Teacher Beliefs and Practice within the Context of an Intensive Teacher STEM Professional Development

Elizabeth Adams
Tryna Knox
Cassandra Hatfield
Leanne Ketterlin-Geller

SMU

Background

- The connection between STEM interventions and student achievement is positive with an average effect size of +0.21 (Lynch, Hill, Gonzalez, & Pollard, 2019)

- Teachers experience unanticipated challenges translating STEM interventions to their unique contexts (Kelly, Gningue, & Qian, 2015)

  - Teacher factors such as confidence are important for overcoming challenges (Allen, Webb, & Matthews, 2016)

  - School factors such as leadership support are important (Camburn et al., 2003)

The STEM Academy

- STEM Academy for Middle School Science Teachers
  - Project-based learning (Capraro, Capraro, & Morgan, 2013)
  - Maker-based instruction (Bevan, Gutwill, Petrich, & Wilkinson, 2014)
  - Socio-emotional learning (Bryan, Moore, Johnson, & Roehrig, 2015)
- Teachers participate for up to three years
  - Each year includes 90 hours of summer professional development and up to 7 one-on-one coaching sessions and PLCs with other participating teachers at the school

Purpose

- Our first purpose is to understand common factors that influence above average implementation of STEM in the classroom

- Our second purpose is to understand how those factors differ for a teacher who increased implementation across the school year and a teacher who did not increase

Research Questions

- Based on a latent class growth analysis (LCGA), what are the <u>profiles of practice</u> for teachers who participated in the STEM Academy for Science Teachers?

- For two teachers with above average implementation in <u>different profiles</u>, what factors influence their instruction? How do these factors differ between the two teachers?

Research Questions

- Based on a latent class growth analysis (LCGA), what are the profiles of practice for teachers who participated in the STEM Academy for Science Teachers?

- **For two teachers with above average implementation in different profiles, what factors influence their instruction? How do these factors differ between the two teachers?**

The STEM Teacher Observational Protocol

- Coaches scored lessons using the STEM TOP

  - 24 items focused on STEM instructional practices

  - Supported with evidence of internal structure based on a multi-level exploratory factor analysis (Adams, Sparks, & Ketterlin-Geller, 2019)

  - Adapted based on the UTOP (Walkington & Marder, 2015)

Qualitative Data Collection

- Teachers participated in one-hour semi-structured teacher interviews

  - Invited to participate if they returned to participate in summer 2019

- 21 of 39 teachers returned in summer 2019; 14 of 21 participated in interviews

Qualitative Data Analysis

- Two researchers coded and analyzed interview transcripts using multiple case study analysis (Stake, 2006)

  - Used a priori codes focused on the STEM Academy (e.g., PBL, MBI, SEL) and teacher beliefs (e.g., teacher confidence, importance of STEM) and emerging codes

- Agreement rates

  - First interview: 74% to 100%

  - Second interview: 99% to 100%

- First researcher summarized each interview, compiled summaries by code in a cross-case matrix, and generated themes (Miles, Huberman, & Saldaña, 2013)

  - Second researcher reviewed for accuracy

For two teachers with above average implementation in <u>different profiles</u>, what factors influence their instruction? How do these factors differ between the two teachers?
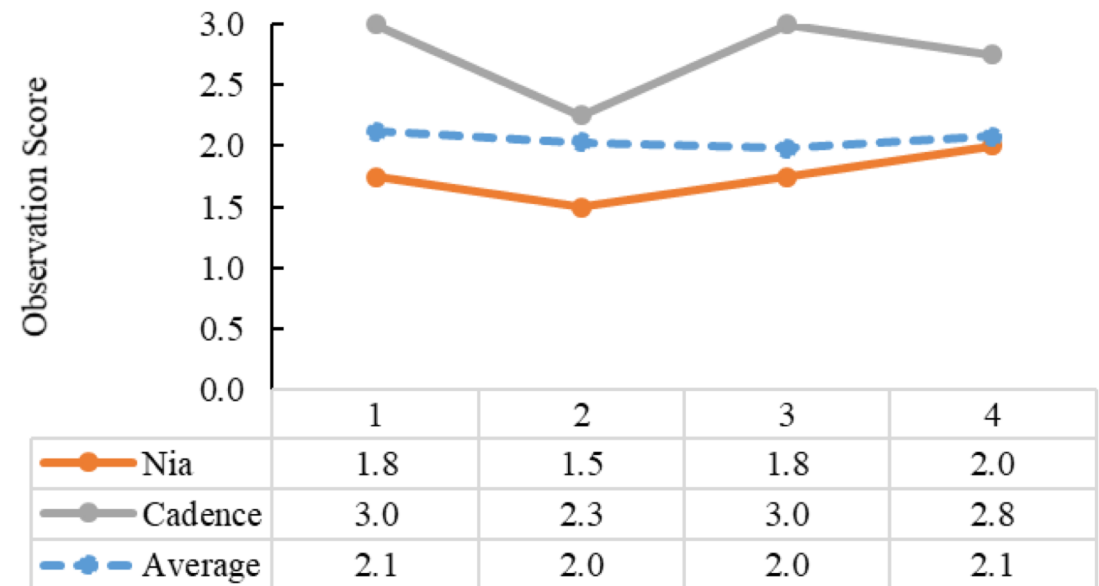
Nia and Cadence

- Selected two teachers with higher than average integrated STEM instruction at the end of school year

- Cadence belonged to Profile 1 (No change or decrease across time)

- Nia belonged to Profile 2 (Increase across time)

Enacted Instruction: Integrated STEM Instruction

	1	2	3	4
Nia	0.8	1.3	1.2	1.4
Cadence	1.9	1.6	2.3	1.6
Average	1.3	1.4	1.3	1.2
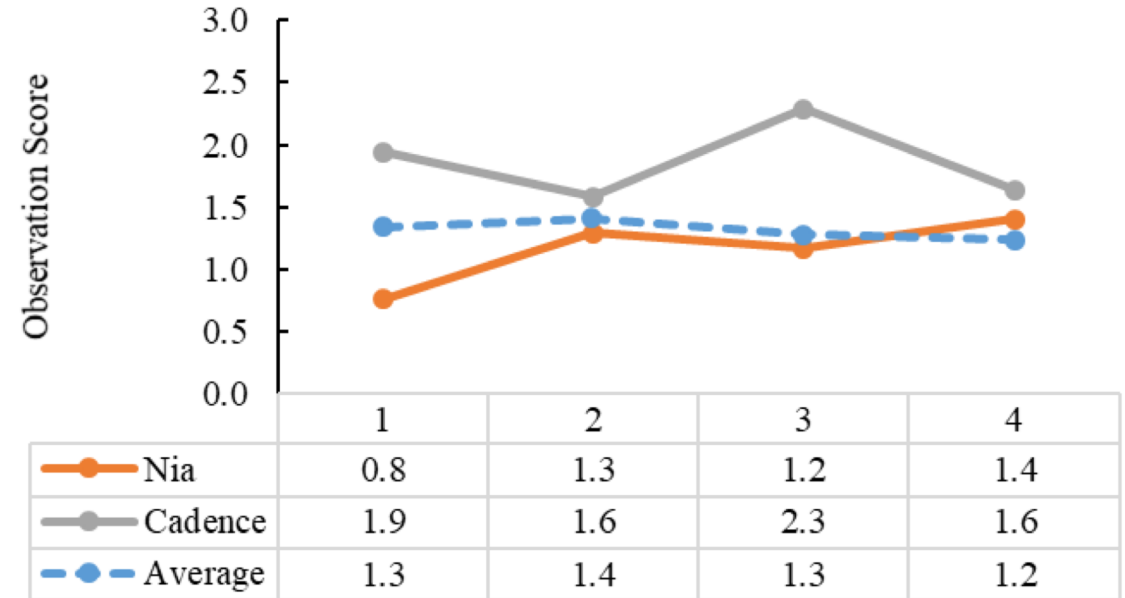
Enacted Instruction: Management and Discipline

	1	2	3	4
Nia	1.8	1.5	1.8	2.0
Cadence	3.0	2.3	3.0	2.8
Average	2.1	2.0	2.0	2.1

Qualitative Findings

- Teachers identified six common factors that influenced their implementation of STEM including factors related to the:

  - Teacher herself (i.e., deep understanding of STEM, interest in school leadership)

  - School environment (i.e., school leadership, testing)

  - Professional development (i.e., teacher collaboration, coaching)

Teacher: Deep Understanding of STEM

- Both teachers emphasized a deep understanding of STEM

  - Both teachers described the importance of inter-disciplinary integration, effective questioning, student agency, real-world and career connections, and socio-emotional learning (i.e., problem-solving, creativity, collaboration)

  - Connections with mathematics were most advanced; connections with technology were least advanced

- Nia described four PBL or MBI units in detail

- Cadence described one MBI unit with less detail

"'Okay, what are some other ways that objects move, other than just towards each other? If they're going to contact each other, what's other ways they can hit each other?' [The students] were like, 'Oh, well maybe they could <u>rub up against each other</u>. Maybe they could, one could <u>go under the other</u>.' … Then I said, 'Okay, what does it look like if they don't hit each other?' I introduced that in the middle of the activity, after they had been interacting with the objects a little bit. They're like, 'Okay, well they're going <u>opposite directions maybe</u>, or <u>just missing each other</u>.'"

~ Nia, Profile 2 Teacher

Teacher: Interest in School Leadership

- Both teachers had an interest in teacher leadership.

- Nia described joining the STEM Academy because she was interested in leadership opportunities

- Cadence described hesitancy in joining because she wanted to pursue other leadership opportunities

"The math department was supposed to integrate more PBL stuff last year. They were like, 'Well, I don't know what I'm doing.' I was like, 'Well, I can send you this [PBL] calendar.' It just has a breakdown of what you should do each day. That helped me a lot like, 'Oh, okay. If I'm doing a three week unit and it's PBL, now I have a structure to know what I should do each day.' Okay, now I have some **organizational tool** in mind."

~ Nia, Profile 2 Teacher

Environment: Leadership Support

- The two teachers had different experiences with school leadership

- Nia said that she did not experience many of the barriers other teachers may have had while implementing STEM. She said her principal trusted her and allowed her autonomy

- Cadence said that her principal was not engaged and was "all test driven" which made implementing STEM challenging

Environment: Standardized Tests

- Neither teacher described a direct connection between STEM and student achievement

- Both teachers emphasized other skills within STEM like making connections across disciplines

"The importance of making connections is a lot more important than a test score. Everyone says they're correlated, but sometimes they're not correlated."

~ Nia, Profile 2 Teacher

What can we learn from Nia and Cadence?

- Both teachers described a deep understanding of STEM coupled with an interest in teacher leadership
  - Important teacher factors for more successful implementation
- Teachers also described teacher collaboration and coaching as important components of the professional development
- Teachers perceived differing levels of support from school leadership
  - Important school factor for more successful implementation
- Neither teacher described a connection between STEM and student achievement
  - PD should be closely aligned to content standards and emphasize the connection between student tasks and knowledge/achievement (Lynch et al., 2019)

Limitations and Next Steps

- LGCMs included a small sample of teachers
  - Not generalizable outside of this sample of teachers

- Qualitative analysis included a small sample of teachers
  - Only examined two teachers

- Next steps include analyzing interviews with four Profile 1 teachers and four Profile 2 teachers

Thank you!

ELADAMS@SMU.edu
TKNOX@SMU.edu
CHATFIELD@SMU.edu
LKGELLER@SMU.edu
**Follow us on Twitter @RME_SMU**

Quantitative Analytic Strategy

- Fit a series of Latent Class Growth Models (LCGMs) examining profile membership based on STEM TOP observations at four time points
  - Beginning of the year, mid-fall, mid-spring, end of school year
- Specified fit criteria for the best fitting model
  - Lowest AIC and BIC, higher classification entropy
 - Tested between 1 and 4 profiles

Latent Class Growth Analysis

- Based on the fit statistics, the 2-profile solution demonstrated the best fit with our sample

- Profile 1:Teachers who decreased or did not change across time in integrated STEM

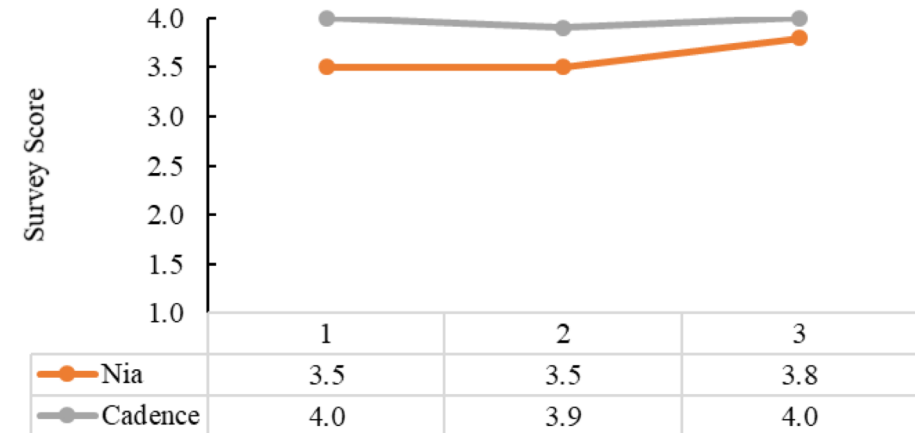- Profile 2: Teachers who increased across time in integrated STEM
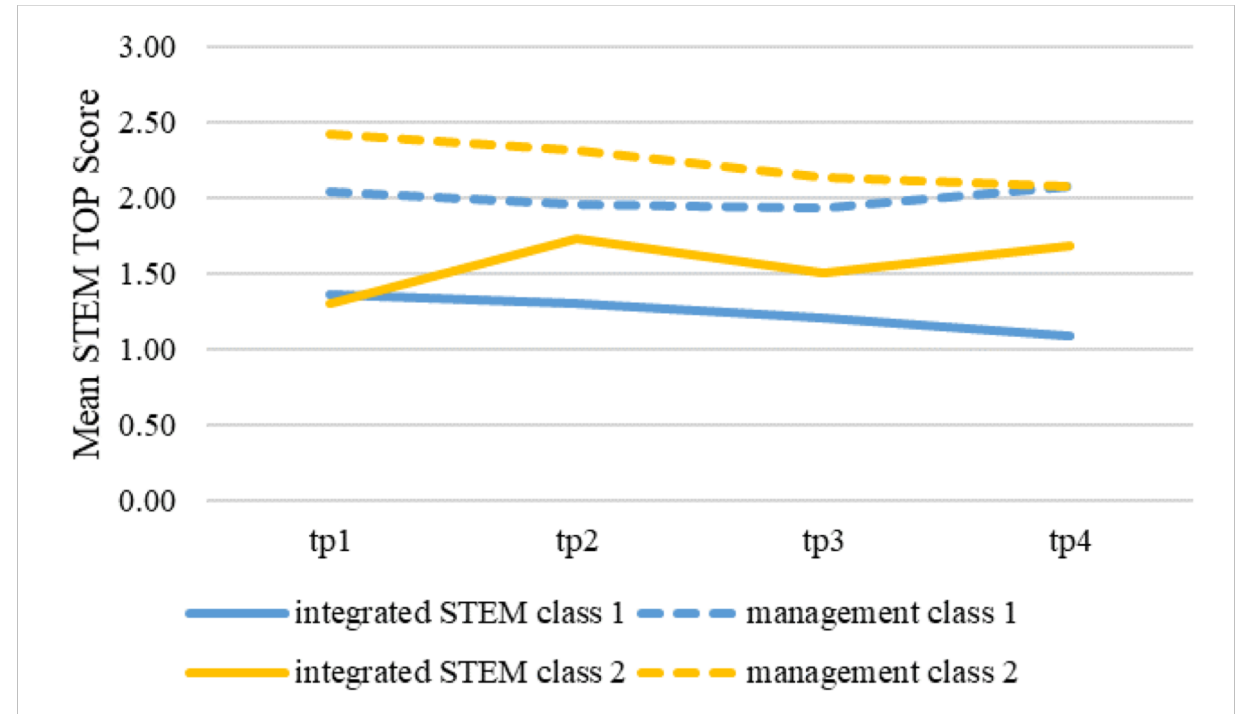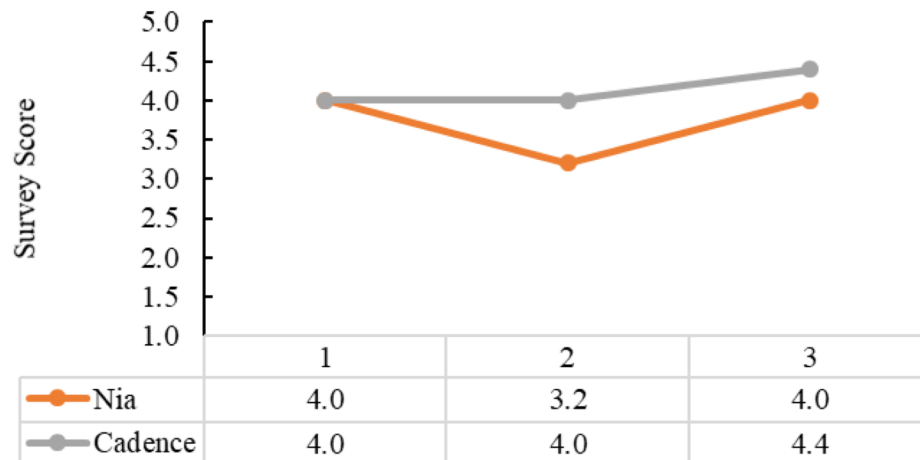
Teachers do not significantly differ in beliefs

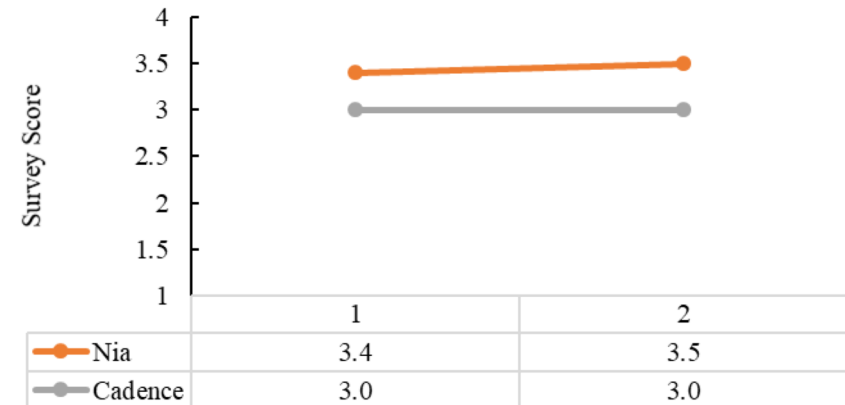## Teacher Beliefs: Confidence in STEM

	1	2	3
Nia	3.1	3.0	3.5
Cadence	2.9	3.3	3.5
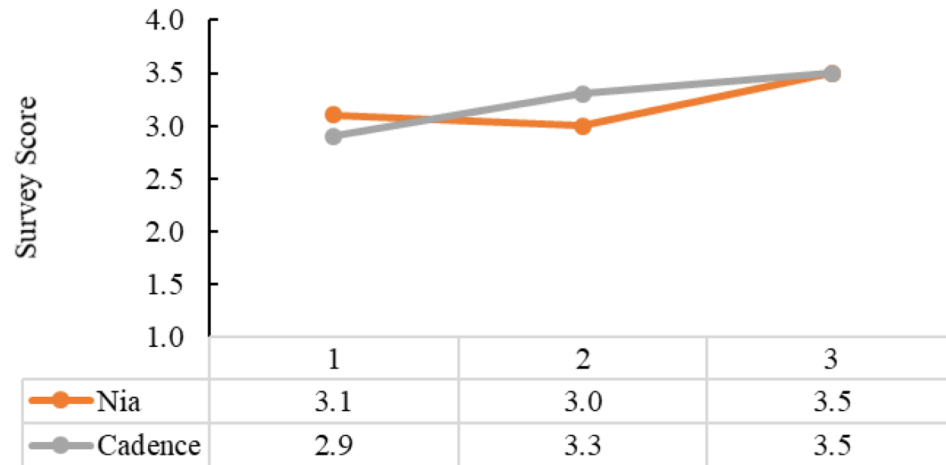
Teacher Beliefs: Importance of STEM

	1	2	3
Nia	3.5	3.5	3.8
Cadence	4.0	3.9	4.0

Teacher Beliefs: Science Self-Efficacy

	1	2	3
Nia	4.0	3.2	4.0
Cadence	4.0	4.0	4.4

Teacher Pedagogical Content Knowledge

	1	2
Nia	3.4	3.5
Cadence	3.0	3.0

"[Students] had to build their own airplanes out of material like paperclips and different kinds of paper that they wanted and different things like that. So I was teaching force in motion, but they also are learning a component of that and it just made the kids <u>excited</u>. Each step that we were going through, they were excited to come back the next day."

~ Cadence, Profile 1 Teacher

"Colleagues have shown me different ways on how to teach something or more knowledge or 'Hey, be sure you include this.'"

~ Cadence, Profile 1 Teacher

PD: Teacher Collaboration

- Both teachers valued the opportunity to connect with other teachers at the STEM Academy

- Nia said that the STEM Academy helped her identify "collaborative partners"

- Cadence identified fewer specific examples of collaboration

"Next year, <u>we've already got a schema and all this stuff, and the projects we're going to do, and the materials we need</u>. We're just going to try doing it that way and just see where it goes. We have to get better at this. We want as much practice as possible at doing this and this stuff, because that's more realistic and can apply better to real life."

~ Nia, Profile 2 Teacher

PD: Coaching

- Both teachers identified coaching as a beneficial aspect of the STEM Academy

- Nia said that coaching "really helped me figure things out"

- Cadence said that the STEM Academy coaching made her more confident

"There was really nobody to go to [for feedback], unless it was a veteran teacher who taught science. But that's the one thing I started seeing that became really valuable was the <u>coaching</u> and that was something I felt like I needed to grow as a teacher."

~ *Cadence, Profile 1 Teacher*