



# Eliciting Students' Voices Through STEM Career Explorations

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## Abstract

This multiple case study elicited the voices of four 8th grade students, from a rural, low-income school district, who participated in STEM career explorations during their science class. Based on students' written reflections during career explorations, interviews, and from field notes, we analyzed the ways students talked about their lives and experiences as they explored STEM-related careers, reflected upon the influences in their lives, and considered their futures. Students drew upon their interests and dispositions, primarily through home-based experiences, and often in spite of negative messages at school. Students aspired to live and work in their rural community, make their families proud, and sought financial stability in a career they would enjoy. Findings highlight the importance of out of school learning for these students, the important role of their families, and the prevalence of negative and racialized school experiences that often undermined students' potential. In many ways, students held perceptions reflective of racial and gender stereotypes about who is successful in STEM, which influenced their aspirations. This study provides examples of how constructs from the expectancy-value theory are operationalized—particularly with regard to cultural and social experiences—through the voices of these rural students. The findings from this study lead to a number of recommendations related to university outreach efforts into rural communities, culturally relevant teacher professional development and pre-service teacher preparation, and dissemination to support others and draw insight from underserved students' lives when undertaking steps to promote their futures.

**Keywords** Careers · Culture · Motivation · Middle school · STEM

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Large-scale research studies depict great variability in the access and opportunities afforded to underrepresented students in science, technology, engineering, and mathematics (STEM) subjects and informal education (Southgate, Kelly, & Symonds, 2015). STEM experiences can vary greatly between students of different socio-economic backgrounds, geographical regions, racial groups, and gender, and play a role in persistence in courses and careers (Alegria & Branch, 2015; Andersen & Ward, 2014; Brown et al., 2016). Nearly 25% of K-12 students in the USA are enrolled in rural schools, 14% of which are designated as high-poverty schools that primarily enroll Black and Brown students (Lavalley 2018). High poverty schools tend to have frequent teacher turnover, with fewer teachers who are certified in their content area than in wealthier schools, limiting students' opportunities to learn from qualified teachers as well as take advanced courses in STEM (Darling-Hammond & Hammond, 2015).

Researchers have used surveys to measure a range of socio-cultural factors to predict why students from marginalized backgrounds are less likely to persist in STEM, specifically with students in high school and higher education settings (Andersen & Ward, 2014; Jeffries, Curtis, & Conner, 2019; Wang & Liou, 2018). Yet, few studies have captured the voices of adolescents to gain an understanding of how STEM relates to their lives and their futures. It is important for students to reflect upon how their life experiences and goals align with experiences in the classroom (Tan, Calabrese Barton, Kang, & O'Neill, 2013), and the middle school years are influential on students' development of career-related interests (Regan & Dewitt, 2015).

## Students' Cultural Assets

The cultural assets of students are influential to future academic and career goals in STEM (Brown, Mangram, Sun, Cross, & Raab, 2017). Cultural assets include students' dispositions, values, and norms—acquired through social experiences at home and in school (Bourdieu, 1986). These factors are particularly salient in STEM subjects, given that students of color, females, and first-generation students are underrepresented in STEM careers (Wang & Degol, 2013). Social support and affirmation by peer groups and family members play a vital role in STEM interest and achievement (Carrico, Matusovich, & Paretto, 2019; Dika, Alvarez, Santos, & Suarez, 2016), as well as having a familial role model in a STEM profession (Holmes, Gore, Smith, & Lloyd, 2018; Xie, Fang, & Shauman, 2015). Parents of rural seventh-grade students in a southern US school perceived that teachers lacked connection to students and had deficit views of struggling learners, which hindered students' achievement (Griffin & Galassi, 2010). Furthermore, African-American middle and high school students state that they have felt overlooked by their teachers, whose racial biases negatively impact their expectations for success in future STEM courses (Andrews & Gutwein, 2017). Thus, understanding how underserved students use cultural assets to think about their futures could lead to more equitable teaching practices (Christensen & Knezek, 2017; Wang & Degol, 2013).

Educators can level the playing field for all students by finding innovative ways to incorporate professional knowledge, role models, and student voices in relatable STEM experiences (Tan et al., 2013; Wright, Counsell, Goings, Freeman, & Peat, 2016).

Broadly, STEM role models have also been found to support students' thinking about careers and goal development (Palmer, Maramba, & Dancy, 2011), and role models who are similar in gender and race can be influential to underserved student populations (Fuesting & Diekman, 2017; Kier & Khalil, 2018; Packard, 2011; Shin, Levy, & London, 2016). Yet, minority students and females in rural areas have fewer role models in these disciplines to whom they can personally relate compared to their White peers (Griffin, Hutchins, & Meece, 2011); this contributes to minority students feeling like outsiders in STEM and assumptions that White males are more successful in STEM than are others (Baker, 2016; Regan & DeWitt, 2015; Riegle-Crumb & Grodsky, 2010). For teachers in rural and remote areas, it can be challenging to provide students with access to role models in STEM; there is evidence that relevant video-based representations of diverse STEM professionals hold promise for supporting underserved students to think about their personal connections to careers (Kier, 2013; Wyss, Heulskamp, & Siebert, 2012).

## Theoretical Frameworks

Students' expectations for their success in school and in their future lives relate to the value they place on task-based experiences. These values include the importance of the task to the student (attainment value), how useful they find it (utility value), their interest in the task, and how much the task takes of their time and effort (cost) in relation to their expectation of success and their goals (Eccles & Wigfield, 1995). In an important addition to Eccles' and Wigfield's expectancy-value framework, Eccles (2009) added the construct of identity; students' expectations for success, values, and goals are filtered through cultural and social experiences that influence how students see themselves, both in and out of school. These school and home experiences influence the choices students make, such as what activities (e.g. homework, hobbies) they want to persist in.

Survey items based on Eccles' and colleagues' extensive prior work have been applied in predictive, quantitative applications with STEM-oriented students and/or those engaged in STEM out-of-school programs (e.g. Andersen & Ward, 2014; Svoboda, Rozek, Hyde, Harackiewicz, & Destin, 2016; Wang & Degol, 2013). For example, students in middle through post-secondary school showed interest in mathematics courses and careers when they felt prepared for coursework, saw how their personal dispositions aligned with the nature of STEM, and had experiences with mentors who come from backgrounds similar to their own (Packard, 2011; Shin et al., 2016). Yet, survey results are unable to show how students from traditionally marginalized backgrounds think about themselves in relation to future careers nor capture students' voices while exploring potential future schooling or career plans.

This study seeks to add to the literature base by a qualitative exploration of the cultural and social influences on underserved rural middle school students' career interests. *Possible selves* theory describes what someone believes that they might become, what they want to become, and what they fear becoming through their narration of past and present experiences, social roles, and group memberships (Markus & Nurius, 1986; Oyserman & Fryberg, 2006). Possible selves theory has been used to explore how students in middle and high school negotiate who they are

when participating in STEM-centered activities (Beier, Miller, & Wang, 2012) and guided the development of the STEM career explorations for this study.

The research design for this study is a multiple case study (Yin, 2017). Students' cases were constructed directly from students' data, eliciting their voices to understand their lives in relation to STEM. The following research question guided our study: *How do students write and talk about their lives, experiences, and their futures during and following STEM career explorations?*

## Methods

### Context

This study took place at Washington Middle School (pseudonym; WMS), a Title I school located in a high-poverty, rural county in the southeastern USA where mathematics and science test scores were significantly below the state average. All STEM teachers in this school had participated in multi-year, grant-funded professional development on ways to include technology-based STEM experiences with students connected to local career opportunities and each of the teachers' content areas. In the year of the study, WMS served 528 students (86% were students of color).

### Career Explorations

One experienced eighth-grade science teacher, Ms. Cruz, who identified as Asian Pacific Islander, invited the first author to lead all of her classes in STEM career explorations for 11 weeks, once each week during the last 45 min of their science class (which was designated as an enrichment period). Eighth-grade students worked with a partner in structured classroom activities to explore age-appropriate online career materials (Stevens, Andrade, & Page, 2016; Wyss et al., 2012). Students explored brief (5–7 min) career videos of their choice with a partner on an iPod or computer, featuring STEM professionals of color in diverse careers (e.g. fashion designer, mechanical engineer, veterinarian) of varying levels of education (e.g. technical/certification program, 2-year degree, 4-year degree). After students explored careers, they also read a researcher-adapted, grade level appropriate fact sheet (adapted from the US Bureau of Labor Statistics, <https://www.bls.gov/jobs/>) about the job requirements, salary level, and educational pathway needed for the job (<https://sites.ced.ncsu.edu/stem-career-awareness/>). Students then selected a career of their choice to write a detailed reflection on how their current experiences were a good fit for the job and how they imagined their personal and professional experiences, if they pursued this opportunity.

### Participant Selection

While working with Ms. Cruz, the lead author asked her to select two students from each class who were interested in being a part of the study. Mrs. Cruz identified students who she perceived to have diverse social experiences, academic motivations and interests, family dynamics, and after school interests; and who would likely be willing to participate in interviews during and after the STEM career exploration

activities. Eight students agreed to take part in an interview (adapted from Aschbacher, Li, & Roth, 2010) led by the first author. Their responses led to the purposeful selection of four participants who had completed all of the career exploration activities, discussed different career goals, were racially and ethnically diverse, and who could potentially provide different perspectives about how STEM was relevant to their lives. These students were Darius, an African-American male; Elle, a White female; Mariah, an African-American female; and Theresa, a Native American female.

## Data Collection and Analyses

This study involved data collected from a number of different sources in order to develop rich case studies, which included students' STEM career exploration sheets, career planning sheets, and an interview. In addition, the lead author was in the classroom with students every day while they explored careers and made observations as they worked. In vivo and axial coding were used to interpret all of the data collected from the students.

**STEM Career Exploration Sheets.** Once a week for 5 weeks, students worked alone or with a partner to complete a STEM career exploration sheet, document which video they selected and explored, explain the reasons for their choice, describe what they learned about the career, liked and disliked, and whether they could ever see themselves in this career (Kier, 2013). On the final exploration, students had additional time and were asked to explore a career that they could never see themselves in and describe why not. Thirteen career exploration sheets in all were collected for the four participants. The students' hand-written responses to these questions were typed verbatim by the lead author and imported into ATLAS.ti© for analyses (examples of students' exploration sheets are found in Supplemental materials).

**Career Planning Guide.** Each student selected one career about which they were most interested, to reflect upon how they could realistically attain this career and why this career was relevant and meaningful to them, which they recorded on a career planning guide. Students did not have to select a STEM career that they watched during the career exploration activities. The planning guide included questions about their favorite classes, after school activities, and how their personal characteristics could benefit them in the career. When planning, students were asked to project what their futures would look like by explaining their responsibilities as a professional, their possible educational pathway, a starting salary, how long they have been working in the field, and how much they earn. They also were prompted to describe their future job environment, including the physical location of their job, what people wore to work, if they saw their coworkers outside of work, and what someone would find when entering their workplace. By considering these factors, students were prompted to make the STEM job more applicable to their lives and narrate an age-appropriate picture of a possible self (Markus & Nurius, 1986).

**Interviews.** Using career planning guides as a reference, the first author interviewed students (for approximately 45 min) using a career identity protocol that was adapted from a similar interview on assessing students' science identity (adapted with

permission from Aschbacher et al., 2010). First, the interview included questions that explored students' personal experiences inside and outside of school and why they considered the future career they selected on their career planning sheet. The interview protocol also included questions that addressed how social influences contributed to their expectations for success in their future, their values, and future career goals (Kier, 2013). Finally, students were asked to consider how they felt about being a male or female in society and how they believed their gender, race, and location (i.e. living in a rural environment) influenced their thinking about their future.

## Data Analyses

Detailed narratives were written for each of the students' interviews, as it was important for us to develop a holistic approach to understanding these students and their experiences (Yin, 2017). After a first round of coding of the themes within all of the data (STEM exploration sheets, planning sheets, and interview transcripts) for each of the students, the narratives were compared to the coding of the responses of the career exploration sheets to look for similarities and differences. For a second round of coding, students' statements were combined. For instance, Darius talked about working on cars, going to car shows, and repairing motorcycles with family members and talked about being a mechanic or mechanical engineer during his interview. He also explored a career as a mechanical engineer, which he wrote about on the career exploration sheet and also discussed in the interview. These data were collapsed into the theme of potential interest in either being a mechanic or a mechanical engineer. After these steps, we again examined patterns across the four students to look for similarities and differences (Yin, 2017). The findings are written as greatly reduced versions of the original narratives of each of the students. The discussion was written by using the summary of the findings from the interview transcripts and the career exploration data. In order to convey the richness of the individuals through their voices, the summaries use as many of the individual's words as possible, in italics and with quotation marks.

## Findings

### Darius: a Future Mechanic

Darius was a gregarious student who talked to anyone who would listen. He played several instruments in the band and described himself as being "*creative*." When discussing his love of music he said, "*sometimes I just be bored so I just start writing down letters then I start playing them notes and I organize 'em*." Darius lived with his mother and two older brothers in his grandmother's house. Darius had recently moved from a neighboring district for the beginning of his seventh-grade year, following the divorce of his parents. After school, he sometimes helped his grandmother clean houses for extra money. On the weekends, he went to his "*dad's house*." Darius' mother graduated from high school and attended community college for one semester before dropping out. At the time of the study, she worked at a major retailer's distribution center. His father attended community college and then enlisted in the Air Force. Upon

leaving military service, he became a manager of a large food service company. At the time of the study, his father had re-enrolled in community college, supported by federal loans, to become a math teacher. He also worked full time at a food distribution center.

During the STEM career explorations and career planning, Darius needed constant attention. He participated in all of the activities but almost never without the assistance of the researcher, who asked him to explain more to her about what he wrote on his exploration sheets and planning guide. Darius worked alone to select three careers to explore and briefly reflected on a career that he could not see himself in. Darius selected a “*mechanical engineer*” as a long-term STEM career goal and shared that he hoped to own his own business, named “*Quick Clutch*” (a cousin’s nickname for him), where he could fix cars, motors, and appliances. He explained that he would use math, “*to calculate ratios and compression*” to make sure that he did not “*blow up the car engines.*” He also recognized that he was “*very organized,*” a characteristic that would be “*helpful in keeping tiny parts in order when I am working.*” He attributed all of his knowledge about cars to his father:

*I was told when I was about six or seven, when I blow up one of the motors on my dirt bike, I'm gonna have to fix it. So my dad taught me once how to do it. ... and then I have to fix it on my own if I blow it up again.*

Darius described experiences with his family throughout his interview. He spent most of his time with his cousin outside of school, who was in his early twenties, reassembling “*muscle cars.*” His cousin worked as a mechanic in a nearby auto shop with his other family members. Darius’s parents were not happy with the relationship he had with his cousin and wanted him to go to college and stay out of trouble. Darius explained being torn between his relationship with his cousin and his family’s concerns:

*My cousin has a bad reputation. I think he's been to jail like twice and most of it's because of racing and others were because of drugs. ... well ever since [he got back from jail] I can really talk to him. ... My [other] cousins live in Tennessee are like very fancy people and they do not deal with my cousin because he's been to jail a few times and they stereotype him because he's been to jail. ... I like both [cousins].*

Darius was also described navigating between his “*good friends*” who cared about school and his “*bad friends*” who were often suspended for fighting or drug use. He tried to “*keep to himself or do school classwork with his good friends.*” Although he believed that he was “*good in science, mathematics, and technology,*” he perceived that his math teacher assigned too much homework, which led to this altercation:

*When I saw that 50-problem [assignment], I'm like, 'I ain't doing it. ... So I just went off on [the teacher] and [said]. ... 'Why don't you look at your own self and realize that when you give people 50 problems a night, you [will be giving] everybody an F.'*

Darius felt that most of his teachers did not like him and that many White teachers were racist and singled him out as a behavior problem, more so than his White, disruptive peers. For example, he described one teacher who consistently singled him out in class:

*Yesterday and the day before she [his teacher] told me to tuck in my shirt. ... And then she said today 'if I see you come back in here one more time with your shirt untucked Imma write you up for dress code violation and you won't come back in this class.' I really did not care because I wanted to get out of that class anyway, but I do not see it as being strict, I think that's just racist.*

Darius said his mother frequently had to meet with the principal. He described his family's advice: "My parents tell me 'you might be Black. There might be low expectations for Black people but you gotta act like White people, especially for White people.'"

Darius often compared his experiences at WMS with experiences in his previous middle school. For example, he found his old school provided "more opportunities for field trips in science and history." In comparison, he shared:

*I hate to say it like this but this school [WMS] is not as academically good as my other school. ...if it were up to me I would take [students] on field trips 'cause you can learn more on a field trip [than] like in a classroom.*

Darius shared that most of his teachers think that "learning had to happen in the classroom" but identified his band teacher (a middle-aged Black male) to be a role model who made him feel confident about his future:

*[My music teacher] has been enrolled in music ever since he was in sixth grade like I have. And he's real strict about music but then at the same time he understands about music, like me, he said I was talented and that I had like a gift or something. So ever since then he's understood that I'm not mature to the very top of the level of a high school band [player] but then at the same time he works with me because I'm good enough to be in the high school band ...*

Darius envisioned several pathways that could help him reach his goal to work in his own mechanic shop. Darius could see himself "go [ing] into the Army 'cause one of my main objectives is [to go] in the Army or Air Force. ...and to see the world." He believed that this pathway would "fully fund college." He also thought that a 4-year college degree could help him to own his own mechanic business and mentioned four Historically Black Universities in the eastern USA where he could play in the band and learn how to manage a business. Darius imagined that when he eventually worked in his auto shop, he would "only hire family members. ...because if they slacked off, he would put them on probation" and that he would "wear the special coat that [his] uncle gave me before he died," again highlighting the expected role of family in his future. Darius imagined life with "his own small family," "making about 60,000 dollars a year," which would be used to support them as well as hobbies like "going to motocross races." He said that he would "support [his] wife whether she went to work or not," and that he "might marry a nurse because his mom always wanted to be a nurse, and he wanted to make her proud."

In summary, Darius described a future guided and enriched by family members and STEM experiences outside of school. He did not identify similar social supports and real-world experiences in school, except for his music teacher, and talked about the



need to change, to “*act White*” in order to be seen as successful by his teachers. Darius showed self-awareness of his abilities in mathematics and hoped to see the world, work with family members, manage a small business, and have a family of his own.

### **Elle: a Future Teacher**

Elle was one of three White females in Ms. Cruz' third period class. The girls were friends who completed their assignments in class together and shared quiet inside jokes during group activities. Elle lived with both of her parents and was an only child; they were teenagers when she was born. At the time of the study, her mother worked as a nanny during the day and attended the local community college in pursuit of an associate's degree (i.e. a 2-year licensing program) in early childhood education. Her father served in the military, and at the time of the study was a policeman who took classes at the community college with the goal of becoming a social studies teacher. Elle identified herself as a “*straight A*” student saying, “*I've always been a smart kid, always been able to do everything advanced.*” She played first base for the school's softball team and had played the piano for 7 years. She shared that her family, friends, and teachers would characterize her as being “*very opinionated and arguing her view point at home and at school.*”

Elle always completed her explorations in a group of two or three White females and came to an agreement with her group on which careers to explore. Elle chose four STEM careers of interest (because she had extra time during one of the career explorations) and identified a nurse as a career that she could see herself in. Although Elle actively engaged in STEM explorations, she shared mixed reactions to STEM experiences and eventually described her vision of being an English teacher to elementary students. Elle's favorite STEM experiences included going to an astronomy summer camp after her sixth-grade year and going to a living museum and aquarium with her family. At the time of the study, students in her grade were scheduled to go to the beach the following week. She explained why she would not ask her parents for money to attend:

*The cost of the trip was fifty dollars per student.. . .money's tight and I go to the beach every year. ...I do not need to go for a couple hours out of the day. It's gonna take four hours to get there, four hours to get back.*

Elle was bored and frustrated with math class because she had been covering the same topics for 2 years. She explained,

*I took [Algebra I] last year in 7th grade and [now am] taking the Advanced Math course this year ...we are doing the exact same thing. We even had an Algebra I book ...I know I can do geometry. [Our teacher] actually gave some of us a little geometry book if we wanted one and I've been looking through it and it's fairly simple.*

Elle talked about her perception of the community's culture and racialized perceptions about who will be successful: “*It is kind of hard going to a school like this because of the racial differences ...There's so many more of one race than there are of another.*”

She described a division between White and Black families in her community and a history of White people believing that Black people were inferior. For example, Elle's family had very clear rules against dating non-White males or any male who did not come from a "*respectable family*." She elaborated upon this:

*I think it's because of the way my parents were both raised. Slavery was down here too and you [still have] White families who do not believe in their children dating other races and that comes up through generations. We're not really as revolutionized as other places and we are not gonna be if nobody tries, nobody cares. [In] itty bitty towns, you know, the past has a lot of effect on the future of other generations.*

Elle also described gender roles that she perceived in her classes and in careers. While she stated that, "*girls do so much better [than boys] because they mature quicker,*" she held the perception that "*males are more likely to be engineers than females because it is a more difficult job.*" She characterized "*teachers, bankers, and nurses as 'female jobs,'*" and "*doctors and surgeons as 'male jobs'*" because "*most of [her] doctors were always males.*" She saw limited opportunities for women professionals in her county, saying that "*most women waitress, teach, have cell phone businesses, and cut hair.*"

Elle saw a bright future for herself as an English teacher. She hoped to receive a recommendation from her sixth-grade English teacher to attend the local early college high school, which had a 2-year teacher preparatory program. She envisioned earning professional credits in her early college experience and receiving a scholarship to a 4-year university (approximately 2 h away) to complete her teaching degree. After college, Elle planned to return to the military base where she was born because it would provide her with a low-rent home and many opportunities to find an available teaching position.

In summary, Elle narrated a story of self-reliance and self-advocacy as she hoped to become an elementary English teacher. She perceived herself to be strong in STEM and even interested in some STEM careers but could not see herself pursuing such careers. Elle's future pathway was inspired by her English teacher but was also shaped by the history of her rural community that was steeped in traditional gender roles and racism.

### **Mariah: a Future Veterinarian**

Mariah is an African-American female who was outgoing and animated outside of class with her family and friends, but sometimes got reprimanded by her teachers for not paying attention and laughing with her friends. She enjoyed "*writing fiction stories with friends.*" Mariah lived with her mother, father, and her brother and his wife in a small house on the same street as her grandparents, aunts, uncles and cousins. Neither of Mariah's parents went to college after high school; her father drove a recycling truck. Recently, her mother enrolled in a nursing assistant's program at the local community college.

Mariah selected three STEM careers that she was interested in: a video game designer, a veterinarian, and a marine biologist. Her explorations were guided by finding careers that included experiences she enjoyed after school, careers that would allow her to help others, and earning money. She could not see herself as a fashion

designer, because she was generally disinterested in the process of designing clothes. She wrote a career plan for pursuing college credits in veterinary science during high school and eventually becoming a veterinarian, and also shared other careers she has considered, in her interview:

*I was gonna be a nurse but then I changed my mind. ...my mom bought me a dog and I really liked it and I went to a veterinarian and I got to spend a day with a veterinarian and it was really fun ...I also wanted to be a teacher ...I change my mind a lot about jobs.*

Through her STEM career interview, Mariah positioned herself as very family-oriented. She stated, “I want to be able to help my family out and. ...give them the stuff that they need to make it through the world.” Mariah described her mother as a strong role model:

*My momma said she wants me to go to college so I can get the education I need and try to have the life that she never had because my mom ...I think she was like twelve when she had her first job and she's been working ever since ...my momma has never been without a job even though she did not go to college and could not follow her dreams that she set for her when she was little. My mom told me that she expects great things for me since she did not go to college and neither did my dad.*

She also identified her sister-in-law as a role model because she overcame barriers of being dyslexic and having many personal and academic challenges. The way in which Mariah described her family suggests that they were an emotional support for her. Mariah hoped to remain close to her family and work near home. She imagined a hopeful future for her rural county if residents focused on improving the community: “There’s a lot of history down here and [if] a group of women got together and helped each other out, we could make it really big.”

Unlike her fond experiences with family, Mariah saw her classes as “a way to get out of middle school.” She described herself as “lazy” and “getting C’s and D’s in most [of her] classes” at the beginning of middle school, which led to poor relationships with her teachers. However, when she began her eighth-grade year, she decided to adopt the perspective that she must do well to move past middle school and to gain more experience and freedom in high school; she earned all A’s in her classes. She did not emphasize experiences in any of her STEM classes that were particularly exciting or memorable. Like Darius and Elle, Mariah shared perceptions of racism, and that teachers paid more attention to White students. She brought up a specific White teacher twice during the interview, saying,

*I raise my hand and she sees somebody else. ...does not even call on me. I was in here trying to give the answer and she just passes by me and I feel like rejected like she does not even want to talk to me and that makes me feel really bad because I know I’m smart and I do not need nobody to tell me that I’m not ...Even though there’s not a lot of White kids in our class. ...it’s mostly Black but she still like ignores mostly all of them. She’s telling us we*

*are not smart, we do not know what we are talking about, and that's making us feel bad. Like that's making us feel like we do not want to raise our hand and show that we can do stuff.*

When Mariah confided in her grandmother that her teacher did not call on her in class, her grandmother told her to “*try more because when somebody say Black, people think we're not smart.*” She also shared her concerns about racism with a trusted African-American female teacher who told her, “*White kids are not from slavery and had more education.*”

In summary, Mariah centered her discussion on navigating middle school and showed less clarity than her peers on how she imagined her future. Mariah described strong familial relationships that connected her to her community. In contrast, she described experiences in school that left her feeling invisible and without clear guidance to future possibilities and potential academic pathways. She considered careers that mirrored hobbies outside of school but described few personal connections and applications of STEM.

### **Theresa: a Future Forensic Pathologist**

Theresa was a confident Native American female who lived with both of her parents and her younger brother. Both of her parents earned 2-year degrees from a local community college; Theresa's mother managed accounts in a law office and her father was a lab technician for a pet food company. As Theresa discussed her background, hobbies, and experiences, she emphasized pride in her Native American heritage:

*I know a lot about being Native. ...I'm proud of it. On my dad's side we are very strong Indian people. ...I sing backup for a drum group called Blue Moon, it's a young drum group that we are getting together. ...I'm just expected to carry myself in a young ladylike way. I got my eagle feathers and that means that I'm a young lady and I'm supposed to act like I'm responsible. ...I'm mature, I'm respectful, I'm just a good all-around person.*

Theresa happily engaged in STEM explorations and selected a food scientist, a surgeon, and a paleontologist because she was “*interested in food,*” “*discovering new things,*” “*solving problems,*” and “*history.*” She could not see herself as a teacher. Theresa envisioned getting her Ph.D. Quite differently than her peers, Theresa exuded confidence in her ability to navigate high school and college. Despite “*being bored*” in her mathematics class, Theresa excelled in STEM and felt confident that she would earn good grades in those classes. For the past two summers, Theresa took part in a residential, week-long camp at a research university, and engaged in STEM courses and competitions (e.g. designing robots to carry out different functions). This camp promoted STEM achievement in minorities, low-income students, females, and first-generation college students. Here, she met STEM professionals who were predominantly minorities, including a Black forensic pathologist. Theresa decided that she wanted to be a forensic pathologist and wrote a plan for this on her career planning sheet. She described a pathway to this career through a bachelor's degree in Biology, followed by a medical degree. Unlike Darius and Mariah, Theresa did not talk to her

parents about career decisions; instead, she discussed her goals with an older peer in her tribe who was enrolled at a local 4-year university.

Theresa considered forensics to be a possible career because she could “*solve mysteries*” and “*earn more than \$100,000 a year.*” According to her planning guide, her daily job responsibilities would include, “*testing DNA and determining how people die,*” and her responsibilities would be consistent from day to day. She described her future lab in a “*small city approximately 30 miles from her hometown,*” including “*dead bodies, policemen, technology such as high-tech computers, medical tubes, and a freezer.*” She would wear a “*special hat for my hair, goggles, and a mask for your mouth and nose.*”

In summary, Theresa identified herself as a “STEM person” and showed clear preferences for STEM careers. Theresa surrounded herself with people who valued higher education and was mentored by an older peer at a university-college-oriented social networks that likely would continue to guide Theresa’s academic decisions and shape her goals in STEM.

## Discussion

Through written artifacts and interviews, three of the students in this study articulated a possible self in STEM (Darius, Mariah, and Theresa), but Elle did not imagine herself in a STEM career. The discussion brings together the findings of each case to discuss similarities and differences between the students and operationalizes predictors of academic pathways through their cultural assets.

### The Role of Home and Family on Students’ Interests and Experiences

For the four students in this study, students’ families and experiences outside of school guided their possible constructions of a self in STEM more so than their school experiences. This is similar to middle school students in Tan & Barton’s (2017) study who drew more upon interesting experiences outside of the classroom in guiding their consideration of future goals, rather than those at school. All students identified strong familial support, largely in terms of offering emotional encouragement, providing STEM opportunities within their financial means, having high expectations, and modeling the worth of a higher education. Social support and recognition by family members affirmed students’ ability to be successful and was important to seeing themselves in STEM, factors also deemed to be important in qualitative studies on rural students who were college-bound (e.g. Carrico et al., 2019). For example, Darius described successful male figures in his life who “*could fix anything*” and a committed mother who promoted positive behavior. His family’s efforts seemed to provide loving support for him, which bolstered his confidence in himself as a strong science and math person, in spite of negative messages from his White teachers at school. Darius’ explanations of his parents’ expectations give voice to previously described, quantitative predictors of how familial support encourages classroom engagement and GPAs for African-American students (Hill & Wang, 2015). Elle’s parents, who attended community college, supported her interest in school and provided her limited opportunities outside of school—such as supporting her attendance at an astronomy camp—

although money was tight enough that she decided not to tell her parents about a class field trip to the beach. This instance speaks to the additional psychological stress that students from low-income families navigate when considering academic opportunities (Eccles, 2009). Mariah felt emotionally encouraged by her mother and sister-in-law to persevere in school and appreciative of a college savings account that her mother had started to support Mariah's future goals. Theresa's family encouraged active engagement in her tribe and an out-of-school STEM program.

Despite long working hours and the financial challenges that these parents faced, the students valued the experiences that their families gave them. Students were highly influenced in their consideration of careers by their parents' academic and career pathways (e.g. Air Force, loans, scholarships), resonant with literature reviews of the causal influences to adolescents pursuing STEM pathways and careers (e.g. Xie et al., 2015). As mentioned by Dewitt and her colleagues in their discussion of underserved elementary and middle school students' science aspirations, the social and cultural capital that working-class families have access to may play a role in parents encouraging children to pursue educational pathways that are practical and safe (DeWitt et al., 2011).

Further, these middle school students grappled with maintaining ties to their home and family, a finding that has also been noted with STEM majors from rural communities (Friesen & Purc-Stephenson, 2016). Specifically, Darius, Mariah, and Theresa all desired to work close to home. Mariah also suggested that if women from her community worked together, the community would improve. Students' experiences of their families' love, support, and guidance offer a counter narrative to often pejorative descriptions of rural spaces and low-income families (Zhang & Barnett, 2015). In fact, students' connections to home, traditions, and familial values were cultural assets of students that unfortunately were segregated from in-school experiences, resonant with other findings (Brown et al., 2017).

### **Social Relationships in and Out of School**

Students talked about their social relationships in the context of their experiences both in and outside of school. Although they attended the same school in a rural, high poverty community, their school experiences varied. Darius was drawn to relationships with those he loved and cared about, some of whom were "*good' friends*" and some who were "*bad' friends*," including his close relationship with his formerly incarcerated cousin. He felt loved and supported by his family, which came with advice about his friendships and behavior, such as his mother's suggestion to "*act White*" at school in order to be successful. Stinson (2013) suggests that Black males who are successful in mathematics often have to navigate social stigmas by peers and deficit narratives by teachers (costs), which can also undermine their conceptual understandings and expectations for success. Elle described feeling internally conflicted about where she fit in at her school, a White female surrounded by predominantly Black peers. It is noteworthy that Elle's immediate group of friends were the only other White females in her classroom and that the science teacher allowed her to work with these friends during class. Mariah indicated that she was working diligently to become a better student despite feeling unseen in large class settings but clearly was hurt by not being recognized by her teachers, similar to the findings of other studies that have

documented the experiences of African-American students (e.g. Andrews & Gutwein, 2017). Unlike the other students, Theresa had purposeful interactions with STEM professionals and like-minded peers through the university STEM program, which positively shaped her perceptions that she would be successful in STEM and higher education. Other studies, using quantitative methods, indicate that like-minded peer networks are important in supporting students' motivation in STEM (Kendricks, Nedunuri, & Arment, 2013). Theresa's greater support network seemed to help her to hone and clarify her goals as well as enhanced her knowledge of how to attain them. She serves as a model for the difference it can make when students—in this case, rural, first generation, and predominantly minority—are advocated for by teachers and provided with outside resources.

### **The Role of School and Community Culture on Students' Expectations for Their Futures**

Students had the shared experience of living in a rural community, with gendered and racialized views that were present at home, school, and in their community. Although they lived in the same community, Theresa had an outlet in her tribal community, and Elle operated outside of the Black community with her family. Three of the students noted clear Black/White racial lines within the community. These students shared statements of their family members, suggesting that Black people needed to act differently at school to be successful and with the expectation that students of color were expected by teachers to be less successful than their White peers. For Mariah and Darius, their voices give us insight into how they were trying to find their place in the White-dominated culture of schooling (D'hondt, Eccles, Van Houtte, & Stevens, 2016). In addition to racialized barriers to the achievement of Black students, the students suggested that community members still held very traditional, gendered perceptions of who works in different careers. Their stories help to operationalize prior findings from predictive survey results indicating that female students' perception of male-dominated careers influence their academic and career pathways in STEM (Regan & DeWitt, 2015).

The role of teachers have been found to be influential on the individual success of middle school students in STEM (Tan & Barton, 2017) and on rural students' ability to navigate college and career pathways (Griffin et al., 2011); the participants in this study had few positive past and present experiences with STEM teachers. Darius and Elle each described a teacher who they identified with in gender and race, to be the most important influence within school on their future selves. We think it is important to note that both Darius and Mariah, Black students, described instances in school of feeling ignored, picked on, and considered less capable by some of their White teachers. Their racialized experiences at school worked to undermine their potential. This was in contrast to the experiences of Elle, a White female, and Theresa, a Native American student, who described only positive experiences with their teachers or through the STEM program (Theresa). Darius and Mariah were often put in the position of having to overcome negative messages they received at school through family support, in order to believe they could have bright futures.

## Conclusions

In this multiple case study, we elicited the voices of diverse middle school students to learn about their lives, experiences, and their futures as they explored STEM careers in a rural community rich in family support, with limited financial resources. These students shared racialized experiences at school and leaned on experiences outside of the classroom to support ideas of who they hoped to become. All of the students were influenced by the careers they saw and knew, including Theresa, who was influenced by the STEM professionals she met through the university program. Relationships worked to support students as well as to undermine their expectations for successful futures, and racial and gender stereotypes contributed to these. Supports included family, tribe, “good” friends, family, college and work role models, university experiences, and supportive teachers. Factors undermining the students’ potential included negative racial stereotypes, “bad” friends, poor role models, and negative attitudes and feedback from teachers. Students felt supported and advised by their families, and therefore believed in their potential, but for two of the students, negative messages from their teachers became something they had to overcome. Finally, data from these students made it clear that they would need more support (information, financial, guidance) in order to attain their goals.

Research that has employed the expectancy-value framework (Eccles, 2009; Eccles & Wigfield, 1995) has relied upon survey data of middle, high school, and post-secondary students (e.g. Andersen & Ward, 2014; Svoboda et al., 2016). This study offers students’ voices to provide richer understanding of these quantitative findings. In considering the findings of this study in light of expectancy-value theory, there is clear evidence of how students’ social experiences at school and at home, embedded in the culture of their communities, have shaped their goals for their futures. In these students, family experiences were more highly valued than those at school, particularly for the Black male and female students who did not feel as supported and valued as did the other two students. An exception is that students have some trusted individuals at school whose opinions they value and thus who are positively influential. Therefore, the culture of the community is an important influence for all of the students. One student had her community enlarged to a university STEM community, and that has supported the idea that she can have a STEM major and career that her peers would consider viable only for a male. Thus, this study provides examples of how expectancy-value theory constructs are operationalized—particularly with regard to cultural and social experiences—for these rural students.

## Recommendations

Given the key findings of our study, we recommend that teacher educators find ways to support rural communities by the following: (1) providing culturally relevant teacher professional development to help teachers address their implicit biases in race and gender in STEM classrooms; (2) provide more information (scholarships, pathways, majors, career information, career nights) to families and students through class exploration, materials sent home, guidance counselors, STEM days, or other career events; (3) bring families to campus to meet (STEM) professionals, faculty, and college



students to provide relatable role models and a sense of what it would be like to be on a college campus; and (4) promote engagement in positive and stimulating STEM activities at school, both in and out of school as a part of pre-service education and in-service teacher professional development. We hope that by sharing these student's voices with the broader teacher education community, researchers and teacher educators will better understand the lives of these underserved students, both in and out of school, and find ways to support equitable STEM experiences and consideration of their futures through their teaching, professional development activities, research, extension, and outreach activities.

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