The Rice University School Mathematics Project (RUSMP)

Evaluation Report for 2021 Summer Campus Program (Virtual)

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2021 Summer Campus Program (Virtual)

In the summer of 2021, the Rice University School Mathematics Project (RUSMP) offered its 35th annual Summer Campus Program (SCP) for mathematics teachers in Houston, its neighboring areas, and around Texas. With emphasis on problem-solving, motivation, use of manipulatives, real-world applications, and technology in mathematics classrooms, the SCP provided an active learning approach to professional development in pedagogy and mathematics content. The SCP focused on concept-based learning activities for numbers concepts, algebraic reasoning, and geometry and calculus. Participating teachers attended one of three classes: Elementary (2nd–5th grade teachers; 25 attendees), Middle School (6th–8th grade teachers; 24 attendees), and High School (9th–12th grade teachers; 18 attendees). RUSMP provided each participant with classroom materials, including books, manipulatives, and other resources to support instruction before the virtual program started on June 14, 2022. At least two Master Teachers led each class. Most Master Teachers were former RUSMP participants themselves. All 67 teacher who attended the SCP were invited to complete pre- and post-surveys and assessments for their specialized content knowledge for teaching mathematics. Fifty-three teachers completed the demographic and professional background questionnaire prior to the SCP. These teachers came from 23 different schools (including public schools in four independent school districts, one charter school system, and two private school) to participate in the program. All participants were classroom teachers during the 2020-2021 school year and except for two, they all had a teaching assignment for the 2021-22 school year as of June 2022.

The program was held from 9:00 a.m. to 3:00 p.m. Mondays through Thursdays via Zoom from June 14 through June 17 and June 21 through June 24. Each morning, teachers joined the Zoom meetings and engaged in different activities where they undertook the role of students and actively explored important mathematics content and discussed pedagogical strategies to enact various educational activities. These activities included hands-on individual work (with resources provided by RUSMP) or mini-projects with peers (using the Zoom breakout rooms). Most of the afternoons were designed for teachers to discuss and engage in various work and tasks with their peers.

All participants received a certificate of attendance and 48 Continuing Professional Education (CPE) contact hours. In addition, Houston ISD awarded 6 hours of Gifted and Talented Professional Development credit.

Program Goals

The program provides rigorous, innovative professional development for teachers who are not "highly qualified" as defined by the former K-12 education law, No Child Left Behind (NCLB) to progress towards this goal. The program assists teachers as they work towards the goal of being "adequately prepared" and helps "adequately prepared" teachers become "highly qualified." Instructional activities foster the development of a conceptual framework that is necessary for a deep understanding of the K-12 mathematics concepts developed.

Program Objectives

- Teachers' content knowledge will increase in targeted mathematics TEKS related to the numbers, operations, quantitative reasoning, patterns, relationships, and algebraic reasoning.
- Teachers' methodology in the appropriate use of technology and manipulatives in the math classroom will improve for the targeted mathematics TEKS.
- Teachers will learn how to implement engaging, student-centered inquiry-based instructional methods for mathematics instruction.
- Teachers will learn how to use a variety of assessment methods including appropriate ongoing formative strategies to guide instruction.
- Teachers' self-efficacy, confidence, and sense of preparedness in teaching mathematics will improve.

Evaluation

Overall, 53 participants completed the pre-survey and less than 42 completed the post-survey. The number of participants who completed both surveys (needed in order to gauge their changes in aforementioned focus areas) fell short of expectations: 38 participants completed both pre- and post-program surveys. Moreover, only 23 participants completed the pre- and post-program content assessments. The surveys and tests included information about the participants as well as items to assess RUSMP's impact on SCP participants' mathematics content knowledge, pedagogy, teacher efficacy, and confidence in their preparedness and teaching skills for mathematics instruction. Participants' test scores and survey results were used to conduct paired samples *t*-tests and measure changes in teachers' motivational beliefs about mathematics and mathematics teaching; teachers' knowledge and beliefs about technology, content knowledge, and pedagogical content knowledge as well as standards-based mathematics teaching and assessments; and confidence in their preparedness and teaching skills for mathematics instruction as a result of participating in the SCP (Tables 2-12). The significant improvements in respective areas are marked by *, **, or *** in these tables (more *s mean greater significance). The tables indicate changes for both by class and the whole group. Participants' evaluations of the SCP classroom climate and ratings about their overall satisfaction with the program were also analyzed (Figures 1-6). Lastly, since online teaching and learning became substantially important during the pandemic, teacher's online teaching dispositions were analyzed at the end of the program. Appendix A contains a list of survey items used to assess teachers' beliefs, attitudes, and perceptions.

Table 1
Program Class Demographics

	SCP Teachers (All)	SCP Teachers (Elementary)	SCP Teachers (Middle/High School)
	N = 53	*N* = 21	*N* = 32
Gender			
Female	70%	91%	56%
Male	30%	9%	44%
Ethnicity			
White, Non-Hispanic	36%	19%	47%
Black, Non-Hispanic	4%	10%	0%
Hispanic	45%	62%	34%
Asian/Pacific Islander	13%	9%	16%
Other	2%	0%	3%
Years Teaching			
0-1	8%	5%	10%
2-3	24%	16%	29%
4-5	22%	32%	16%
6-10	26%	16%	32%
11-20	14%	21%	10%
21-30	6%	11%	3%
31+	0%	0%	0%
Certification			
Standard	45%	43%	47%
Provisional	42%	48%	37%
None	13%	9%	16%
Volunteered	42%	10%	62%

Program Outcomes

Self-efficacy for Teaching

Table 2
Paired-Samples t-test Results on Measures of Teacher Self-efficacy Before and After PD

	Time 1		Time 2				95% CI		Cohen's d
Variable	**M**	**SD**	**M**	**SD**	**Mean Δ**	**t**	**LL**	**UL**	
Elementary									
Instruction	3.95	.61	4.38	.59	.43	4.04**	.20	.66	1.08
Student Engagement	4.13	.58	4.39	.60	.27	2.11	-.01	.54	.56
Classroom Mgmt.	4.21	.54	4.48	.49	.27	2.26*	.01	.52	.60
Middle/High School									
Instruction	3.77	.74	3.79	.57	.02	.182	-.23	.27	.04
Student Engagement	3.62	.72	3.82	.59	.20	1.66	-.05	.44	.35
Classroom Mgmt.	3.85	.41	3.88	.52	.03	.27	-.22	.29	.06
Overall									
Instruction	3.84	.69	4.01	.64	.18	1.96	-.01	.36	.32
Student Engagement	3.81	.71	4.03	.65	.22	2.58	.05	.40	.42
Classroom Mgmt.	3.99	.49	4.11	.58	.12	1.37	-.06	.30	.22

Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Self-efficacy for Mathematics Teaching

Table 3
Paired-Samples t-test Results on Measures of Teachers' Self-efficacy for Mathematics Teaching Before and After PD

	Time 1		Time 2				95% CI		Cohen's d
	M	**SD**	**M**	**SD**	**Mean Δ**	**t**	**LL**	**UL**	
Elementary	3.98	.57	4.10	.61	.12	1.01	-.13	.36	.27
Middle/High School	3.89	.63	4.01	.46	.12	1.37	-.06	.31	.28
Overall	3.92	.60	4.04	.51	.12	1.72	-.02	.26	.28

Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Mathematics Teaching Interest

Table 4
Paired-Samples t-test Results on Measures of Teachers' Interest in Mathematics Teaching Before and After PD

	Time 1		Time 2				95% CI		Cohen's d
	M	**SD**	**M**	**SD**	**Mean Δ**	**t**	**LL**	**UL**	
Elementary	4.36	.73	4.27	.71	-.09	-1.44	-.22	.04	-.39
Middle/High School	4.42	.57	4.30	.55	-.12	-1.04	-.36	.12	-.22
Overall	4.40	.62	4.29	.61	-.11	-1.45	-.26	.04	-.24

Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Mathematics Self-Concept

Table 5

Paired-Samples t-test Results on Mathematics Self-Concept Before and After PD

	Time 1		Time 2				95% CI		Cohen's d
Variable	**M**	**SD**	**M**	**SD**	**Mean Δ**	**t**	**LL**	**UL**	
Elementary	3.44	.73	3.58	.57	.14	1.52	-.06	.35	.41
Middle/High School	3.69	.75	3.80	.77	.11	1.23	-.08	.30	.25
Overall	3.60	.74	3.72	.70	.12	1.86	-.01	.26	.30

Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Epistemic Beliefs for Mathematics

Table 6

Paired-Samples t-test Results on Measures of Teachers' Epistemic Beliefs for Math (non-Availing) Before and After PD

	Time 1		Time 2				95% CI		Cohen's d
Variable	**M**	**SD**	**M**	**SD**	**Mean Δ**	**t**	**LL**	**UL**	
Elementary									
Certainty of Knowledge	2.63	.44	2.22	.55	-.41	-2.96*	-.71	-.11	-.80
Source Authority	2.93	.46	2.82	.58	-.11	-.65	-.46	.25	-.17
Attainment of Truth	3.75	.51	3.79	.61	.04	.21	-.33	.40	.06
Middle/High School									
Certainty of Knowledge	2.70	.38	2.47	.51	-.23	-2.96**	-.39	-.07	-.61
Source Authority	3.08	.55	2.86	.59	-.22	-2.48*	-.40	-.04	-.51
Attainment of Truth	3.52	.83	3.48	.94	-.11	-.27	-.036	.28	-.06
Overall									
Certainty of Knowledge	2.67	.40	2.38	.53	-.30	-4.16***	-.44	-.15	-.68
Source Authority	3.03	.52	2.85	.57	-.18	-2.18*	-.34	-.01	-.35
Attainment of Truth	3.61	.73	3.59	.84	-.01	-.12	-.24	.22	-.02

Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Technological Pedagogical Knowledge

Table 7

Paired-Samples t-test Results on Technological Pedagogical Knowledge Before and After PD

	Time 1		Time 2				95% CI		Cohen's d
Variable	**M**	**SD**	**M**	**SD**	**Mean Δ**	**t**	**LL**	**UL**	
Elementary	3.81	.64	4.09	.73	.27	2.61*	.05	.50	.70
Middle/High School	3.84	.66	4.01	.64	.17	1.40	-.08	.41	.29
Overall	3.83	.65	4.04	.67	.21	2.49*	.04	.37	.41

Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Technological Pedagogical Content Knowledge

Table 8
Paired-Samples t-test Results on Technological Pedagogical Content Knowledge Before and After PD

	Time 1		Time 2				95% CI		Cohen's d
Variable	**M**	**SD**	**M**	**SD**	**Mean Δ**	**t**	**LL**	**UL**	
Elementary	3.74	.69	4.03	.63	.29	2.69*	.06	.52	.72
Middle/High School	3.75	.63	3.92	.72	.17	1.67	-.04	.39	.35
Overall	3.75	.64	3.96	.68	.22	2.86**	.06	.37	.47

Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Standard-Based Teaching

Table 9
Paired-Samples t-test Results on Measures of Teachers' Standards-Based teaching Before and After PD

	Time 1		Time 2				95% CI		Cohen's d
Variable	**M**	**SD**	**M**	**SD**	**Mean Δ**	**t**	**LL**	**UL**	
Elementary									
Student Tasks	3.67	.52	4.12	.55	.45	3.00*	.13	.78	.80
Student-Student Interaction	4.05	.64	4.67	.52	.62	2.74*	.13	1.11	.73
Teacher's Role	3.96	.66	4.82	.37	.86	5.32***	.51	1.20	1.42
Manipulatives and Tools	3.24	.42	3.17	.47	-.07	-.38	-.48	.34	-.10
Discovery	3.36	1.28	4.14	.95	.79	2.35*	.06	1.51	.63
Middle/High School									
Student Tasks	3.79	.59	3.97	.67	.18	1.30	-.11	.47	.28
Student-Student Interaction	3.98	.55	4.18	.68	.20	1.20	-.14	.54	.26
Teacher's Role	3.50	.62	4.30	.73	.80	4.23***	.40	1.19	.90
Manipulatives and Tools	3.21	.63	3.20	.56	-.02	-.11	-.31	.28	-.02
Discovery	3.41	.67	4.14	.71	.73	3.31**	.27	1.19	.71
Overall									
Student Tasks	3.74	.56	4.03	.62	.29	2.74*	.07	.50	.45
Student-Student Interaction	4.01	.58	4.37	.66	.36	2.66*	.09	.64	.44
Teacher's Role	3.68	.67	4.50	.66	.82	6.33**	.56	1.08	1.06
Manipulatives and Tools	3.22	.55	3.19	.52	-.04	-.33	-.26	.19	-.06
Discovery	4.14	.80	3.39	.93	-.75	-4.07**	-1.12	-.38	-.68

Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Assessment

Table 10

Paired-Samples t-test Results on Teachers' Beliefs about Assessment Before and After PD

	Time 1		Time 2				95% CI		Cohen's d
Variable	**M**	**SD**	**M**	**SD**	**Mean Δ**	**t**	**LL**	**UL**	
Elementary									
Summative	2.77	.70	2.86	.60	.09	.62	-.22	.40	.17
Formative	4.27	.58	4.11	.62	-.16	-1.39	-.40	.09	-.37
Testing	2.30	.54	1.98	.58	-.33	-2.11	-.66	.00	-.56
Large-scale	2.50	.93	2.57	.88	.07	.31	-.42	.56	.08
Middle/High School									
Summative	2.72	.66	2.58	.52	-.14	-1.16	-.39	.11	-.24
Formative	4.30	.52	4.16	.52	-.14	-1.10	-.40	.12	-.23
Testing	2.33	.54	1.87	.53	-.46	-3.71**	-.71	-.20	-.77
Large-scale	2.84	.85	2.70	.82	-.15	-1.04	-.44	.15	-.22
Overall									
Summative	2.74	.67	2.68	.56	-.05	-.58	-.24	.14	-.10
Formative	4.29	.54	4.14	.55	-.15	-1.69	-.33	.03	-.27
Testing	2.31	.53	1.91	.54	-.41	-4.26**	-.60	-.21	-.70
Large-scale	2.71	.89	2.65	.83	-.06	-.53	-.31	.18	-.09

Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Level of Preparedness to Use Pedagogical Techniques

Table 11

Paired-Samples t-test Results on Pedagogical Preparedness Before and After PD

	Time 1		Time 2				95% CI		Cohen's d
Variable	**M**	**SD**	**M**	**SD**	**MeanΔ**	**t**	**LL**	**UL**	
Elementary	2.73	.69	4.25	.64	1.53	10.23***	1.21	1.85	2.73
Middle/High School	2.55	.66	3.94	.62	1.39	14.09***	1.19	1.60	3.00
Overall	2.62	.67	4.06	.64	1.45	17.36***	1.28	1.61	2.89

Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Mathematical Knowledge for Teaching

Table 12

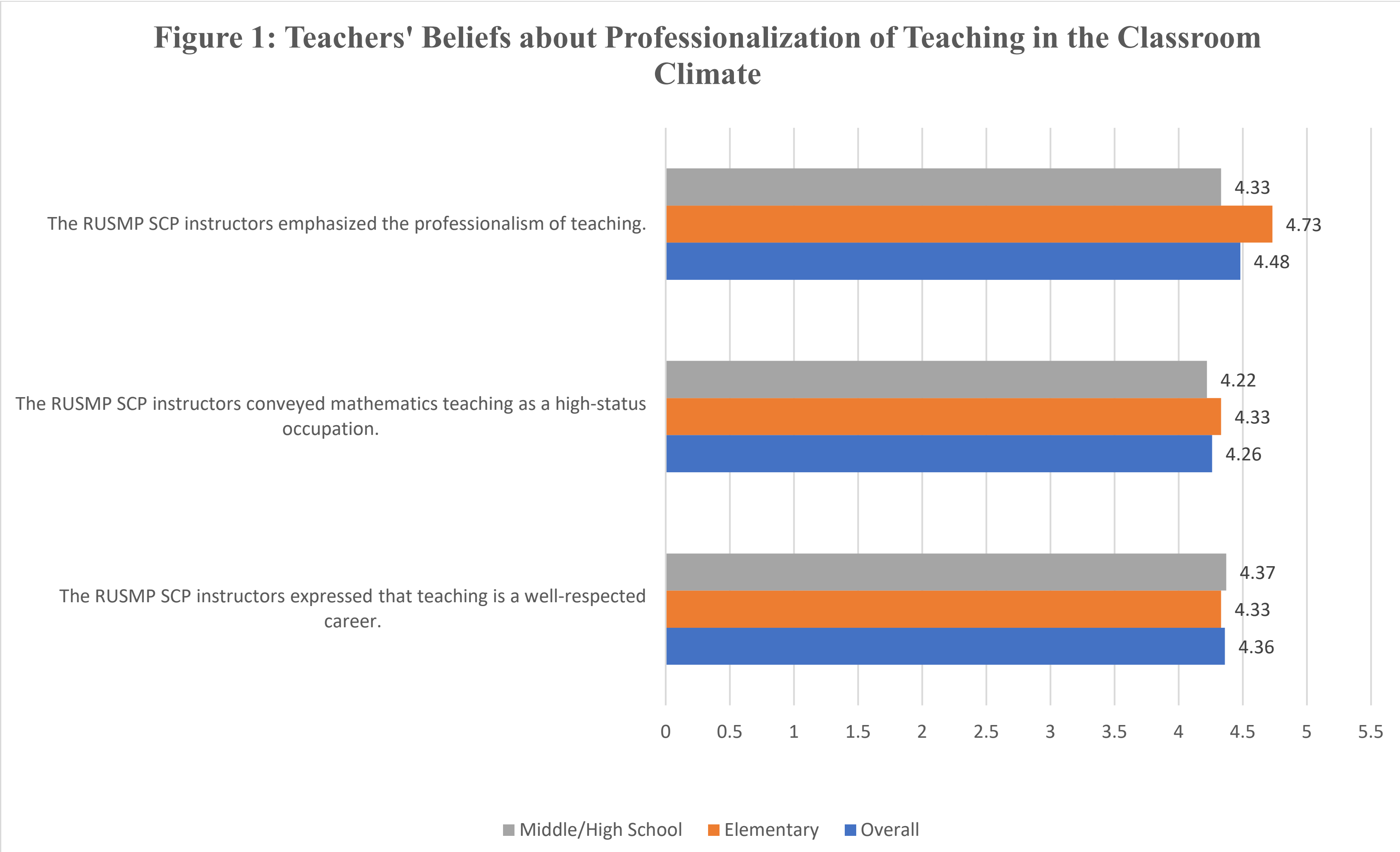
Paired-Samples t-test Results on Mathematical Knowledge for Teaching Scores[1] Before and After PD

	Time 1		Time 2				95% CI		Cohen's d
Variable	**M**	**SD**	**M**	**SD**	**MeanΔ**	**t**	**LL**	**UL**	
Elementary	-.15	1.13	-.19	.97	-0.50	0.16	-.65	.74	-.05
Middle/High School	.77	1.25	.88	1.01	.12	.47	-.43	.66	.14
Overall	.33	1.26	.37	1.12	.04	.19	-.36	.43	.04

Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

[1]Test scores are normally standardized with a mean of 0 and SD of 1 using nationally representative data. Mean of 0 roughly corresponds to 65-70% correct on the test.

SCP's Classroom Climate



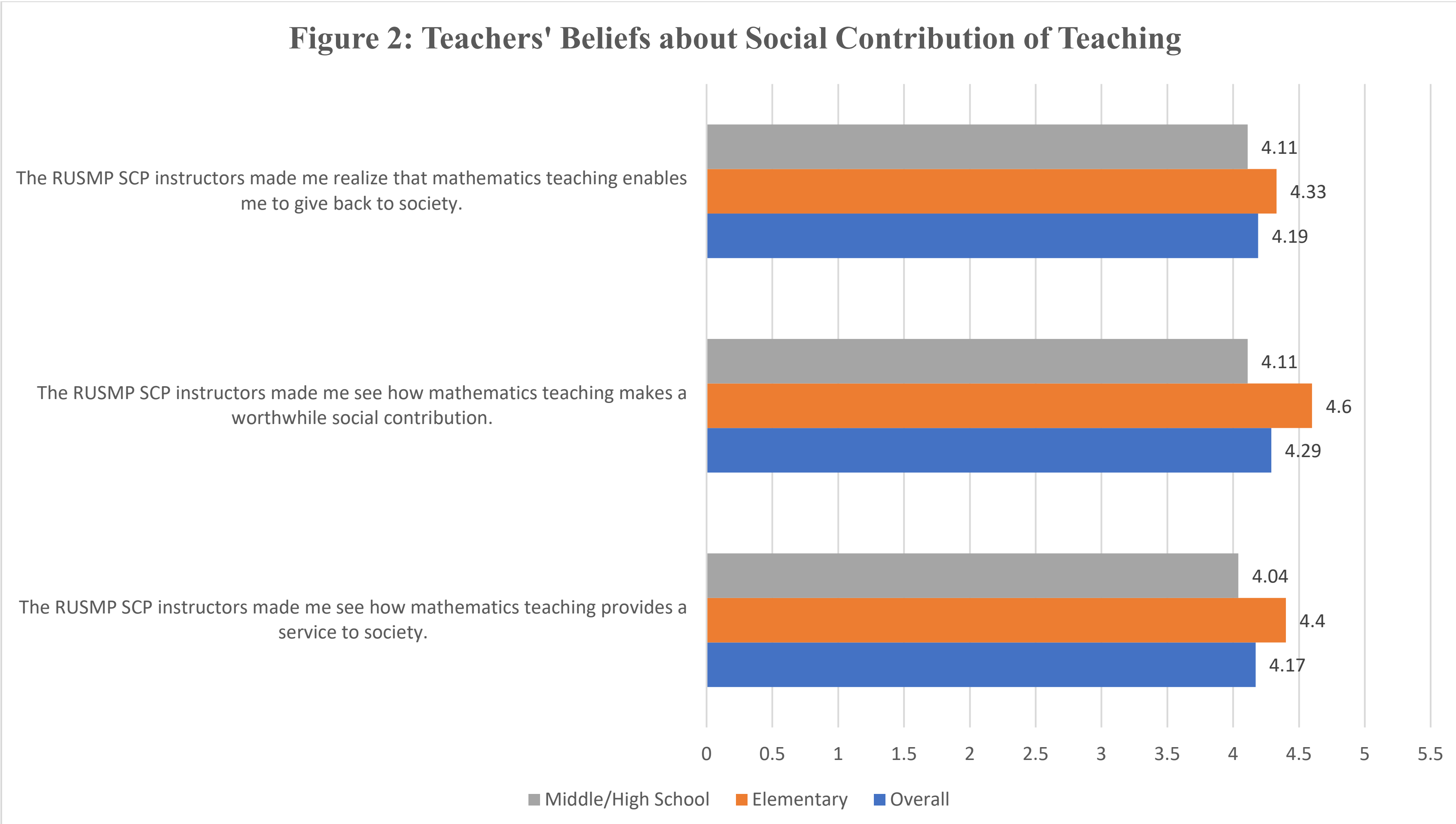


Figure 2: Teachers' Beliefs about Social Contribution of Teaching
The RUSMP SCP instructors made me realize that mathematics teaching enables me to give back to society.
4.11
4.33
4.19
The RUSMP SCP instructors made me see how mathematics teaching makes a worthwhile social contribution.
4.11
4.6
4.29
The RUSMP SCP instructors made me see how mathematics teaching provides a service to society.
4.04
4.4
4.17
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5
Middle/High School
Elementary
Overall

Figure 3: Teachers' Beliefs about Active Learning in the Classroom Climate

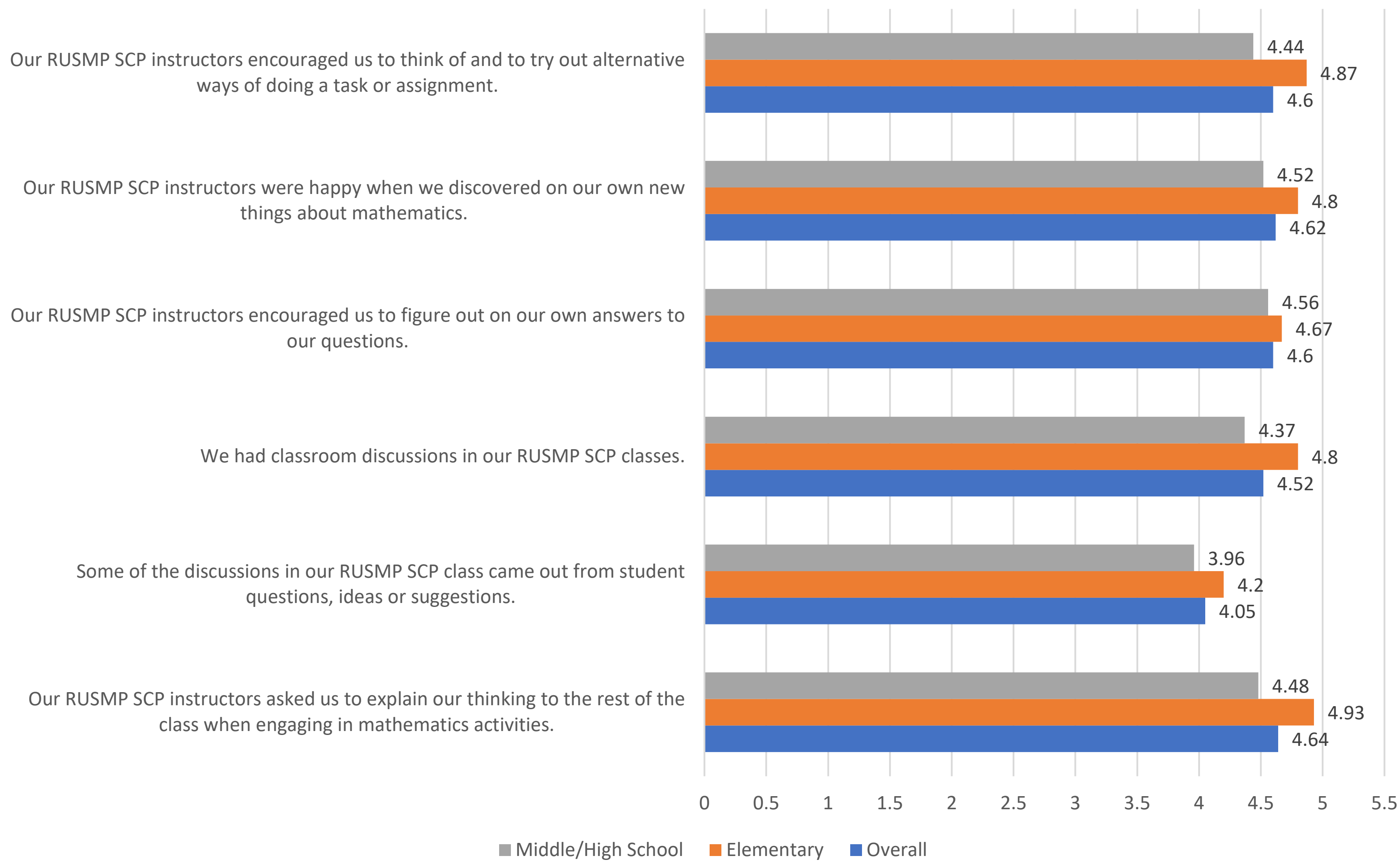
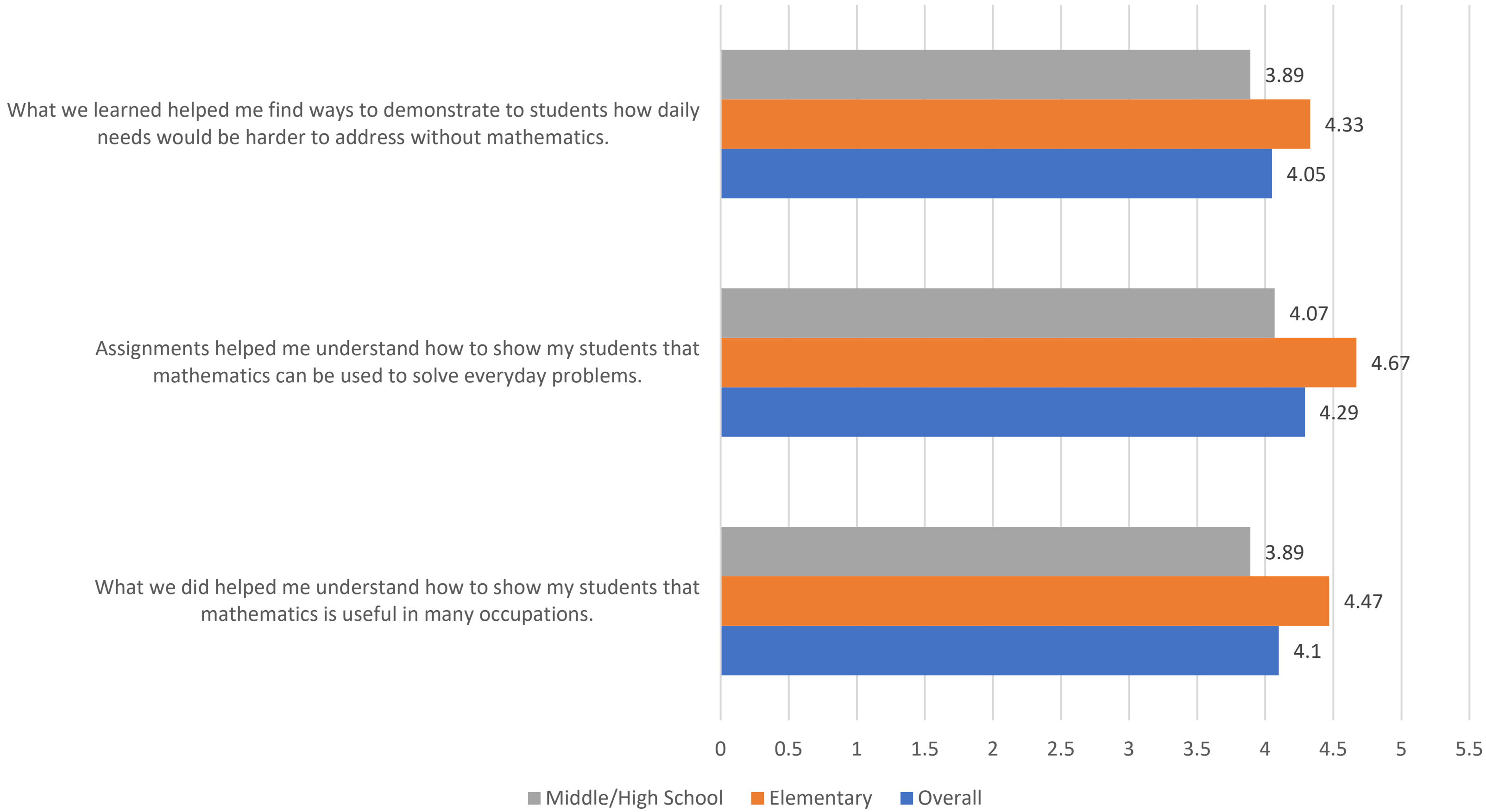


Figure 4: Teachers' Beliefs about Meaningful Learning in the Classroom Climate



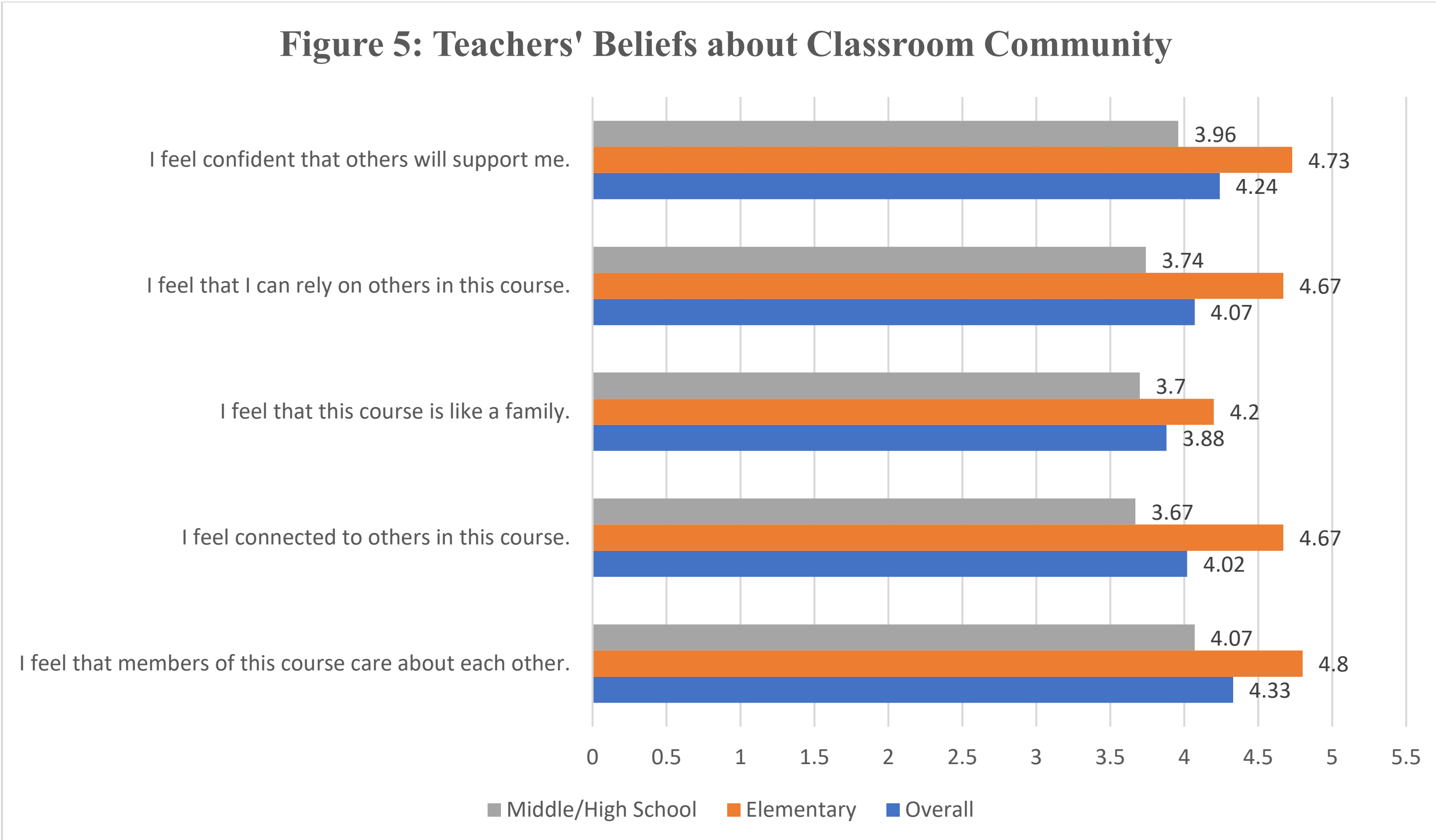


Figure 5: Teachers' Beliefs about Classroom Community
I feel confident that others will support me.
3.96
4.73
4.24
I feel that I can rely on others in this course.
3.74
4.67
4.07
I feel that this course is like a family.
3.7
4.2
3.88
I feel connected to others in this course.
3.67
4.67
4.02
I feel that members of this course care about each other.
4.07
4.8
4.33
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5
Middle/High School
Elementary
Overall

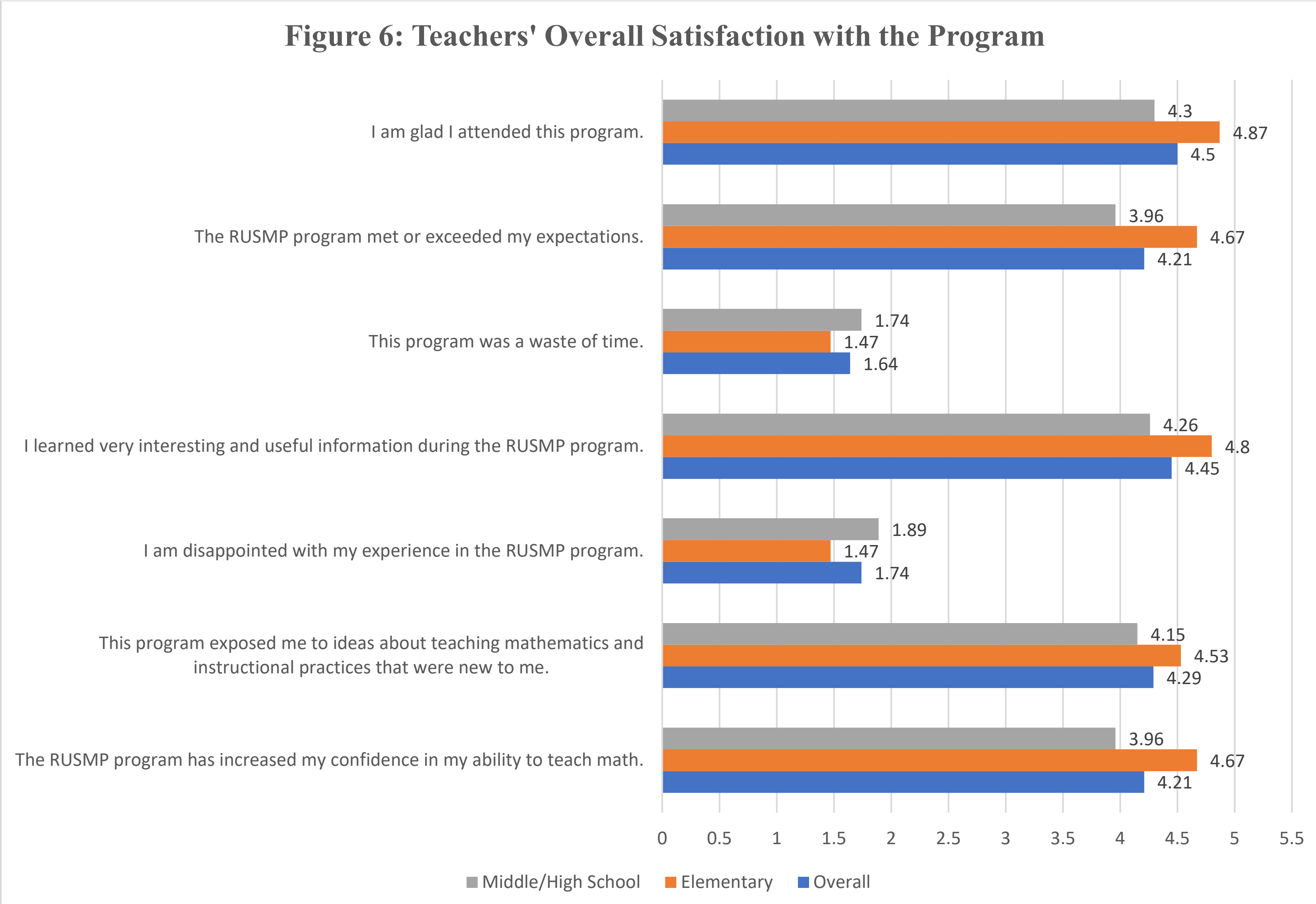
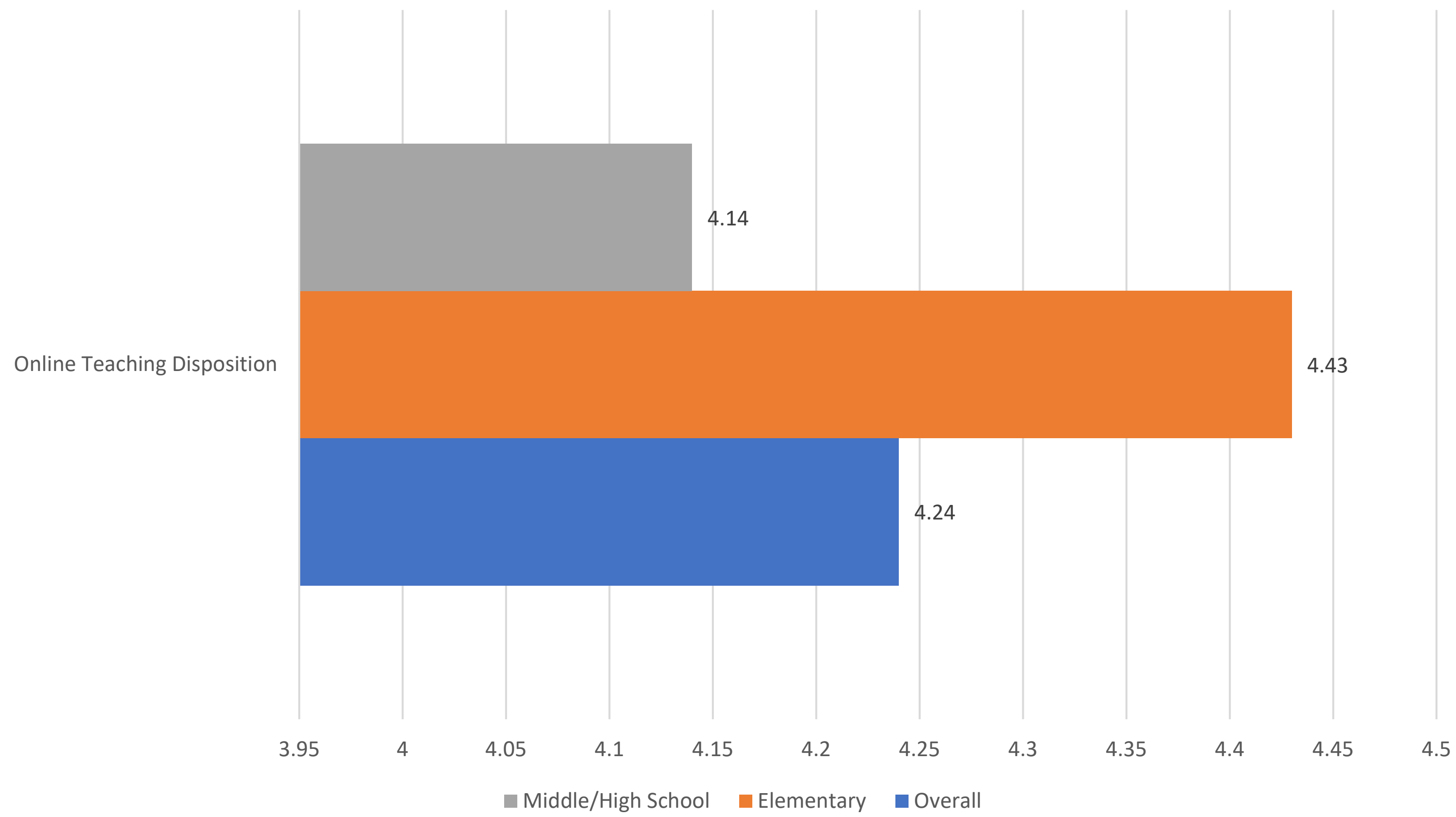


Figure 6: Teachers' Overall Satisfaction with the Program
I am glad I attended this program.
4.3
4.87
4.5
The RUSMP program met or exceeded my expectations.
3.96
4.67
4.21
This program was a waste of time.
1.74
1.47
1.64
I learned very interesting and useful information during the RUSMP program.
4.26
4.8
4.45
I am disappointed with my experience in the RUSMP program.
1.89
1.47
1.74
This program exposed me to ideas about teaching mathematics and instructional practices that were new to me.
4.15
4.53
4.29
The RUSMP program has increased my confidence in my ability to teach math.
3.96
4.67
4.21
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5
Middle/High School
Elementary
Overall

Figure 7: Teachers' Beliefs about Online Teaching



Conclusion

Overall, the participants have benefited from the SCP in several ways. The paired-samples *t*-tests indicated some significant changes in teachers' beliefs, knowledge, and confidence in teaching mathematics. Elementary teachers significantly improved their self-efficacy for teaching in terms of instruction and classroom management after participating in the SCP. All teachers' epistemic beliefs for mathematics significantly improved around the certainty of knowledge and source authority as the result of participating in the SCP. Further, their technological pedagogical knowledge and technological pedagogical content knowledge improved significantly. For both elementary and middle/high school teachers, the teacher's role and discovery as a part of beliefs about standards-based teaching significantly progressed. Additionally, for elementary teachers, the changes in all the other sub-categories of standards-based teaching except for use of manipulatives and tools were significant. Middle/high school teachers' beliefs about testing—as a part of beliefs about assessments—significantly changed—developing more non-availing beliefs about testing. All teachers' level of preparedness to use pedagogical techniques has significantly increased as the result of participating in the SCP.

Overall, teachers had positive feedback about their experiences in the SCP. The SCP at RUSMP provided opportunities for these teachers to learn about and engage in activities and discussions about classroom climate including teaching professionalization and societal contribution of teaching as well as active and meaningful learning. The RUSMP's SCP helped teachers to see the value in the teaching profession and highlighted the importance of attending to the community's needs, particularly learning about online teaching in times as COVID-19.

Appendix A
Scale Items and Reliabilities

*Indicates reverse-coded items

Teaching Self-Efficacy (Instructional strategies)

How much can you do to craft good questions for students?
How much can you do to implement a variety of assessment strategies?
How much can you do to provide an alternate explanation when students are confused?
How much can you do to implement alternative strategies in your classroom?

Teaching Self-Efficacy (Student engagement)

How much can you do to motivate students who show low interest in school work?
How much can you do to get students to believe they can do well in school work?
How much can you do to help students value learning?
How much can you do to assist families in helping their children do well in school?

Teaching Self-Efficacy (Classroom management)

How much can you do to control disruptive behavior in the classroom?
How much can you do to get children to follow classroom rules?
How much can you do to calm a student who is disruptive or noisy?
How much can you do to establish a classroom management system with each group of students?

Epistemic Beliefs for Mathematics (Certainty of knowledge)

Answers to questions in mathematics change as experts gather more information.*
All experts in mathematics understand the field in the same way.
Truth is unchanging in mathematics.
In mathematics, most work has only one right answer.
Principles in mathematics are unchanging.
All professors in mathematics would probably come up with the same answers to questions in this field.
In mathematics, it is good to question the ideas presented.*
Most of what is true in mathematics is already known.

Self-Efficacy for Mathematics Teaching

I'm continually finding better ways to teach mathematics.
Even if I try very hard, I don't teach mathematics as well as I teach other subjects.*
I know the steps to teach mathematics concepts effectively.
I'm not very effective in monitoring mathematics activities.*
I generally teach mathematics ineffectively.*
I understand mathematics concepts well enough to be effective in teaching mathematics.
I find it difficult to use manipulatives to explain to students why mathematics works.*
I'm typically able to answer students' questions.
I wonder if I have the necessary skills to teach mathematics.*
Given a choice, I would not invite the principal to evaluate my mathematics teaching.*

When a student has difficulty understanding a mathematics concept, I'm usually at a loss as to how to help the student understand it better.*
When teaching mathematics, I usually welcome student questions.
I don't know what to do to turn students on to mathematics.*

Intrinsic Value for Mathematics Teaching
I enjoy teaching mathematics.
I get excited about teaching mathematics.
I like what I teach in my mathematics classes.
I find teaching mathematics interesting.

Technological Pedagogical Content Knowledge

I can teach lessons that appropriately combine mathematics, technologies, and teaching approaches.
I can use strategies that combine content, technologies, and teaching approaches that I learned in my coursework in my teacher preparation/certification program.
I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.
I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school and/or district.
I can choose technologies that enhance the content for a lesson.

Level of Preparedness to Use Pedagogical Techniques

Please rate each of the following statements about how prepared you feel to do the following in mathematics instruction:
Providing concrete experiences to introduce abstract concepts.
Developing students' conceptual understanding of mathematics.
Taking students' prior understanding into account when planning curriculum and instruction.
Practicing computational skills and algorithms.
Making connections between mathematics and other disciplines.
Having students work in cooperative learning groups.
Having students participate in appropriate hands-on activities.
Engaging students in inquiry-oriented activities.
Having students prepare project/laboratory/research reports.
Using calculators.
Using computers.
Engaging students in applications of mathematics in a variety of contexts.
Using performance-based assessment.
Using portfolios.
Using questioning strategies to assess student understanding.