way to see how other people think, and you can improve your skills by learning from them.
3. Students are comparing different ways to solve...because sometimes if, if the way that the teacher teaches you maybe may not work for a situation at that time, and maybe you need another way to solve it. I like having more ways to solve it 'cause when she tells us to solve it this way, and I'm like what if that way is too hard for people? And it's like, I always ask: Are there any more ways?

4. Sometimes in your group, 'cause sometimes we might get them wrong in a set, and we gotta learn from our mistakes a lot and our answers. So we compare ways that we got it wrong and how we didn't do it wrong.

There were instances where students described an activity that involved checking that everyone got the correct answer, without mention of comparing solutions (e.g., “When we compare answers to see what other people get. To know if it’s right or wrong.”). This does not align with our intent for this item, suggesting some students may have had a different interpretation of the activity in mind when selecting whether they experienced it and/or liked it.

Only 10% of groups mentioned that comparing solutions builds confidence (e.g., “To show people how to do it my way and for people to say mine is the easiest and everyone starts doing it my way. Makes you feel like you're accomplishing something.”). Students never reported that this instructional strategy improves enjoyment.

Similar reasons arose when students discussed showing work on the board, which more students chose as being a liked strategy. Helping students learn was a common theme, discussed by 49% of groups that discussed the strategy. For example, one student noted: “I like how students show their work on the board. When I get the wrong answer, they take the information and help us get the right answer.” Another student summarized, re-voicing comments made by other students in the group:

> I like the students showing their work on the board. Like Tionni said, because like when you show your work, you can know your mistake and what you made. You can see, like Gracie said, how other people worked it out, so you can see like, oh, there's multiple ways to work it.

Showing work on the board also helps build confidence for some students, noted in 24% of groups that discussed it. For example, one student said: “Because you get to show how smart you are,” and another said: “I like working it out on the board because I feel like the teacher when I'm working it out, 'cause I'm like explaining it and writing it.” Students rarely mentioned that it improves enjoyment.

Next, considering the most liked instructional strategies - small group work or projects, without a teacher present. Two-thirds of groups that discussed the strategy mentioned that it helps them learn. Examples include: (1) “I like working in groups because if you don’t understand a problem, sometimes another person in your group can explain.” (2) “I like working in small groups because you get to solve a problem like a team and help each other.” And (3) “Sometimes I don’t get what’s going on. I’m totally lost. It allows me to have help if I don't understand.” Thus, some students clearly voiced how much other students helped them learn and understand material. Only a small percentage of groups mentioned that small group work improves enjoyment or builds confidence.

Two unique themes arose when students discussed small groups. One was hearing what other students’ think (e.g., “I like working in small groups because I can hear others’ opinions.”), raised by 29% of groups that discussed the strategy. A second was socializing (e.g., “I like talking, but not about mathematics,”), raised by 33% of groups that discussed the strategy. Overall, a large majority of groups voiced how small group work and projects helps them learn, with some groups also discussing more general opportunities to hear what other students are thinking and to socialize.

Next, in terms of small group work with a teacher, 88% of groups who discussed it noted that it helps them learn. For example: (1) “Work together with the teacher, when we have problems we don't know she'll break it down so we can understand. Do this often during small group work.” (2) “I like small groups with teacher. You can get confused with students. The mathematics teacher makes it clearer.” And (3) “The teacher pulls kids that are still confused with the lesson. It helps me understand more.”

Students did not mention that small group work with a teacher builds confidence or improves enjoyment. A unique reason that arose in 17% of groups that discussed the strategy was that they liked getting more attention from the teachers (e.g., “When we work in small groups with the teacher so they can answer my questions right away—we get more attention.”)

Only 14% of groups that discussed games mentioned that games help them learn (e.g., “When we play Kahoot, it helped me.”). A quarter of groups mention that games improve enjoyment (e.g., “Playing games because it's fun, free time instead of doing a lot of work”). Overall, we gained limited insights about playing games in mathematics class.

Finally, completing worksheets was discussed in about a quarter of groups. Of those groups, 24% mentioned that worksheets helped them learn (e.g., “One of my likes is doing worksheets 'cause to me when I do worksheets, it's like, it helps me learn more and like get it quickly in my head. But then when I'm doing worksheets, like if I don't understand, I'll go ask the teacher for help, and if when they help me, if I actually get it when they help me, I'll go back and do the worksheet.” and “I like working by myself a lot. When I do the worksheets, it challenges me to think more, and I'll understand it more. So when it comes to the test, I'll be familiar with, like all the problems”). Students almost never mentioned that worksheets built their confidence or enjoyment. A unique reason for liking this instructional strategy was that it allowed for individual work (e.g., “Doing worksheets because I like doing work by myself.”), mentioned by 44% of groups that discussed worksheets.

Discussion

Marginalized students reported on their personal experiences with a variety of instructional strategies in their middle-school mathematics classes. First, a majority of students indicated that they experienced multiple student-focused instructional strategies. However, students attending racially-segregated schools reported experiencing fewer student-focused instructional strategies than students attending racially-balanced schools. Second, a majority of students liked most of the student-focused strategies and did not like the teacher-directed ones. For example, they noted that several of the strategies, such as small group work with a teacher, provided them with opportunities to learn.

Instructional Strategies and School Segregation

As in past research, the traditional instructional strategies of lecturing and students individually completing worksheets were experienced by almost all students (Hiebert et al., 2003; Wenglinsky, 2002). Most students also said they experienced a range of more student-focused instructional strategies, especially small-group work and sharing solutions by showing their work on the board. The use of these instructional strategies in middle-school mathematics instruction aligns with teacher survey data from the NAEP (Lubienski, Camburn, & Shelley, 2004). Most students also indicated they were allowed to solve problems in multiple ways, and a majority of students said they compared solutions with other students. Small group projects and games were the least commonly experienced instructional strategies that we studied.

It is encouraging that some student-focused instructional strategies are being used in middle schools serving students who have often been marginalized. Many of these instructional strategies have the potential to improve students' mathematics learning and motivation (Lubienski, 2006; Webb et al., 2014; Woodward et al., 2012). Their effectiveness depends on the quality of implementation, such as the cognitive demands of the mathematical tasks and the intensity and quality of broad student involvement, but their use is one important component of effective instruction (Stein, Grover, & Henningsen, 1996; Webb et al., 2014). Students in the current study liked most of these strategies and perceived them as helping them learn and building their confidence, providing further evidence for their value with diverse students. Unfortunately, we do not have information about how frequently these practices occurred in their mathematics classrooms.

The current research adds to concerns about fewer opportunities to learn at racially segregated schools. The 75% of students in this study who attended schools with a high-concentration of students of color (i.e., racially-imbalanced schools) reported experiencing fewer student-focused instructional strategies than the students who attended racially balanced schools. In particular, fewer students at racially-imbalanced schools experienced several of the instructional strategies, such as small group work (with a teacher) and sharing solutions to mathematics problems with other students (including on the board), that have been shown to improve student learning (Lubienski, 2006; Rittle-Johnson & Star, 2007) and that students in the current study often believed helped them learn. We could not identify past research on school segregation that contrasted instructional strategy use by segregation level across many schools, rather than considering more distal factors that might influence opportunities to learn, such as teacher qualifications and funding. Thus, the current study provides evidence for more proximal influences on opportunities to learn: teachers' instructional strategies. Further, reported teacher qualifications were not lower in the racially-segregated schools compared to the racially-balanced schools in the current study, highlighting the importance of gathering more direct indicators of opportunities to learn in racially-segregated schools. At the same time, because students in the current study did not report on how frequently the strategies were used, it is possible that teachers at racially-imbalanced schools are using some of the student-focused strategies more frequently, offsetting their use of fewer of the strategies.

In contrast, students' reports did not differ based on economic segregation of their schools. Rates of experiencing different student-focused instructional strategies was very similar in high-poverty and economically balanced schools, despite some evidence that teachers in the high-poverty schools in the current sample were less qualified to teach mathematics (as they were less likely to have majored or minored in mathematics in college than teachers at the economically-balanced schools). Although economic and racial segregation often co-occurred, a sixth of students in the current study attended a racially segregated school that was not considered high-poverty. It is very difficult to disentangle racial and economic segregation given their frequent co-occurrence, but the current study contributes to research on the influence of race on instruction that is not simply explained by poverty (Joseph et al., 2017). We identified very few large-scale studies that considered racial and economic school segregation in the same sample or compared high-concentration schools to balanced, rather than low-concentration, schools. Even when compared to racially balanced schools, rather than to predominantly White schools, teachers in racially segregated schools may user fewer student-focused instructional strategies.

The current study suggests that racial segregation in particular continues to be an issue for instructional quality at a time when schools are becoming increasingly segregated by race, compared to 20 years ago (Fiel, 2013). The current study adds additional evidence for the urgency of improving opportunities to learn across all schools, to address the broader issues that lead to segregation in schools, and to address the racialization of mathematics education (Joseph et al., 2017).

Students' Views of Instructional Strategies

Too often, teachers and researchers do not invite the perspectives of marginalized students (Lee, 2017). We cannot assume that marginalized students' perceptions will match the views of teachers or experts in education, especially White teachers and experts, or of White, middle-class students. In the current study, marginalized students' liking of instructional strategies and explanations of why they liked them provided insights into their beliefs about mathematics learning and instruction, with important implications for student attitudes and learning in middle school mathematics. It helps disrupt teachers' and policy-makers' deficit views of marginalized students and should encourage teachers' greater use of student-focused strategies. As hypothesized, most students liked many of the student-focused instructional strategies and disliked the teacher-directed strategies. Student-focused strategies seem better matched to developmental needs of students in middle school (Wigfield & Eccles, 2002), as well as to many of the students' cultural backgrounds (Ford, 2016; OECD, 2017). There is evidence to suggest that when students like instructional strategies, they are more motivated to engage in the work and tend to learn more than students who do not like the strategies (Lubienski, 2000), though this study was done in a very different context (researcher-led instruction with mostly white students). Further, students' justifications for why they liked particular instructional strategies revealed which strategies they considered to provide opportunities to learn.

First, consider the one student-focused instructional strategy that only half of students liked - students comparing solutions. Most students (80%) reported experiencing the strategy. However, past research suggests that their experiences with the strategy were likely limited.

Video coding of representative eighth-grade mathematics lessons in the U.S. indicate that only 2% of problems included students comparing solutions, with at least one instance in 17% of lessons (Jacobs et al., 2006). This suggests that although the instructional strategy is used, it is not used frequently, and/or that students' interpretation of the instructional strategy was less rigorous than that of experts. We need to learn more about students' experiences with comparing solutions and why some do not like it.

Second, consider why students liked particular instructional strategies. Three main themes emerged. One was that they believed the strategy helps them learn, providing insights into which strategies they considered to provide opportunities to learn. Students provided a variety of relevant reasons, including helping them correct their mistakes, learning alternative ways to solve a problem that are easier or useful for new situations, reducing their confusion, and improving their understanding through clearer explanations. Small group work, especially with a teacher, was most often mentioned as providing opportunities to learn. Their reasons matched research evidence for how student-focused strategies aid learning. For example, small group work often improves learning in part because students have more opportunities to generate explanations, to listen to others' explanations and to engage with more ideas (Webb et al., 2014). Similarly, experimental evidence indicates that students comparing solutions provides opportunities for students to learn new strategies, identify when a strategy is most appropriate, understand common errors and articulate what concepts justify solution steps (Durkin, Star, & Rittle-Johnson, 2017; Rittle-Johnson & Star, 2007). It is encouraging that these students were noticing and articulating how student-focused instructional strategies provided learning opportunities.

A second theme was that an instructional strategy helps build their confidence. This was most common for the strategy of students showing work on the board. This strategy could be considered anxiety provoking or harmful to students' confidence because students may make mistakes that would embarrass them. However, the current study indicates that some students liked the opportunity to play the role of teacher or show how smart they are, building their confidence. Building students' confidence in mathematics is important because it is related to their mathematics achievement and persistence (Joseph et al., 2017; Pajares & Miller, 1994).

A third theme was that some instructional strategies improve their enjoyment. This was most common for games and small group work. Past survey research has also reported that student-focused instructional strategies are associated with greater enjoyment of mathematics (Noyes, 2012). In turn, students' enjoyment of mathematics is related to their mathematics achievement (Ma, 1997) and is a major factor contributing to whether students persist in studying mathematics through the end of high school (Brown, Brown, & Bibby, 2008).

Overall, marginalized students appeared to recognize the impact of student-focused instructional strategies on their learning, confidence and enjoyment. Because each is related to mathematics learning, attitudes or persistence, supporting all three is an important instructional goal. Sharing students' views with teachers may help disrupt teachers' deficit views of marginalized students and convince teachers to use more of the strategies.

Third, consider potential limitations to some student-focused instructional strategies that arose from students' discussions. Some students liked small group work or projects without a teacher because they provided opportunities for socializing about non-mathematics content. This aligns with some teachers' concerns that small group work allows for too much off-task behavior. In addition, some students liked doing worksheets, appreciating the opportunity to work alone and to practice to prepare for tests, opportunities they may have experienced less during student-focused instructional activities. In line with these concerns, mathematics education guidelines suggest maintaining some opportunities for individual work and practice (NCTM, 2000).

Limitations and Future Directions

First, the current study focused on students' perspectives. Students' perspectives, including their informal definitions of instructional strategies, may not match experts' coding of classroom observations. Past classroom observation studies have not contrasted instructional practices by school type (Boston & Wilhelm, 2015). Conducting direct observations of instructional strategies and how they differ by school type would complement students' perspectives on these practices.

Second, the card sort activity, which included photos, could restrict the range of responses from students compared to a more open-ended questioning format. We used a card sort activity because physical activities and concrete stimulus materials facilitate conversation when interviewing young people (McHugh et al., 2013; Punch, 2002). Replication of the findings with alternative methods is important.

Third, students reported on whether the instructional strategy ever happened, but not how frequently it was used. Teachers could use fewer strategies, but use those strategies more frequently than teachers who use a larger variety of strategies. For example, it is possible that teachers in racially-imbalanced schools may use fewer student-focused instructional strategies, but use those strategies more frequently than teachers in racially balanced schools.

Fourth, we need to build understanding of when and how student liking impacts their learning, achievement and motivation. Students' preferences may not translate to greater student learning as measured by assessments that teachers and policy-makers value. Future research is also needed to understand when and why students do not like some instructional strategies. This is especially true for students comparing solutions.

Finally, the current study provides insights into the perspectives of predominantly Black, middle-school students in a Southern metropolitan school district. Future research is needed to compare their perspectives to those of students from a broader range of backgrounds in different educational contexts and whether perspectives differ by student race. Additionally, future work needs to be integrated with the broader context of teaching and learning, including teachers' views of their students and use of culturally relevant teaching practices that empower marginalized students and help them view knowledge critically (K. Jackson & Wilson, 2012).

Conclusion

The current study contributes to efforts to understand marginalized students' experiences in middle-school classrooms. Student-focused instructional strategies were often experienced and liked by the students and were perceived by students as helping them learn, building their confidence and/or increasing their enjoyment. In contrast, they had less positive views towards traditional instructional strategies such as completing worksheets independently. However, an opportunity gap was present, with students at racially segregated schools reporting experiencing fewer student-focused instructional strategies than students attending racially balanced schools in the same metropolitan school district. Overall, students' positive perspectives on student-focused instructional strategies provide additional urgency for efforts to increase their use in middle-school mathematics instruction.

References

Akiba, M., LeTendre, G. K., & Scribner, J. P. (2007). Teacher Quality, Opportunity Gap, and National Achievement in 46 Countries. *Educational Researcher, 36*(7), 369-387. doi:10.3102/0013189X07308739

Aud, S., Fox, M. A., & KewalRamani, A. (2010). *Status and trends in the educatoin of racial and ethnic groups (NCES 2010-015)*. Retrieved from Washington, DC:

Berry, R. Q. (2005). Voices of success: Descriptive portraits of two successful African American male middle school mathematics students. *Journal of African American Studies, 8*(4), 46-62. doi:10.1007/s12111-005-1003-y

Boaler, J., & Staples, M. (2008). Creating Mathematical Futures through an Equitable Teaching Approach: The Case of Railside School. *Teachers College Record, 110*, 608-645. doi:http://www.tcrecord.org ID Number: 14590

Boston, M. D., & Wilhelm, A. G. (2015). Middle School Mathematics Instruction in Instructionally Focused Urban Districts. *Urban Education, 52*(7), 829-861. doi:10.1177/0042085915574528

Brown, M., Brown, P., & Bibby, T. (2008). "I would rather die": Reasons given by 16-year-olds for not continuing their study of mathematics. *Research in Mathematics Education, 10*(1), 3-18. doi:10.1080/14794800801915814

Darling-Hammond, L. (2000). New Standards and Old Inequalities: School Reform and the Education of African American Students. *The Journal of Negro Education, 69*(4), 263-287. doi:10.2307/2696245

Durkin, K., Star, J. R., & Rittle-Johnson, B. (2017). Using Comparison of Multiple Strategies in the Mathematics Classroom: Lessons Learned and Next Steps. *Zdm, 49*, 585 - 597. doi:doi.org/10.1007/s11858-017-0853-9

Farran, D. C., Durkin, K., & Ziegler, J. (2017). *Mathematics Development from Pre-K Through 7th Grade in Urban, High Poverty Students*. Paper presented at the Society for Research in Child Development Biennial Meeting, Austin, TX.

Fiel, J. E. (2013). Decomposing School Resegregation: Social Closure, Racial Imbalance, and Racial Isolation. *American Sociological Review, 78*(5), 828-848. doi:10.1177/0003122413496252

Ford, D. Y. (2016). Black and Hispanic students: Cultural differences within the context of education. In L. Corno & E. Anderman (Eds.), *Handbook of educational psychology* (Third ed., pp. 364-377). New York: Routledge.

Haberman, M. (1991). The pedagogy of poverty versus good teaching. *Phi Delta Kappan, 73*, 290-294.

Hiebert, J., Gallimore, R., Garnier, H., Givvin, K. B., Hollingsworth, H., Jacobs, J., . . . Stigler, J. W. (2003). *Teaching mathematics in seven countries: Results from the TIMSS 1999 video study* (NCES 2003-013). Retrieved from Washington D.C.: http://nces.ed.gov/timss

Jackson, C. K. (2009). Student Demographics, Teacher Sorting, and Teacher Quality: Evidence from the End of School Desegregation. *Journal of Labor Economics, 27*(2), 213-256. doi:10.1086/599334

Jackson, K., Gibbons, L., & Sharpe, C. (2017). Teachers' Views of Students' Mathematical Capabilities: Challenges and Possibilities for Ambitious Reform. *Teachers College Record, 119*, 1-43. doi:http://www.tcrecord.org ID Number: 2179

Jackson, K., & Wilson, J. (2012). Supporting African American Students' Learning of Mathematics. *Urban Education*, *47*(2), 354-398. doi:10.1177/0042085911429083

Jacobs, J. K., Hiebert, J., Givvin, K. B., Hollingsworth, H., Garnier, H., & Wearne, D. (2006). Does Eighth-Grade Mathematics Teaching in the United States Align with the NCTM Standards? Results from the TIMSS 1995 and 1999 Video Studies. *Journal for Research in Mathematics Education*, *37*(1), 5-32. doi:10.2307/30035050

Joseph, N. M. (2017). The invisibility of Black girls in mathematics. *Virginia Mathematics Teacher*, *44*, 46-52.

Joseph, N. M., Hailu, M., & Boston, D. (2017). Black Women's and Girls' Persistence in the P–20 Mathematics Pipeline: Two Decades of Children, Youth, and Adult Education Research. *Review of Research in Education, 41*(1), 203-227. doi:10.3102/0091732X16689045

Ladson-Billings, G. (2006). From the Achievement Gap to the Education Debt: Understanding Achievement in U.S. Schools. *Educational Researcher, 35*(7), 3-12. doi:www.jstor.org/stable/3876731

Lee, C. D. (2017). Integrating research on how people learn and learning across settings as a window of opportunity to address inequality in educatonal processes and outcomes. *Review of Research in Education, 41*, 88-111.

Lee, J. (2012). College for All: Gaps Between Desirable and Actual P-12 Math Achievement Trajectories for College Readiness. *Educational Researcher*, *41*(2), 43-55. doi:10.3102/0013189x11432746

Lubienski, S. T. (2000). Problem Solving as a Means toward Mathematics for All: An Exploratory Look through a Class Lens. *Journal for Research in Mathematics Education, 31*(4), 454-482. doi:10.2307/749653

Lubienski, S. T. (2002). A closer look at the Black-White mathematics gaps: Intersections of rase and SES in NAEP achievement and instructional practices data. *Journal of Negro Education, 71*(4), 269-287. doi:10.2307/3211180

Lubienski, S. T. (2006). Examining instruction, achievement, and equity with NAEP mathematics data. *Education Policy Analysis Archives, 14*, 1-29. doi: http://epaa.asu.edu/epaa/v14n14/.

Lubienski, S. T., Camburn, E., & Shelley, M. C. (2004). *Reform-Oriented Mathematics Instruction, Achievement, and Equity: Examinations of Race and SES in 2000 Main NAEP Data*. Retrieved from Aimes, IA: www.researchgate.net/publication

Ma, X. (1997). Reciprocal Relationships Between Attitude Toward Mathematics and Achievement in Mathematics. *The Journal of Educational Research, 90*(4), 221-229. doi:10.1080/00220671.1997.10544576

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion and motivation. *Psychological Review, 98*, 224–253. doi:10.1037/0033-295X.98.2.224

McGee, E. O. (2014). When It Comes to the Mathematics Experiences of Black Pre-Service Teachers . . . Race Matters. *Teachers College Record, 116*, 1-50. doi:http://www.tcrecord.org ID Number: 17469

McHugh, R. M., Horner, C. G., Colditz, J. B., & Wallace, T. L. (2013). Bridges and barriers: Adolescent perceptions of student-teacher relationships. *Urban Education, 48*(1), 9-43. doi:10.1177/0042085912451585

McKinney, S., & Frazier, W. (2008). Embracing the Principles and Standards for School Mathematics: An Inquiry into the Pedagogical and Instructional Practices of Mathematics Teachers in High-Poverty Middle Schools. *Clearing House: A Journal of Educational Strategies, Issues and Ideas, 81*(5), 201-210.

Mickelson, R. A. (2015). The Cumulative Disadvantages of First- and Second-Generation Segregation for Middle School Achievement. *American Educational Research Journal, 52*(4), 657-692. doi:10.3102/0002831215587933

Moses, R. P., & Cobb, C. E. (2001). *Radical Equations: Math Literacy and Civil Rights*. Boston: Beacon Press.

NCTM. (2000). *Principles and Standards for School Mathematics*. Reston, Va: NCTM.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All*. Reston, VA: National Council of Teachers of Mathematics, Inc.

Noyes, A. (2012). It matters which class you are in: student-centred teaching and the enjoyment of learning mathematics. *Research in Mathematics Education, 14*(3), 273-290. doi:10.1080/14794802.2012.734974

Oakes, J. (1990). *Multiplying inequalities: The effects of race, social class, and tracking on opportunities to learn mathematics and science*. Retrieved from Santa Monica, CA:

OECD. (2017). PISA 2015 Results (Volume V): Collaborative Problem Solving. Retrieved from www.oecd-ilibrary.org

Pajares, F., & Miller, M. D. (1994). Role of self-efficacy and self-concept beliefs in mathematical problem solving: A path analysis. *Journal of Educational Psychology, 86*(2), 193-203. doi:10.1037/0022-0663.86.2.193

Punch, S. (2002). Interviewing strategies with young people: The 'secret box' stimulus material and task-based activities. *Children & Society*, *16*(1), 45-56. doi:10.1002/chi.685

Rittle-Johnson, B., & Star, J. R. (2007). Does comparing solution methods facilitate conceptual and procedural knowledge? An experimental study on learning to solve equations. *Journal of Educational Psychology*, *99*(3), 561-574. doi:10.1037/0022-0663.99.3.561

Ruffell, M., Mason, J., & Allen, B. (1998). Studying Attitude to Mathematics. *Educational Studies in Mathematics, 35*(1), 1-18. doi:https://www.jstor.org/stable/3482863

Stein, M. K., Grover, B. W., & Henningsen, M. (1996). Building Student Capacity for Mathematical Thinking and Reasoning: An Analysis of Mathematical Tasks Used in Reform Classrooms. *American Educational Research Journal*, *33*(2), 455-488. doi:http://dx.doi.org/10.3102/00028312033002455

Stodolsky, S. S., Salk, S., & Glaessner, B. (1991). Student Views about Learning Math and Social Studies. *American Educational Research Journal, 28*(1), 89-116. doi:10.2307/1162880

Webb, N. M., Franke, M. L., Ing, M., Wong, J., Fernandez, C. H., Shin, N., & Turrou, A. C. (2014). Engaging with others’ mathematical ideas: Interrelationships among student participation, teachers’ instructional practices, and learning. *International Journal of Educational Research*, *63*, 79-93. doi:10.1016/j.ijer.2013.02.001

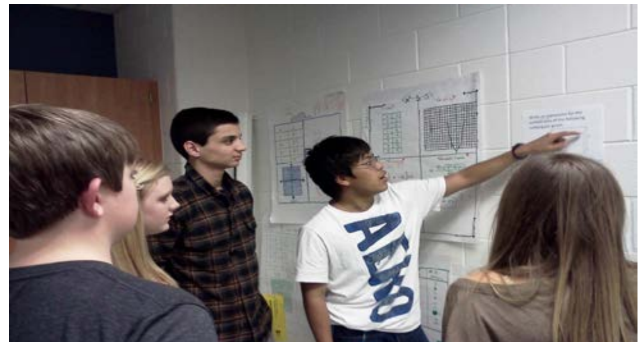
Wenglinsky, H. (2002). How Schools Matter: The Link Between Teacher Classroom Practices and Student Academic Performance. *Education Policy Analysis Archives*, *10*, 1-30. doi:10.14507/epaa.v10n12.2002

Wigfield, A., & Eccles, J. S. (2002). Students' Motivation During the Middle School Years. In J. Aronson (Ed.), *Improving Academic Achievement* (pp. 159-184). San Diego: Academic Press.

Woodward, J., Beckmann, S., Driscoll, M., Franke, M. L., Herzig, P., Jitendra, A. K., . . . Ogbuehi, P. (2012). *Improving mathematical problem solving in grades 4 to 8: A practice guide*. Washington, D.C.: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences.

Appendix


Students are working in small groups.


Students are comparing different ways to solve a problem.


Students are playing games.


Students are doing projects in small groups.


Students are listening to the teacher lecture.


Students are doing worksheets.


Students are working in a small group with the teacher.

Students show their work on the board.

Table 1

Teachers' Teaching Background: Percent of Teachers Overall and by School Type

	Overall	Racially imbalanced schools	Racially balanced schools	High poverty schools	Economically balanced schools
Majored/minored in math	37	34	42	27	49
First-year teacher	9	7	13	11	7
5+ yrs teaching experience	64	63	68	62	67
First year teaching middle-school math	16	18	13	18	14
5+ yrs teaching middle-school math	52	49	58	49	56
Completed survey	88	86	91	83	93

Note: Chi-square tests indicated there were no significant differences in teacher qualifications or survey completion rate by school type, except teachers at high-poverty schools were less likely to have majored or minored in math in college than teachers at economically-balanced schools, χ^2 (1, 97) = 4.829, p = .028.

Table 2

Percent of Students Who Reported Each Instructional Strategy Happens in Their Mathematics Class, Overall and by School Segregation Type

Instructional strategy	Overall	Racially imbalanced schools	Racially balanced schools	High poverty schools	Economically balanced schools
Traditional					
Doing worksheets on own	98	97	100	97	100
Teacher lecture	94	93	97	92	96
Student-Focused					
Small group without teacher	94	94	94	94	94
Students show work on board	87	84	95	86	87
Students comparing solutions	80	78	87	79	81
Small group with teacher	77	74	86	77	79
Small group project	55	55	54	57	51
Games	45	44	49	47	42
Number experienced	4.40	4.28	4.66	4.40	4.34

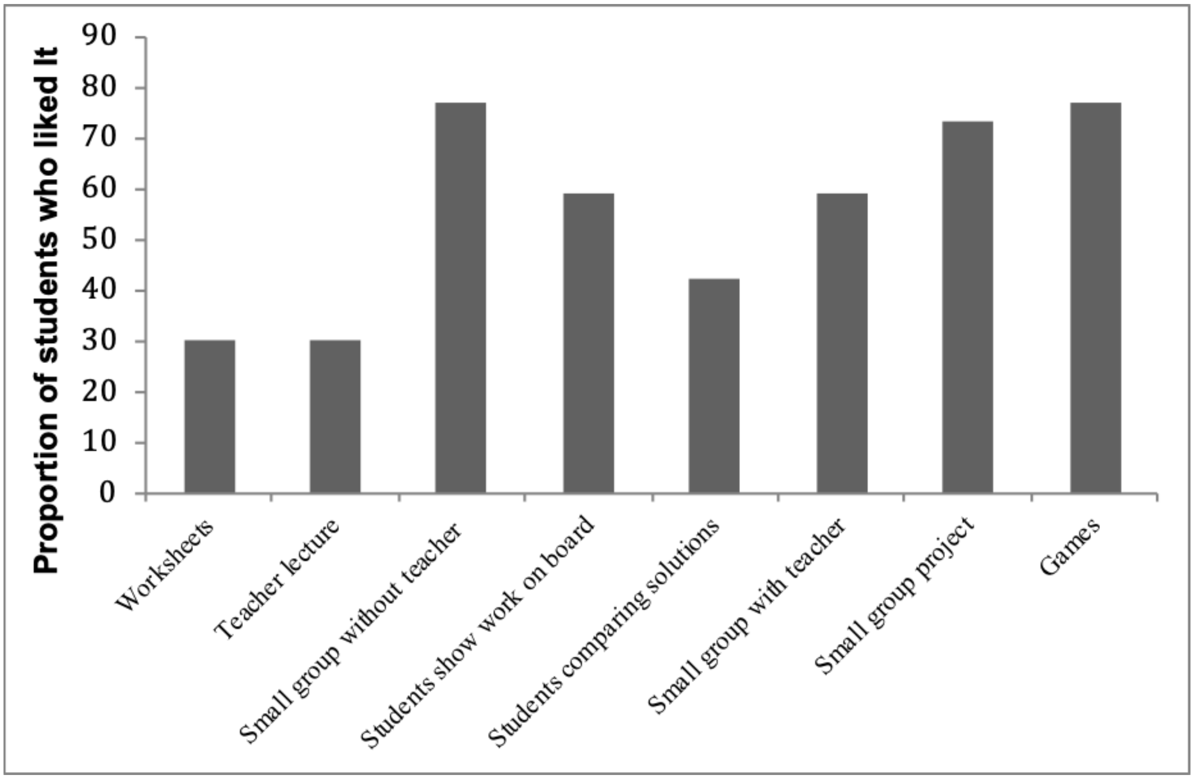
Table 3

Percentage of Groups that Mentioned Each Reason When Discussing Instructional Strategies, with Percentage of Groups that Discussed Each Strategy in Final Column

Instructional Strategy	Helps learning	Builds confidence	Improves enjoyment	Discussed
Traditional				
Doing worksheets on own	24 (10)	0	5 (2)	25 (42)
Student-Focused				
Small group without teacher or small group project	66 (88)	3 (4)	10 (13)	78 (133)
Students show work on board	49 (44)	24 (21)	3 (3)	52 (89)
Students comparing solutions	56 (22)	10 (4)	0	23 (51)
Small group with teacher	88 (45)	0	0	30 (51)
Games	14 (8)	0	25 (15)	35 (59)

Note: Percentages in the first three columns are number of groups receiving the code divided by the number of groups that discussed the strategy. Number of groups receiving each code is in parentheses for each column. Teacher lecture was rarely discussed, so it was not included.

Figure 1



Note: Only students who reported that an instructional strategy happened were asked whether they liked the strategy. [a]Based on a binomial test, a majority of students who experienced the strategy liked it (p's $\leq .001$), except liking of students comparing solutions was not different from 50% and liking of worksheets and teacher lecture was less than 50% (p's $< .01$).