Middle School girls' self-efficacy and motivation toward Mathematics before and after attending an all-girls summer Mathematics camp

LYNDA R. WIEST[1], HEATHER G. CRAWFORD-FERRE[2]

[1]*College of Education*
University of Nevada, Reno
USA
wiest@unr.edu

[2]*Nevada Department of Education*
University of Nevada, Reno
USA
hcrawfordferre@doe.nv.gov

Abstract

The purpose of this study was to investigate the influence of a five-day summer residential mathematics and technology program on the mathematics motivation and self-efficacy of 210 middle-grades girls who participated in this female-only event. Entrance measures and gain scores were examined for the study sample as a whole and for demographic groups formed by race/ethnicity, family socioeconomic status, and grade level. The results show that this program favorably influenced participants' short-term self-efficacy and motivation for learning mathematics. Overall, significant increases appeared in self-efficacy, intrinsic motivation, and extrinsic motivation from program beginning to end. Self-efficacy showed the strongest improvements, followed by intrinsic motivation, and finally extrinsic motivation. Some differences appeared among demographic subgroups.

Keywords

Summer programs, females, Mathematics, middle school, motivation, self-efficacy

Résumé

L'objectif de cette étude était d'examiner l'influence d'un programme d'été de mathématiques et de technologie en résidence de cinq jours sur la motivation et

l'auto-efficacité en mathématiques de 210 filles de niveau intermédiaire qui ont participé à cet événement réservé aux femmes. Les mesures d'entrée et les scores de gain ont été examinés pour l'ensemble de l'échantillon de l'étude et pour des groupes démographiques formés par la race/l'ethnie, le statut socio-économique de la famille et le niveau scolaire. Les résultats montrent que ce programme a favorablement influencé l'auto-efficacité à court terme des participants et leur motivation pour l'apprentissage des mathématiques. Dans l'ensemble, des augmentations significatives sont apparues au niveau de l'auto-efficacité, de la motivation intrinsèque et de la motivation extrinsèque du début à la fin du programme. L'auto-efficacité a montré les améliorations les plus fortes, suivie de la motivation intrinsèque et enfin de la motivation extrinsèque. Certaines différences sont apparues entre les sous-groupes démographiques.

Mots–Clés

Programmes d'été, femmes, mathématiques, collège, motivation, auto-efficacité

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Some research indicates that females perform more poorly than males in mathematics achievement (Anaya et al., 2022; Arens et al., 2022; Contini et al., 2017; Recber et al., 2018), making mathematics a continued area of concern in relation to gender. Even where no mathematics achievement differences appear by gender, females tend to show less favorable dispositions toward mathematics and themselves in relation to mathematics (Anaya et al., 2022; Arens et al., 2022; Dang & Nylund-Gibson, 2017; Levy et al., 2021; Mann-Walshaw, 2019; Reilly et al., 2019). Gendered perceptions about mathematics begin as early as the second grade, wherein girls consider mathematics to be more appropriate for boys, and boys identify more strongly with the subject area (Cvencek et al., 2011). It is not surprising, then, that women continue to be underrepresented in science, technology, engineering, and mathematics (STEM) careers and career aspirations, especially those that are mathematics-intensive (Anaya et al., 2022; Saw et al., 2018; Wang & Degol, 2017). Accordingly, in 2008, the U.S. House of Representatives formally recognized in H. Res. 1180 the need to increase the number of women in the STEM disciplines.

In addition to gender, other demographic identifiers have been shown to relate to students' academic performance. On the whole, White students display higher achievement

in mathematics and other academic areas than Blacks, Hispanics, and Native Americans, but not Asian Americans, who tend to perform on par with or better than Whites (e.g., Kuhfield et al., 2018; Potter & Morris, 2017). Further, socioeconomic status (SES) can influence academic achievement (Agirdag, 2018; von Stumm, 2017). Both family and school socioeconomic indicators have been shown to influence student mathematics performance, with higher income and more resources associating with higher achievement (Arens et al., 2022; Das & Sinha, 2017; Murphy, 2019). In general, being from an underrepresented racial or ethnic group in the United States, coming from a low-SES family, and/or attending a low-income school tend to associate with lower academic achievement (Sandy & Duncan, 2010). Community type has been shown to associate with achievement level, with a tendency for suburban students to perform best, followed by rural and then urban (Graham & Provost, 2012; Sandy & Duncan, 2010; Stewart, 2009). However, Sandy and Duncan (2010) note, "While differences between urban and suburban families contribute to test score differences, the decisive family characteristic is income" (p. 309). The authors note that urban students are more likely to be poor. In sum, demographic groups that tend to show higher mathematics achievement are those who are White or Asian American, have middle/high family SES, attend a non-Title I school, and reside in a suburban community (e.g., Brown-Jeffy, 2009; Chiu, 2010). As noted, SES appears to be a particularly influential factor in relation to school outcomes.

Out-of-school-time programs are among efforts designed to address weak mathematics performance. Thus, the purpose of this study was to investigate the influence of a five-day summer residential mathematics and technology program on the mathematics motivation (intrinsic and extrinsic) and self-efficacy of 210 middle-grades girls who participated in this female-only event. Entrance measures and gain scores were examined for the study sample as a whole and for demographic groups formed by race/ethnicity, family socioeconomic status, and grade level.

Review of related literature

Dispositions in Mathematics

Self-concept, such as self-confidence, and other dispositions can influence mathematics achievement and perseverance (Arens et al., 2022; Ker, 2017; Pitsia et al., 2017; Recber et al., 2018). The dispositional domain, which includes confidence, interest, motivation, and other affective characteristics, is an area in which females tend to be weaker than males in mathematics, as noted. In this section, we focus on academic self-efficacy and motivation because they are important constructs that are most pertinent to the study reported in this paper.

Self-efficacy. Self-efficacy is "one's perceived capabilities to learn or perform actions at designated levels" (Schunk & DiBenedetto, 2021, p. 154). This self-perception of competence in specific situations can influence motivation, which in turn affects individuals' effort, persistence, activity choice, and achievement (Schunk & DiBenedetto, 2021; Yu et al., 2022). Both perceived competence and academic motivation are construed to be domain-specific such that self-beliefs are grounded in specific subject areas rather than being general across disciplines (Bong et al., 2012; Gunderson et al., 2017; Schunk & DiBenedetto, 2021). Thus, in general and specific to mathematics, self-efficacy can influence achievement, attitudes, and engagement and persistence in activities (Acar Güvendir, 2016; Arens et al., 2022; Bong et al., 2012; Pitsia et al., 2017; Prast et al., 2018). The relationship between self-efficacy and school outcomes (e.g., achievement) has been shown to be particularly important in middle school mathematics (Arens et al., 2022; Bong et al., 2012). This is especially concerning for females, who demonstrate lower mathematics self-efficacy than males, with this difference in self-beliefs potentially contributing to gender gaps in mathematics achievement and career choices (Dang & Nylund-Gibson, 2017; Hand et al., 2017; Recber et al., 2018; Reilly et al., 2019). Therefore, it is important to foster mathematics self-efficacy and other favorable self-beliefs in students, which might help to reduce mathematics anxiety and its debilitating effects (Dang & Nylund-Gibson, 2017; Mann-Walshaw, 2019; Rozgonjuk et al., 2020).

Motivation. According to Schunk and DiBenedetto (2021), motivation is "the internal cognitive and affective processes that instigate and sustain goal-directed actions and outcomes" (p. 154). Motivation has been shown to relate to school performance. Higher motivation associates with better academic achievement and more positive academic self-perceptions (Acar Güvendir, 2016; Martin & Lazendic, 2018; Pitsia et al., 2017). Intrinsic motivation, or the drive to "engage in the activity for its own sake" (Gillet et al., 2012, p. 77), such as for enjoyment or self-growth, is more beneficial to learning and education goals than extrinsic motivation, which influences an individual to perform a particular way in response to external stimuli, such as rules and consequences (Acar Güvendir, 2016; Gottfried et al., 2009; Vansteenkiste et al., 2009). Vansteenkiste et al. (2009) state that extrinsic goals "do motivate behavior, although such goals are likely to instantiate a rigid and narrow-minded approach to learning" (p. 160) that results in less persistence with activities and "forestall[s] the learning process, rather than contributing to optimal learning" (p. 161). Conversely, they note, "Intrinsic goals provide satisfaction of students' basic psychological needs for autonomy, competence, and relatedness" (p. 161).

Academic motivation tends to decline over time during the school years, particularly in mathematics (Gillet et al., 2012; Gottfried et al., 2009; Hoffman et al., 2021; Ker, 2017; Yu et al., 2022). Declining attitudes toward STEM during schooling is particularly true

for females (Lofgran et al., 2015; Mata et al., 2012). Girls' motivation in mathematics and science associates with a number of factors, including parent and peer support, which have been shown to be domain-specific in that support in a particular subject area can favorably influence motivation in that subject area (Leaper et al., 2012; You & Sharkey, 2012; Yu et al., 2022).

Out-of-School-Time Programs

Out-of-school-time (OST) programs, such as summer and afterschool programs, have been proposed and implemented as strategies for improving students' academic performance. Krishnamurthi et al. (2014) describe the increasing number and rising prominence of OST programs thus: "Recent years have seen a growing recognition that…young people require supports that extend beyond the school walls" (p. 1). Similarly, Traphagen (2014) states, "Ensuring equitable access to high-quality out-of-school programs is becoming more urgent as we deepen our collective understanding of the transformative potential of informal learning on children's academic and social success" (p. 4).

OST programs have been shown to favorably influence participant achievement and dispositions in mathematics, including self-confidence, motivation, and appreciation for its utilitarian value (Krishnamurthi et al., 2014; Weinberg et al., 2011; Wiest et al., 2021; Yu et al., 2022). Further, based on their retrospective study of 174 young women who had participated in girls-only OST STEM programs, McCreedy and Kierking (2013) conclude, "Peers who are supportive and 'like me' are also critically important to the community fostered in informal STEM programs" (p. 8). Indeed, adolescents in Hoffman et al.'s (2021) study showed a strong sense of belonging in their OST STEM program, which positively predicted mathematics and science motivation. Weinberg et al. (2011) found that participants who attend residential programs show stronger gains in dispositions than those who attend commuter programs and that females are more likely than males to participate in residential programs. In their study, summer STEM programs had no significantly different influence on the motivation of participants from underrepresented racial/ethnic groups than their counterparts, but Krishnamurthi et al. (2014) conclude, "The math achievement gap between low- and high-income students narrows when low-income students attend afterschool programs with greater frequency" (p. 7). Note, however, that OST program providers tend to investigate program influence on STEM participation and dispositions, such as anxiety and motivation, instead of achievement (Krishnamurthi et al., 2014).

Research Question

The question investigated in this research was: What influence, if any, does participation in a one-week summer residential mathematics and technology program have on the

short-term mathematics motivation (intrinsic and extrinsic) and self-efficacy of the middle-grades girls who attend? Further, how might any observed influence differ by participant race/ethnicity, family and school socioeconomic status, community type, and grade level?

Method

The data collected for this study come from survey ratings for four summer camp sessions. An overview of the program is first provided as context for the research findings.

Program Description

The Northern Nevada Girls Math & Technology Program, which began in 1998 and ran until 2019, was developed to address concerns about females' underrepresentation in and potentially unfavorable dispositions toward mathematics and technology. Specifically, the program's purpose was to increase girls' knowledge, skills, and confidence in mathematics and technology to enhance mathematical and technological competence in girls' personal, academic, and occupational lives. The main program component was a one-week overnight summer camp held on a university campus.

Northern Nevada girls of all abilities and backgrounds who were rising seventh or eighth graders (i.e., would enter those grades in the fall) were eligible to participate in the summer camp. Sixty girls (30 for each grade level) were randomly chosen to attend the camp each year. Academic sessions, conducted during mornings and afternoons, were based on content students would learn the following school year according to the state mathematics standards. Technology, mainly calculators and powerful computer applications for learning mathematics, were incorporated into the mathematics lessons. During the evenings, the girls participated in group recreational activities.

The main instructional approaches were those known to serve girls well in mathematics: use of collaborative group work; student communication (e.g., discussion while doing mathematics and explanation of solution methods and results); technology use; and active, hands-on learning (Ashcraft et al., 2012; Dillivan & Dillivan, 2014; Mohr-Schroeder et al., 2014). Other methods foundational to the camp were use of a female-only environment with exposure to women role models and mentors and some attention to career awareness and preparation (Ashcraft et al., 2012; Mohr-Schroeder et al., 2014; Shapiro et al., 2015).

Participants

Participants in this study were 210 Nevada females ages 12-13 who attended the Northern Nevada Girls Math and Technology Camp in the summers of 2015-2018. Only girls who attended the full camp and completed both the pre and post assessment

were included. Participants' self-reported race/ethnicity was 64.5% White/non-Hispanic, 18.8% Hispanic/Latina, 4.7% Asian American/Pacific Islander, 2.6% American Indian/Alaskan Native, 1.3% Black/African American, and 8.1% two or more of these. The 11 participants who did not report their race/ethnicity were included in the whole-group measures but were excluded from the race/ethnicity comparisons. Of the study sample, 50.4% were rising seventh-grade students (i.e., would attend the seventh grade the following fall) and 49.6% were rising eighth graders, and 25.6% received a financial-need scholarship based on eligibility for free or reduced-price meals via the National School Lunch Program. Because participants in the summer program were drawn randomly from those who applied, the girls were diverse in terms of ability levels, types of communities in which they resided, life experiences, and other background characteristics.

Data Collection Instrument

This research employed a modified Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich & De Groot, 1990; Pintrich et al., 1993). The questionnaire was adapted to refer specifically to the mathematics camp. For example, "I know I will like what I learn in the class" was adjusted to "I know I will like what I learn at this mathematics camp." For the purpose of this study, the following subscales, consisting of 19 items total and distributed as indicated, were administered: Self-Efficacy, Internal Motivation, and External Motivation. Sample items for the three subscales include:

- *Self-Efficacy* (8 items): I know that I will be able to learn the material taught at this camp.
- *Internal Motivation* (6 items): Understanding mathematics is important to me.
- *External Motivation* (5 items): It is important that teachers, friends, and others see me as a good mathematics student.

Participants completed the instrument at the beginning of the camp prior to any activities or instruction, and again at the end of the camp. They were instructed to respond to the items on a seven-point Likert-type scale ranging from 1 (*not at all true of me*) to 7 (*very true of me*). Previous research using the MSLQ has reported Cronbach's alpha ranging from .52 to .93 for the items (Duncan & McKeachie, 2005; Moos & Honkomp, 2011). Further, confirmatory factor analysis has demonstrated reasonable factor validity for each scale (e.g., Duncan & McKeachie, 2005; Pintrich et al., 1993; Rao & Sachs, 1999).

Data Analysis

The 19 survey items were scored 1 to 7, which corresponded to the least favorable (1) to the most favorable (7) responses along the scale (i.e., a rating of 1 was scored 1, a rating of 2 was scored 2, and so forth through 7). Thus, the total points possible was 56 for the 8 Self-Efficacy subscale items, 42 for the 6 Internal Motivation subscale items, and 35 for the 5 External Motivation subscale items.

A paired-samples t-test was used to compare means for pre and post measures, testing for significance at the .05 level using a two-tailed test. Participants' perspectives about mathematics, as measured by the MSLQ subscales, were the dependent variables. Of the 210 participants who attended the entire camp and completed both the pre and post assessment, 210 scores were analyzed for the Self-Efficacy subscale and 209 were analyzed for the Intrinsic and Extrinsic Motivation subscales (the latter being lower due to skipped items). Further, a paired samples t-test was used to compare mean pre and post scores for the following subgroups: White/non-Hispanic and Asian American/Pacific Islander (combined) compared with Hispanic/Latina, Black/African American, American Indian/Alaskan Native, and two or more of these (combined); scholarship compared with non-scholarship based on eligibility for free/reduced-price lunch as a proxy for family income; and rising seventh- compared with eighth-grade girls (hereafter, called seventh and eighth grade). The two chosen groupings for the racial/ethnic categories was based on the groups' differing tendencies toward higher versus lower mathematics performance, as noted in the literature review section of this paper. Given that multiple paired t-tests were conducted, the Bonferroni Correction was applied.

Results

Table 1 shows mean scores for the Self-Efficacy, Internal Motivation, and External Motivation subscales for all participants at the beginning and the end of the camp. Paired-samples t-tests conducted for each scale show significant increases from program beginning to end in Self-Efficacy (t=-8.236, p<.001), Intrinsic Motivation (t=-5.557, p <.001), and Extrinsic Motivation (t=-3.191, p=.002).

Table 1

MSLQ subscale scores

Subscale		Pre		Post		t	p	d
	n	M	SD	M	SD			
Self-Efficacy	210	45.50	7.11	47.92	7.13	-8.236	<.001*	0.34
Intrinsic Motivation	209	38.29	3.84	39.72	3.20	-5.557	<.001*	0.40
Extrinsic Motivation	209	31.75	4.35	32.46	3.65	-3.191	.002*	0.18

Note. A paired-samples t-test was used to compare mean pre and post scores for each subscale, testing for significance at the .05 level using a two-tailed test.

Table 2 shows mean scores for the three subscales for the beginning and the end of the camp for two racial/ethnic subgroups: Group One (White and Asian American), and Group Two (all participants who are not White or Asian American). Paired-samples t-tests indicate significant increases from program beginning to end for participants who identified as White or Asian American in Self-Efficacy (t=-7.86, p<.001) and Intrinsic Motivation (t=-4.03, p<.001). However, this group did not show a significant increase in Extrinsic Motivation (t=-2.10, p=.037). Group Two (non-White or Asian American) participants showed significant score increases for all three subscales: Self-Efficacy (t=-3.571, p=.001), Intrinsic Motivation (t=-4.827, p<.001), and Extrinsic Motivation (t=-2.637, p=.010).

TABLE 2

MSLQ subscale scores by race/ethnicity

Subscale		Pre		Post		t	p	d
	n	*M*	*SD*	*M*	*SD*			
Group One Self-Efficacy	136	44.84	7.06	48.76	6.29	-7.86	<.001*	0.59
Group One Intrinsic Motivation	136	38.97	3.29	40.09	2.35	-4.03	<.001*	0.39
Group One Extrinsic Motivation	135	32.07	3.77	32.53	3.40	-2.10	.037	.013
Group Two Self-Efficacy	66	43.84	6.88	46.55	6.93	-3.571	.001*	0.39
Group Two Intrinsic Motivation	65	37.30	4.62	39.30	3.34	-4.827	<.001*	0.43
Group Two Extrinsic Motivation	66	31.01	5.47	32.36	4.06	-2.637	.010*	0.28

Note. A paired-samples t-test was used to compare mean pre and post scores for each subscale, testing for significance at the .05 level using a two-tailed test.

Table 3 shows mean scores for the three subscales for the beginning and the end of the camp for two subgroups based on family socioeconomic status: scholarship and non-scholarship (eligibility versus non-eligibility for free/reduced-price lunch). Paired-samples t-tests show significant increases in two subscales from program beginning to end for participants who did not have a financial-need scholarship: Self-Efficacy (t=-7.136, p<.001) and Intrinsic Motivation (t=-5.28, p<.001). These non-scholarship participants, however, did not show a significant increase in scores for Extrinsic Moti-

vation (t=-1.99, p=.048). Scores for participants with a financial-need scholarship significantly increased from program beginning to end for Self-Efficacy (t=-3.502, p<.001) and Extrinsic Motivation (t=-2.519, p=0.15). Participants in this group did not show a significant increase in scores for Intrinsic Motivation (t=-2.046, p=.046).

TABLE 3

MSLQ subscale scores by family socioeconomic status

Subscale		Pre		Post		t	p	d
	n	*M*	*SD*	*M*	*SD*			
No Scholarship: Self-Efficacy	148	44.77	7.10	48.25	6.67	-7.136	<.001*	0.60
No Scholarship: Intrinsic Motivation	149	38.34	3.88	39.79	2.84	-5.28	<.001*	0.42
No Scholarship Extrinsic Motivation	149	32.22	4.26	32.69	3.32	-1.99	.048	0.12
Scholarship: Self-Efficacy	57	43.84	7.29	46.83	8.33	-3.502	.001*	0.38
Scholarship: Intrinsic Motivation	55	38.13	3.93	39.45	4.15	-2.046	.046	0.33
Scholarship Extrinsic Motivation	55	30.55	4.49	31.91	4.42	-2.519	.015*	0.31

Note. A paired-samples t-test was used to compare mean pre and post scores for each subscale, testing for significance at the .05 level using a two-tailed test.

Table 4 shows mean scores for the three subscales for the beginning and the end of the camp for participants entering the seventh grade in the fall following the camp ("7th Grader") and those entering the eighth grade ("8th Grader"). Participants entering the seventh grade showed significant score increases in all three subscales: Self-Efficacy (t=-7.136, p<.001), Intrinsic Motivation (t=-6.469, p<.001), and Extrinsic Motivation (t=-2.989, p=.004). Scores for participants entering the eighth grade significantly increased from program beginning to end for Self-Efficacy (t=-4.468, p<.001) and Intrinsic Motivation (t=-2.266, p=.025) but not for Extrinsic Motivation (t=-1.507, p=.135).

TABLE 4

MLSQ subscale scores by grade level

Subscale		Pre		Post		t	p	d
	n	*M*	*SD*	*M*	*SD*			
7th Grader Self-Efficacy	105	44.90	7.73	49.09	6.55	-7.110	<.001*	0.58
7th Grader Intrinsic Motivation	103	38.52	3.21	40.41	2.05	-6.469	<.001*	0.70
7th Grader Extrinsic Motivation	102	31.98	3.76	32.90	3.06	-2.989	.004*	0.27
8th Grader Self-Efficacy	104	44.12	6.48	46.72	7.55	-4.468	<.001*	0.37
8th Grader Intrinsic Motivation	105	38.07	4.40	39.02	3.93	-2.266	.025*	0.23
8th Grader Extrinsic Motivation	106	31.53	4.87	32.02	4.12	-1.507	.135	0.11

Note. A paired-samples t-test was used to compare mean pre and post scores for each subscale, testing for significance at the .05 level using a two-tailed test.

DISCUSSION

In terms of overall scores for participants, scores improved from the beginning of the camp week to the end in all three subscales, namely, self-efficacy, intrinsic motivation, and extrinsic motivation. This is somewhat unsurprising in that participants spent an intense week learning and becoming empowered in mathematics in a strong community of peers and role models gathered for the same purpose. The program emphasizes learner responsibility for solving mathematics tasks collaboratively, as well as explaining and defending work, while critically examining that of others, in small groups and as a class. Participants are explicitly told that hard work and appropriate learning experiences, and not natural ability, influence mathematics performance (Dweck, 2006; O'Sullivan & Ríordáin, 2017). Thus, the camp is fertile ground for bolstering favorable dispositions involving self-efficacy beliefs and intrinsic motivation. Less emphasis is given to external factors, but some attention to the value of mathematics to personal and vocational lives, to mathematics' accessibility to everyone, and to mathematics-based career options and associated career preparation is likely to have influenced increases in external motivation as well. However, the lesser attention given to external factors is reflected in the effect sizes for the significant changes that occurred for each of the three subscales. According to Cohen's (1992) classification of effect sizes, which indicate the power associated with statistical analyses, self-efficacy and intrinsic motivation

results in this study have moderate effect sizes, and extrinsic motivation has a small effect size.

It is encouraging that significant improvements in self-efficacy and motivation largely took place across racial/ethnic groups. One result to note is that participants in underrepresented racial/ethnic groups showed significant increases in all three dispositional categories assessed. Although the effect sizes for the three were small, they show favorable movement from participation in a STEM OST program. The White/Asian American group showed significant increases in self-efficacy and intrinsic motivation but not extrinsic motivation. Perhaps this group receives sufficient external validation from society, schools, and families such that they do not rely on the small "nudges" the program provided in that regard, whereas external encouragement for underrepresented groups might hold greater value. For example, students from minoritized racial/ethnic groups might be socialized to believe that their mathematics capabilities are not valued or that improved mathematics performance will not yield substantial benefits in a society that offers them fewer opportunities (e.g., Martin, 2009). Perhaps some degree of demonstrated external belief in youth from underrepresented groups bears more weight than for more privileged individuals. Likewise, this societally induced self-doubt might relate to the small effect size in improvement in self-efficacy for the underrepresented racial/ethnic group, whereas the White/Asian American group had a moderate effect size for the same. It likely takes a stronger, wider, more sustained, and genuine effort to support underrepresented racial/ethnic groups in mathematics self-beliefs.

Girls who did and girls who did not demonstrate financial need significantly improved their self-efficacy and motivation by participating in this program. However, increased motivation was intrinsic for non-scholarship participants and extrinsic for scholarship participants, both with small effect sizes. Perhaps non-scholarship participants welcome an opportunity to be motivated internally, given that youth from middle/higher-income families tend to have more directed and structured lives (e.g., Aktop, 2010; Stuij, 2015). Conversely, girls from lower-income families (scholarship recipients), who tend toward less structured lives outside of school, might appreciate having somewhat greater external direction, at least in relation to their mathematics potential. Nevertheless, the fact that girls on scholarships did not significantly improve in intrinsic motivation, an important driving force in academics and in life in general, warrants more investigation to determine constraints and potentially favorable influences on internal motivation in OST programs and beyond.

In terms of results by grade level, both rising seventh and rising eighth graders significantly improved their self-efficacy and intrinsic motivation, with moderate effect sizes in both cases, from beginning to end of the OST program investigated in this study. Academic motivation tends to decrease during adolescence, thus making efforts to sustain it particularly important at this age (Hoffman et al., 2021; Yu et al., 2022). Rising seventh

graders also showed significant improvement in extrinsic motivation (small effect size). The fact that rising eighth graders, who are one year older and at the upper end of the middle school grades, did not do the same might be due to possessing somewhat greater independence and maturity that is less sensitive to external influence.

The results of this study show that a one-week residential mathematics program for middle school girls can favorably influence participants' short-term self-efficacy and motivation for learning mathematics. Overall, significant increases appeared in self-efficacy, intrinsic motivation, and extrinsic motivation from program beginning to end. Self-efficacy showed the strongest changes, with moderate effect sizes in four of the six subgroup analyses conducted and small effect sizes in the other two. Intrinsic motivation was next strongest, with moderate effect sizes in two subgroups, small in three, and nonsignificant differences for one. Changes in extrinsic motivation were least strong and most variable, with small effect sizes for three measured subgroups and nonsignificant differences for the other three.

Arguably, the strength of observed improvements appears in the most favorable order, given the importance of self-beliefs for ability to perform particular tasks (self-efficacy) likely being especially conducive to mathematics learning. Further, self-efficacy is an important foundation for developing motivation (Schunk & DiBenedetto, 2021; Yu et al., 2022). Internal (intrinsic) and external (extrinsic) motivation then follow in order in terms of their potential benefits for supporting mathematics learning. Interestingly, significant increases in extrinsic motivation occurred only for the non-White/Asian American, scholarship (financial-need), and rising seventh-grader subgroups. Perhaps the first two groups are more sensitive to outside influence based on greater need for external validation and reasons for learning mathematics because more "privileged" groups receive this more routinely outside of the program. Regarding grade level, it might be that the older girls are more immune to the rhetoric of the utilitarian value of mathematics they have heard over time, be more resistant to external suggestion from authority figures, or be more interested in other types of external influences (e.g., social). Further, as noted, students have been shown to experience a decline in motivation over time that appears to be particularly salient at this age and especially in mathematics (Gillet et al., 2012; Gottfried et al., 2009; Hoffman et al., 2021; Ker, 2017; Yu et al., 2022).

As discussed early in this paper, positive dispositions can favorably influence mathematics performance. Many authors concur with the importance of productive mental states (e.g., attitudes, such as confidence, beliefs, and openness) and associated actions (e.g., perseverance) in relation to engaging with mathematics, and thus the need to nurture those perspectives and behaviors (Cutumisu & Bulut, 2017; Ganley & Lubienski, 2016; O'Sullivan & Ríordáin, 2017). Gunderson et al. (2017) note that "math-specific beliefs may be especially important targets for intervention" (p. 1188), and Hand et

al. (2017) suggest showing real-world uses of mathematics and science, such as highlighting women role models, as one way to promote STEM-specific self-efficacy.

Looking forward, greater use of qualitative and mixed-methods designs could enrich future research on OST programs for females in STEM. In addition to potential attitudinal gains, research might investigate potential achievement and other favorable outcomes of such programs, as well as possible interactions of factors, in the short-term and, especially, in the long-term. While the present study focused on the overall short-term influence of an OST STEM program on middle school girls as a whole and subgroups formed by race/ethnicity, family SES, and two middle-grades grade levels, further research might examine other subgroups according to, for example, ability level, ableness, community type (e.g., urban, suburban, rural), and grade level (a broader range than studied here). Different types of programs based on program length, residential versus commuter status, instructional focus, and so forth are also important to research in order to expand our collective knowledge of the value of OST programs for potentially increasing the proportion of females and other underrepresented groups in STEM.

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