Undergraduates Transitioning from STEM Degrees to Elementary Education Degrees: Driving values and motivating factors

Objectives and theoretical framework

There is a need for elementary school educators who bring positive STEM attitudes and abilities to the profession (STEM positive teachers). Teachers who have less anxiety about STEM content and consider themselves "good at" math and science are more confident in teaching these subjects (Bursal & Paznokas, 2006). In addition to recruitment into elementary education teaching programs, teacher retention is an issue (Smethem, 2007). Knowing that such challenges and disparities exist, many approaches have been implemented to address issues of recruitment and retention of STEM positive teachers with varying levels of success as evident in various literature reviews (Borman & Dowling, 2008; Guarino, Santibanez & Daley, 2006).

In recent years there has been a hopeful shift in the field of education. Some research suggests that, perhaps, despite potential benefits of STEM careers such as job security, lucrative salaries, and prestigious jobs, potential candidates for STEM fields are finding space and personal satisfaction in elementary teaching fields (Chen, 2014).

Furthermore, from a different perspective, evidence suggests that many women and minoritized students who begin college in STEM are leaving their original fields of study to pursue other degrees. "There is something about the college STEM experience that disproportionally affects certain students and causes them to lose enthusiasm for STEM" (Poodry & Asai, 2018). Undergraduate STEM attrition rates cause concern and understanding this phenomenon is important.

Despite important concern for STEM attrition, students leaving STEM presents an opportunity for schools of education. However, missing is an understanding of the reasons why undergraduates with strong STEM backgrounds would choose elementary education careers. This is important as this population has the potential to develop into elementary teachers that are strong in their subject specific STEM knowledge and have STEM positive perspectives. With this background, we examine why STEM majors would switch into an elementary education track, their motivating factors and choices, with a goal of shedding further light on the persistent problem of teacher recruitment.

Specifically, here we seek to uncover the factors that compelled two pre-service teachers to leave their successful years of undergraduate STEM education and pursue an education as elementary school teachers. If these factors are present in the narratives of other STEM students, then steps to enhance and build satisfaction in learning environments for these students could be beneficial for recruitment and retention of STEM positive teachers in elementary education settings.

Methods

This case study analysis uses phenomenological in-depth interviewing methods because there was a goal of examining the participants' meaning-making as a function of their lived experiences, specifically their schooling experiences embedded in their life histories and connections to future teaching goals and attitudes. Using this approach brought focus to phenomenological themes of the temporary and transitory nature of human experiences, subjective understanding, sense making of lived experiences through language, and an emphasis of meaning in context that was aligned with the research goals (Seidman, 2013).

We recruited participants from a pool of pre-service elementary teachers in their last year of training at a university in the western United States. Two women, one identifying as Latina and the other white, volunteered for three interviewing sessions each. During the interviews participants were allowed a liberal discourse environment to define and construct their experiences within the context of

the interviews. Furthermore, a multiple interview format allowed participants elbow-room to ease into the process and time to reflect, clarifying or revising along the way.

We conducted six interviews, each ranged from about 30 to 80 minutes over a six-week period. Interview questions were designed to facilitate opportunities for the women to describe their experiences in their elementary education program, specifically their thoughts about math and science education in the program, as well as describing the values and motivating factors related to their choice of teaching careers.

Our interviewing and coding techniques were also informed by feminist interviewing theory. In particular, Anderson's & Jack's (1991) guidelines for conducting oral histories and interviews with women served as a guide. In their writings the authors refer to Reik's theory that when interviewing a woman "what is often missing is her own interpretation of her experience or her own perspective on her life and activity" (p. 19) because she often has "internalized categories that represent a deposit of the desires and disappointments of men" (p. 19). Although Reik's theory of "listening with the third ear" dates to 1948, it was useful during the interviews and analysis of the interviews afterwards. It seemed especially pertinent since the STEM fields these women left were, and are, traditionally male dominated fields (both participant's spoke of "masculine spaces" or "masculine traits" being valued in the field).

Upon completion we transcribed the interviews and there was an iterative coding process. Due to our interest in uncovering motivations for the dramatic mid-undergraduate detours that the participants had undertaken, we pursued meaning-making through the use of "values" coding (Gable & Wolf, 1993; LeCompte & Preissle, 1993). According to Saldana (1995), "The greater the personal meaning, [of something to someone] the greater the personal payoff; the greater the personal payoff, the great the personal value" (p. 28). What were the "payoffs" participants experienced by changing careers and, and what are their values that guided the decision making process?

We carefully coded each conversation looking for attitudes, beliefs, and values. We then categorized and analyzed the value statements looking for relationships between the participants' values and relative frequencies. This coding, connecting, and paring of the initial values codes was used to connect to theory behind motivations in the participants' narratives.

Data analysis and results
Both women had begun their undergraduate career in STEM fields (engineering and biology) and after several dedicated years of course work, good grades, self-reported "success", potential prestige and high salaried jobs, the participants transferred into elementary education and found satisfaction in their new field of study.

Participants: "Josie", a 23-year-old white female, is in her final year of teacher training. She will be a teacher intern in fourth grade next semester. In interview one she described her educational history in this way: **"**I recognized that I enjoyed science and I was good at it... I was really gung-ho, thinking I wanted to go into the medical field... and then I [took] an intro to education course and...ended up loving it...I liked elementary education a lot...being in the classroom was really energizing and I felt really motivated. More motivated than I'd felt in my other career choices."

"Ascension" described herself as a 24-year-old Latina female, in her final year of the teacher training program and now has a job teaching 4th grade at a Charter school with a focus on cultural relevance. She described herself as, "always lov[ing] school and education...Like, I just got things really quick...when it came to math and things like that. I started [university] as an engineering and an architecture major and then when I realized that wasn't the way, that wasn't what I wanted to do, I changed my major to elementary education."

Initial coding: Initial coding efforts focused on finding cause-effect relationships between the participants' STEM education experiences and reasons for leaving their respective fields. In the initial coding we found that the two participants were very happy and content with their choice of changing

career paths. What did they value that was absent in STEM and/or present in elementary education? How did those values translate into their choices?

When both participants described their STEM experience they used words like, "burn-out", "suffocation", being "miserable", being "lonely" or "excluded", and feeling like, despite their high grades and good standing, that other students were doing fine but that they were "struggling." Josie described the experience as "barely staying afloat."

When the two participants described their education program they expressed happiness and relief that they changed majors. They described the experience as having "powerful" learning experiences, "energizing", "motivating", and a "safe place to ask questions". The words "fun" and "enjoyable" were common. Josie said, "I don't feel like I'm regurgitating information in education. I'm doing much more." Ascension said she felt like she could "make a difference" in education and offer something unique to the field. Both spoke of professors and mentors that had been pivotal in their satisfaction with the field of education.

Results in thematic form: Six main themes of values emerged from the data. They are summarized in Table 1. Due to the goal of understanding the participants' experiences within their educational and future career settings I looked for ways in which they spoke of their environments and important, desirable elements of value within them.

Valuing environments rich in opportunities for discovery and creativity were most ubiquitous in the data. Josie expressed, "I felt like I was craving *creativity* a little bit. And I felt like education gave me that outlet. Professors [in the education department] are more lenient towards you taking creative license to projects.'' Contrastingly, she said that in her STEM courses "I didn't have a chance to work creatively at all. I felt like the sciences were just draining me of that."

Ascension described herself as having a "passion for art and creativity". She spoke frequently of wanting to do something "different" in her life, career, and field of study. This part of her identity it seems wasn't honored in her undergraduate science and math courses.

Values concerning environments that are fun and enjoyable, and collaborative, supportive relationships were prevalent in the data. Enjoyment and pleasure from learning and work appear to be highly valued for the participants. Josie said, "Being in the classroom was really energizing and, it was like I felt really motivated, more motivated than I'd felt in my other career choices prior to education."

Ascension spoke often of relationships. In reference to her STEM courses she said, "People would group together, and help each other out, but they wouldn't help other people...and you kind of feel out of place." In sharp contrast she describes an experience with an education professor: "I was... confused a lot of the time and I could go to her office...and she was there to help me out and understand. I really liked her. We got to bond. Really talk about life and stuff like that...I liked that class...she was nice."

Josie describes the contrast in her STEM experiences versus her education experiences: "I was the only girl in my lab session...I wasn't allowed to touch a lot of things. I wasn't allowed to do a lot of things...It was a night and day experience between that and the education program where the words that come out of my mouth are, like, valid".

Significance, possible extensions, and limitations
The case study of two participants is hardly conclusive evidence generalizing an entire population. Further case studies and analysis are necessary. However, if initial findings prove to be consistent, then recognition of these themes could have important implications for understanding career choices and motivating factors as they apply a unique population of pre-service teachers that has the potential for significant impact in STEM.

These results raise questions about how this unique population fairs once teaching full-time. Do the unique factors that drew them to teaching persist in impacting them at later points? Or are their trajectories similar to the more typical elementary teacher population? Can schools and policy makers use the same themes, compatible with STEM positive teachers' values, to improve professional setting and, consequently, retain more teachers?

For university based pre-service elementary programs, these results highlight unique dimensions of their programs that could support future recruitment, which is important in a landscape with so many recruitment challenges. For alternative teacher preparation programs, these results highlight factors motivating career choice that could be leveraged when recruiting from the general population into teaching. These results could have an impact on the design and implementation of new introductory education courses aiming to recruit undergrads from other fields into the teaching profession, specifically courses that highlight discovery-based, enjoyable, supportive, safe, inclusive environments.

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Value	Examples include...	Frequency
Environments that encourage discovery and creativity.	...creativity, inquiry, inquisitiveness, novelty, space to experiment, and authenticity.	**51 times**
Environments that enhance fun and enjoyment.	...engagement, having fun, being energized, liking class or job, passion, fulfilment, and being motivated.	**29 times**
Environments of collaboration with friends and supportive mentors.	...small classes, connections with teachers, having peers who "look like you", relating, community, friends, and having a "good" professor.	**29 times**
Environments of equity and inclusiveness.	...success for all students, accessibility, diversity of people and ideas, making a change for good in the world, not perpetuating bad teaching and education, different perspectives, educational experiences of people of color, stopping systems of oppression, making a unique contribution, and social justice in authentic learning situations**.**	**20 times**
Environments that are safe, healthy, and failure-tolerant.	...not being pushed to 'burn out", failure tolerant learning, being able to ask questions, being able to take risks, non-volatile non-competitive environment, questions being "invited", and safe place to make mistakes.	**19 times**
Environments encouraging of ownership, success, and freedom.	...ownership of one's learning, success in career, faith in self, persistence, resilience, freedom of ideas, patience with ones' self., not being confined, being able to get a job upon graduation.	**16 times**

Table 1: Major value themes, examples from coding, and frequency of occurrence.