Making the Case for Elementary Biomedical Education in Rural Communities

Amanda Obery
Central Washington University

Matt Queen
Montana State University Billings

Abstract

Exploring the intersections of CTE and STEM education may foster interest in critical rural biomedical careers beginning in elementary school. Starting early to develop career awareness may be essential and take advantage of the flexibility that rural schools can provide. This study provides a theoretical foundation for rural biomedical education efforts and measures impact of an elementary biomedical intervention. Results show an increase in career aspirations and self-efficacy while maintaining high levels of student interest. In addition, student interest is found as the primary driver of career aspirations. Overall, the study shares one effective educational path to enable students to become aware of and develop an interest in biomedical careers present in their community.

Introduction & Background Information

Promoting college and career readiness is an ongoing and important challenge in education, particularly in light of the COVID-19 pandemic putting a global spotlight on biomedical careers. "'Biomedical' refers to the full range of biological, biomedical, behavioral, and health sciences supported by the National Institutes of Health" (National Academies of Sciences, 2018, p. 1), both researchers and healthcare providers included therein. Many professionals are encapsulated by the term *biomedical* including: cell biology, nutritional science, nursing, environmental life sciences, and even anthropology (National Academies of Science, 2018, p. 17). Importantly, the United States is projected to experience extreme healthcare workforce gaps alone, up to 3.2 million people short, by 2026 (Mercer, 2021), and these gaps will be felt more acutely in rural areas. Now, and likely increasing in the future due to limited providers, those living in rural areas are more likely to experience health disparities, lowered health outcomes, and limited access to healthcare services (American Association of Medical Colleges, 2021, p. 19). Current efforts to support recruitment and retention of rural healthcare professionals largely focus on recruiting students from rural areas (e.g., Neilson et al., 2017) or on rural practicum experiences (Ross et al., 2020). Walker et al. (2012) found that "students from rural backgrounds were 10 times more likely to prefer to work in rural areas when compared with other students" (p. 3). Thus, it is crucial to inspire rural students to pursue biomedical careers as a means of filling the future workforce gap.

CTE & STEM Education

Education as a means for career or workforce development is a key criterion for current K-12 education and many states have adopted college and career readiness standards (U.S. Department of Education, 2019) through programs such as Career & Technical Education (CTE). CTE focuses on the need to prepare students for jobs after school in diverse ways from specialized courses to integrated school wide programs (Kim et al., 2021). CTE programs vary but medical and health services-oriented programs are one of the most prevalent career clusters (U.S. Dept. of Education, 2019). Graduates of CTE programs in the medical/health/social services were most likely to be employed in careers related to their training, with 70% of students entering the field (Tillman & Tillman, 2008). Thus, CTE programs are viable paths to help close the biomedical provider gaps looming in the future.

However, rural areas have challenges implementing CTE programs. For one, there are often fewer industries to offer workplace experiences and fewer colleges to become potential partners, making things like dual credit or post-secondary options more limited (Kim et al., 2021). Though online partnerships can be a solution to issues with offering dual-credit opportunities, many rural communities still struggle to have consistent or sufficient internet access (Williams, 2021). Finally, issues with finding qualified individuals capable of offering biomedical CTE programs, particularly those with adequate experience and education to earn CTE teaching credentials, is challenging (Park & Johnson, 2019). Those that do manage to become licensed often face additional stress (Kerlin, 2002), possibly as a result of the alternative pathways that many take to gain licensure. Thus, while clearly a worthy avenue to help foster future biomedical providers, CTE programs alone may be insufficient to meet the future workforce demands, particularly in rural areas.

Ensuring a capable and innovative biomedical workforce with Science, Technology, Engineering, and Mathematics (STEM) knowledge and skills is important for the overall development of the United States (National Academies of Sciences, 2016). Improving students' access to quality STEM education has been a focus of rural educational reform for many years (e.g., Harris & Hodges, 2018) as effective STEM instruction piques students' inherent curiosity, builds upon existing knowledge, and engages through practices to sustain interest (National Research Council, 2011, p. 18). Lent et al.'s (1994) seminal work in social cognitive theories highlights the role of interest as a main driver of career intentions, and defines them as "patterns of likes, dislikes, and indifferences regarding career-relevant activities" (p. 88). Raising interest in STEM careers such as healthcare is a longstanding goal of STEM education, and fostering sustained interest may support increases in the healthcare workforce careers (e.g., Tai et al. 2006, Kemp et al., 2021). In fact, the National Research Council (NRC, 2014), suggests that the future of the United States biomedical research field is predicated on strong science and STEM backgrounds (p. 7).

Sometimes referred to as applied STEM education or coursework (e.g., Gottfried, 2015; Gottfried et al., 2014), successful STEM education articulates goals for workforce readiness, focuses on interest and engagement, and ultimately STEM-related employment (NRC, 2011; NRC, 2014). Programs or schools that use CTE pathways to learn and share STEM skills, have been successful in supporting content knowledge growth in math (Boznick & Dalton, 2013), offering more advanced science and math coursework (Gottfried, 2015), and supporting student beliefs about their own capabilities in these fields (Sublett & Plasman, 2017). The belief in one's ability to exert control over their own lives, known as self-efficacy, impacts the goals one sets and how much effort they put into attaining the goal (Bandura, 1991, p. 257). Self-efficacy has long been tied to science and STEM achievement, and is noted as a "key predictor of STEM performance and perseverance" (Rittmayer & Beier, 2009). Thus, deliberate inclusion of CTE best practices might enable STEM education to have the same impact on student self-efficacy in biomedical career fields.

Enabling all students access to high quality STEM education is a goal of the Framework for K-12 Science Education (NRC, 2012), the guiding research behind the Next Generation Science Standards (NGSS). Unlike CTE programs, STEM education reaches all K-12 students through science instruction. Particularly, as a result of the challenges faced by rural areas with CTE programs, ensuring that STEM education has a focus on biomedical career development may offer the best way to augment efforts in rural communities.

Rural STEM Education

Persistent barriers in rural education, including geographic isolation, funding, equipment, and low teacher numbers and training, make it difficult for students to be prepared for the workforce or college (Gutierrez, 2016; Nugent, et al., 2017). These 6.5 million rural students outnumber the total population of the combined enrollment at 20 of the largest urban districts in the United States, yet they receive a small percentage of attention from reformers, researchers, and legislation (Harris & Hodges, 2018, p.4). Neglecting to provide satisfactory STEM education to rural populations not only negatively impacts the country's ability to compete in the global economy, it also unjustly neglects rural populations. In order to eradicate these problems, external sources of aid need to come together and address the lack of resources rural schools receive, how to approach STEM education in a locally relevant way, and how to equalize current outreach disparities (Boyer, 2006).

Despite barriers, rural education settings can be well suited to engage in relevant CTE informed STEM education. Rural students score as well as (or better in some cases) than eighth grade students from suburban, town, or urban communities on science, technology, and engineering standardized tests (Showalter et al., 2017; U.S. Department of Education, 2019). Additionally, rural communities can provide teachers with more agency in determining curriculum and often spend more on science equipment (Banilower et al., 2018).

Rural education has many benefits often including a focus on local environments, resources, with varied and deep community involvement (Avery, 2013; Lakin et al., 2021), especially for science (e.g., Zinger et al., 2020). Known sometimes as place-based education, centering local people and places fosters connection between students and their specific community (Sobel, 2004). Intentionally including and valuing local rural knowledge (Avery, 2013) might be one way to gain the family and community support crucial in determining student attitudes, academic interest, and ultimately success in STEM disciplines (Cooper et al., 2005). Family and community support also leads to increased self-efficacy in science (Sha et al., 2016). Especially due to the role that self-efficacy can play in persistence (Sha et al., 2016) and possibly career choice (Dorfman & Fortus, 2019), having involved family is a benefit that rural communities may more easily engage. Rural teachers and administrators often are vested members of the community with knowledge of the people and community, and can be more flexible in their approach to supporting students' STEM interests and aspirations (Lakin et al., 2021). Investing in quality STEM education in rural areas offers the chance to develop skills and knowledge from within the community for future biomedical careers. Particularly as Petrin et al. (2014) found that high-achieving students in rural communities had high community attachment (p. 320), underscoring the promise of showing students what careers are available in their area. Furthermore, centering community in education, "reflects a deep respect for rural life and honors the determination of residents to sustain rural communities" (Boyer, 2006, p. 115). Thus, rural areas are well situated to do educational interventions that support biomedical career interest and self-efficacy through place-based STEM approaches.

Sadly, research by Vedder-Weiss & Fortus (2011; 2013) suggests that students' motivation to engage with STEM decreases in the transition from upper elementary into middle school. Self-efficacy in science may stay consistent between upper elementary and middle school (Rice et al., 2013), however this also suggests that self-efficacy in science is set by the time students leave elementary school. STEM fields also have persistent inequities in both achievement and interest with regards to women and students of color (Riegle-Crumb et al., 2011; Sadler et al., 2012). These findings, coupled with the understanding that middle school students who do have an interest in science or math are significantly more likely to pursue these careers in the future (Tai et al., 2006), point to a critical time to engage all students in STEM based biomedical education prior to middle school.

Fostering interest and self-efficacy in STEM around biomedical careers must begin in elementary school, especially since CTE programs typically occur in middle and high school. This call, while not novel (Knight, 2015; Mariani et al., 2016), is not commonplace and often requires many entities (e.g., advising, counseling, community partners, and K-12 teachers) to collaborate. However, "since the formation of personal and career self-concepts occur at such an early age, proactive and intentional guidance to support the exploration of careers while building college expectations should be further explored [in elementary school]" (Pulliam & Bartek, 2018, p. 358). Particularly for rural areas, integrating biomedical career awareness through STEM education may be the best solution for communities to foster their own healthcare providers, beginning in elementary school (Figure 1).

Rural Biomedical Education

The Centers for Disease Control (CDC) notes, "teaching public health in grades K–12 can support lifelong health literacy in students and help them build essential skills for the future" (para.1, 2021). Key features of effective instruction for health sciences CTE programs include hands-on instruction and work-based learning experiences. The students who are most successful in these programs have a passion for healthcare professions, are high achieving, and have strong support in the teachers and guidance counselors who can help make career-based decisions and create plans to achieve the goals (Thessin et al., 2018). Many of these features align well with quality STEM instruction, particularly in rural areas (Boyer, 2006). Importantly, whereas many STEM careers often require relocation to more urban locations, biomedical careers are essential and in-demand positions in many rural areas, offering the potential for students to pursue STEM careers and stay in their hometowns (Peterson et al., 2015).

Increasing access to biomedical education opportunities has been shown to be an avenue to support students' interest in science careers (Rohrbaugh & Corces, 2011), especially for rural students (Taylor et al., 2017). Research suggests that CTE programs with a STEM focus not only provides students with valuable work-based experiences, but also enhances their STEM content knowledge (NRC,

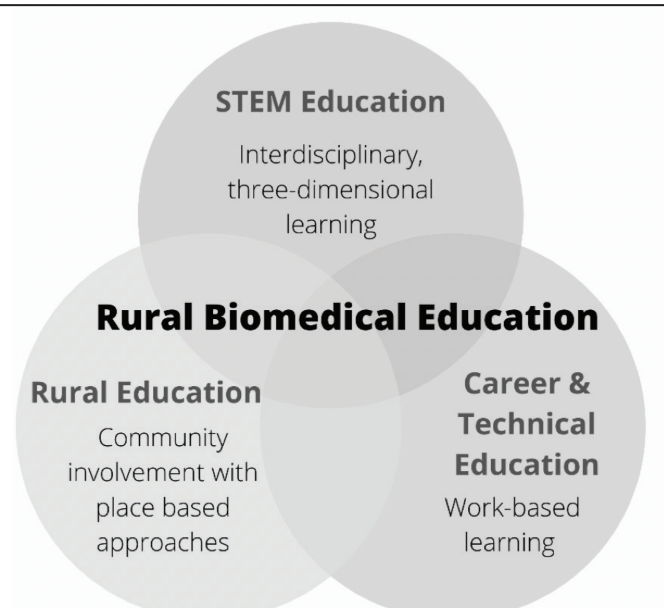

Figure 1. Conceptual Framework for Rural Biomedical Education

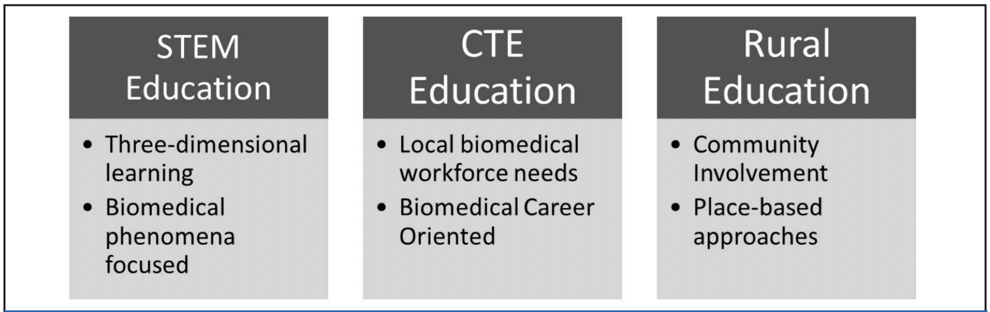

Figure 2. Overview of the Rural Biomedical Education Curriculum Components

2011, p. 13). By integrating best practices from biomedical and healthcare CTE programs with STEM education in rural upper elementary classrooms, unique and powerful pathways could be created to support students' future career aspirations. Rural biomedical education (RBE) utilizes key elements from CTE and integrates them into STEM education where all students can access them, specifically for rural communities, see Figure 1. Main characteristics of RBE are shared next in greater depth.

Community Involvement & Local Relevance. RBE should be steeped in the community, directly valuing local knowledge. Deeply integrating community values and phenomena into curriculum will enable the resulting interventions to privilege the language, culture, and lived experiences of students (Avery, 2013). Including the community members, administrators, or teachers as co-developers (e.g., Severance et al., 2016) can be one way to ensure that RBE interventions provide agency to involved stakeholders, make implementation feasible (Bhaduri et al., 2022), and support community workforce needs (Tillman & Tillman, 2008). Further, when RBE can explicitly connect learning in the classroom to their daily lives, it is likely to increase students' interest and willingness to persist through challenges (Hulleman & Harackiewicz, 2009). The explicit centering of a place, both the environmental and community resources, is at the center of place-based pedagogies. As put by Gruenewald & Smith (2008), the movement to deliberately include local people and places "is not only about creating the economic conditions that make staying put possible; it is also about conserving...the foundation of community well-being" (p. Xvi).

Three-Dimensional Learning. "There is currently a consensus that science and engineering learning should focus on explaining phenomena and designing solutions to problems by engaging in three-dimensional learning" (Lee & Grapin, 2022, p. 3). Three-dimensional learning encompasses the disciplinary core ideas, science and engineering practices, and cross-cutting concepts that students engage in science during grades K-12. When learning about a natural phenomenon through a three-dimensional approach, students are able to make progressively more complex explanations of the world around them (NRC, 2012). Integrating community involvement and place-based phenomena with three-dimensional learning, RBE can have students engaging and grappling with a locally relevant biomedical phenomenon authentically in science (Lakin et al., 2021; NRC, 2012). Biomedical phenomena are diverse, encompassing areas of both biology and medicine. Thus, biomedical phenomena are human or animal health, related to environmental factors such as water or air, or focus on community or individual health factors (National Institute of Health, 2017). As students engage with the biomedical phenomena, they have the opportunity to learn STEM content knowledge, and engage in behaviors similar to rural biomedical professionals.

Career-Oriented Learning. In order to connect students with role models and gain an understanding of the local career options, RBE efforts should feature local biomedical professionals (Lakin et al., 2021) or community members who utilize similar skill sets and knowledge bases. Examples of in-demand biomedical careers particularly suitable for rural areas that students could pair up with as role models include: medical laboratory technicians, phlebotomists, biomedical researchers, health educators, nutritionists/dietitians, biomedical engineers, environmental health specialists, healthcare administrators, medical and clinical laboratory scientists, public health researchers, occupational therapists, veterinarians, and community health workers. These biomedical careers offer diverse opportunities to engage with and contribute to the study of biomedical phenomena while fulfilling crucial roles in healthcare delivery and research within rural settings. Using the context of local biomedical careers also provides the opportunity for students to connect their learning, current and future, with a possible career (Thessin et al., 2018), a skill many middle schoolers lack (Blotnicky et al, 2018). Finally, the involvement of biomedical professionals will ensure that RBE interventions align with local workforce needs (Northern & Petrilli, 2019) and directly connect community members to education (Avery, 2013).

Purpose

Encouraging biomedical career interest in rural areas through STEM education may show students a viable STEM career path in their community through the biomedical workforce. Starting early to develop this critical interest and career aspirations may be essential and best take advantage of the flexibility that rural schools can provide. As such, this study aims to make the case to include specific biomedical educational efforts through STEM education in rural elementary schools and is driven by two questions: 1) Can rural biomedical education interventions lead to increased STEM career aspirations or interest? and, 2) Does 5th grade student self-efficacy and interest in STEM drive biomedical career aspirations in rural areas?

Methods

This pre-post survey research study was conducted to test the impact of a biomedical education intervention on 5th grade students. The co-created biomedical education curriculum reflects a partnership between nine elementary-endorsed school teachers, two administrators, two higher education researchers, and numerous community partners. The curriculum team developed, and pilot tested over the course of 2 years, meeting one to two times per month to detail out a 5th grade unit. The curriculum (Figure 2) focuses on local biomedical issues in water, engages students in hands-on problem solving by purifying water, teaches STEM content knowledge through water treatment and water borne illnesses, and features videos of local biomedical professionals (e.g., medical laboratory scientists, water treatment facility director) who share both the context of the issue and provide guidance in the projects, showcasing local biomedical careers. For both years, pilot classrooms engaged with the curriculum, and data collection tools, and provided feedback for improvement.

Context & Participants

The study occurs in a rural state in the Northern Rocky Mountains and the researchers are located at regional comprehensive institutions of higher education. Participating classrooms were selected by the nine teachers who co-created the curriculum. Ultimately, 5th grade students (N=179; 9-11 years old) from 10 classrooms at four different schools took part in the study. Of these 5th grade students, 45% of students identified as female. 77% identified as white, 9% as American Indian/Alaskan Native, 8% Hispanic, 4% Black, and 2% Asian.

Data Collection & Analysis

The pre-post surveys build on a pilot study conducted one-year prior (32 questions; unpublished data), which identified six-point Likert scale questions regarding self-efficacy (Bandura, 2006), STEM career aspirations (Science component of the STEM-CIS; Kier et al., 2014), and interest in science (Lent et al., 1994). During pilot testing, analyses lead to drop half of the questions due to high correlation and cross loading, leaving a final tool of 16 questions. In addition, in the post-survey, there were 2 open-ended questions asking students to share what influenced their thoughts on STEM careers and to share a question they have for a scientist. The 16 (pre) to 18 (post) question surveys were implemented two days pre- intervention and one-week post-intervention by the classroom teachers through Google Forms, as this was the district's request.

Pre-post quantitative survey data was matched through student ID numbers and analyzed using descriptive and inferential statistics through Stata (statistical software program), including structural equation modeling (SEM). The qualitative data was coded through two rounds of analysis, starting with open-coding, and then collapsing codes into larger themes (Creswell & Creswell, 2017).

Results

The pre-post survey results used in the study are used to address two main research questions regarding RBE interventions ability to support student's biomedical career aspirations, and what are factors influence these aspirations?

RQ1: Can biomedical education interventions lead to increased biomedical career aspirations or interest?

An exploratory factor analysis (EFA) was run on the 16 question pre-post survey results (N=179; Table 1) to determine if the underlying structure aligned with the theoretical framework of interest, self-efficacy, and career aspirations. 4 variables were dropped due to issues with cross loading, thus only 12 variables were included in the analysis. Following Costello & Osborne (2005), 3 factors were extracted wherein all items loaded above 0.6, and all factors had at least three variables (p. 3); all eigenvalues above 0.9. Given the high loading, low number of factors, and small number of questions, EFA can still yield good results with a smaller sample size (deWinter et al., 2009). The 3 latent constructs of aspirations, interest, and self-efficacy emerged (Table 2) and the 12 variables were averaged accordingly to generate new latent variables that are used to understand students pre-post survey results.

The latent variables were analyzed through paired-samples t-tests. These tests revealed positive increases in self-efficacy ($t = 2.35$, $p < 0.05$) and career aspirations ($t = 4.65$, $p < 0.05$), with career aspirations having the largest effect size of 0.35. There was no significant change in interest ($t = 1.40$, $p = 0.16$), though the pre-survey score was near to scale maximum of 5 and they remained the highest scored latent variable. MANOVA's were conducted to test if the latent constructs differed by gender and race, and none were statistically significant ($p > 0.05$). Thus, responding directly to RQ1, RBE interventions can lead to significant increases in career aspirations and self-efficacy, and can maintain high levels of interest in STEM.

RQ2: What drives STEM/biomedical career aspirations?

Drawing on the literature suggesting that interest led to career aspiration (Tai et al., 2006) and that self-efficacy was fully mediated by interest (Blotnicky et al., 2018), a SEM (Figure 3) was conducted to measure the relationships between career aspirations, interest and self-efficacy in the post-survey data. All variables loaded onto the latent constructs identified in the factor analysis over 0.7, with the exception of two variables loading above 0.5, considered acceptable for a satisfactory fitting model (Figure 2; Bagozzi & Yi, 2012). The root mean square error of approximation is 0.06, the comparative fit index is 0.97, and the standardized root mean square residual is 0.06, indications of acceptable to good fit (Schermelleh-Engel et al., 2003).

	Pre		Post	
Variable	Mean	SD	Mean	SD
like[2]	4.64	1.18	4.79	1.00
interesting[2]	4.99	1.05	4.93	1.07
learning[2]	4.47	1.37	4.68	1.19
jobnow[1]	2.87	1.72	3.14	1.64
future[1]	3.28	1.68	3.59	1.62
good[3]	4.39	1.15	4.48	1.10
proficient[3]	4.29	1.40	4.53	1.23
college[1]	2.79	1.61	3.13	1.59
quickly[3]	4.07	1.38	4.25	1.28
expectjob[1]	2.81	1.58	3.34	1.61
likelyjob[1]	3.18	1.64	3.64	1.70
Imagine[1]	3.06	1.73	3.47	1.74

Note. [1] Variable loaded onto the construct of Aspirations
[2] Variable loaded onto the construct of Interest
[3] Variable loaded onto the construct of Self- Efficacy
SD. Standard deviation

Table 1. Descriptive statistics for the Pre-Post Survey Results and the Loading Structure from the Factor Analysis

	Pre		Post	
Variable	Mean	SD	Mean	SD
Aspirations	3.00	1.41	3.38	1.43
Interest	4.70	1.08	4.80	0.94
Self- Efficacy	4.25	1.08	4.42	0.96

SD. Standard deviation

Table 2. Descriptive Statistics for the Pre-Post Latent Constructs SD. Standard deviation

Total effects on aspirations is 0.57 ($z = 4.96$, $p < 0.00$) and the $r2 = 0.27$, sharing that more than a quarter of the variance in espoused biomedical career aspirations can be explained by the combined effects of interest and self-efficacy. Interestingly, a SEM was conducted to test whether self-efficacy in science directly leads to career aspirations in addition to being mediated by interest and the resulting path was not statistically significant ($p > 0.05$), thus results bolster the findings of Blotnicky et al., (2018). However, given the essential role that self-efficacy plays in interest ($\beta = 0.72$; $z = 6.56$, $p < 0.00$), both are critical to supporting future biomedical career aspirations.

The qualitative responses from the post-survey add nuance to quantitative survey results for RQ 2. On the post-survey, participants were asked to share how the intervention changed their interest in having a job or career using science, and results to this question ($N = 171$; Table 3) were coded by commonalities. Eight codes were uncovered, sharing varied sentiments regarding the impact of the RBE on biomedical career aspirations.

While approximately one quarter of students described their interest increasing due to the RBE being fun in general, an almost equal amount noted that the RBE did not increase their interest, though this may be explained by a pre-existing high level of interest heading into the experience. An intriguing finding from the open-ended responses is that notion that 5th grade participants may have already formed a career identity. Almost 10% of participants mentioned the idea that science careers were not for them as they had already decided on a different career path, suggesting that identity formation, or the ability to see oneself as a STEM professional, is well underway by 5th grade.

Collectively, interest is a determinant of career aspirations in STEM/biomedical education and self-efficacy is essential in supporting overall interest. Describing more than a quarter of the variance in career aspirations in 5th grade students is large, considering the life-long and community-wide implications of these decisions. Understanding the mechanisms that drive self-efficacy and interest is important because, while students may be interested in the material (interest) and believe they can be successful (self-efficacy), they may already have their "mind set on one career" (student participant).

Discussion

Ensuring that rural communities have ready access to biomedical professionals is a challenge that will likely intensify in the future given projected workforce shortages (Mercer, 2021; AAMC, 2021). Supporting current efforts, such as those through medical schools (Ross et al., 2020) and K-12 CTE healthcare programs are important steps to help fill the gap. However, with the limited availability of rural practicums for medical schools and the reality that most rural healthcare providers come from rural communities (Walker et al., 2012), additional pathways through K-12 STEM education are necessary. Rural biomedical education (RBE) through STEM education can help foster interest and self-efficacy for biomedical careers that allow students to stay in their communities.

RBE, drawing on the best practices of CTE and STEM education, offers up solutions to address the current and future biomedical professional shortages. Ensuring that interventions center community involvement is the first step to providing opportunities that have local relevance.

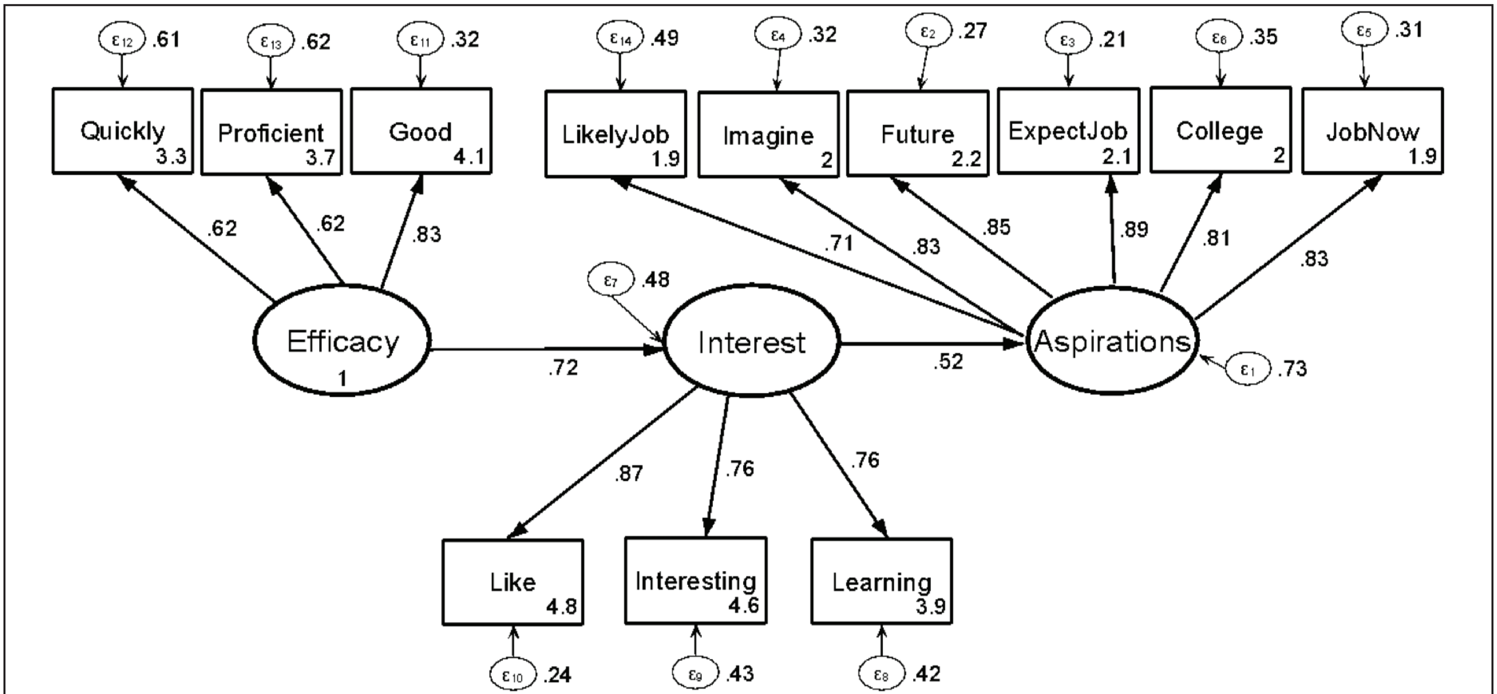

Figure 3. Structural Equation Model Showing The Relationships Between Career Aspirations, Interest, And Self-Efficacy With Standardized Coefficients.

Interventions that focus on the culture and lived experience of the students (Avery, 2013) support motivation and persistence. Through the partnerships with community members, such as teachers and administrators who can be pivotal community members (Lakin et al., 2021), interventions can be authentically place-based and directly connect students to local phenomena. RBE should come from STEM classrooms, or science classrooms, as these will reach all students and lack many of the challenges faced by CTE programs (e.g., Kim et al., 2021; Park & Johnson, 2019). In doing so, RBE will have three-dimensional learning experiences that allow students to both understand and design solutions for the phenomena under focus (Lee & Grapin, 2022). Finally, because CTE programs do have direct connections to community professionals, they are often successful in supporting students in joining the workforce (Tillman & Tillman, 2008). Thus, RBE should include local biomedical professionals to support students in seeing the relevance and utility of the STEM knowledge and skills they learn through the phenomena.

Using RBE can boost student's aspirations to biomedical careers and increase their self-efficacy in STEM, while maintaining a high level of interest. When students gain self-efficacy for doing biomedicine through STEM, their interest can increase, which leads to an overall increase in their future aspirations in biomedical careers.

Limitations & Implications for Future Research

The study is limited by the context and methods. First, the small sample size, indicative of rural areas, and rural context of the participants limit the ability to apply the findings to other contexts. Second, the tools used are self-report, which have a long standing and controversial place in research (e.g., Chan, 2009), yet they remain a consistent and reasonable method to study student perceptions (Greene, 2015). Additional methodological approaches may help parse out the mechanisms and timing that students identify with a particular career field.

Code	Percent Frequency	Example
Career	5.3	it made me think I can have a lot more fun in a science career than I originally thought.
Change	5.9	I liked everything you did and I loved it so much.
Content	7.0	It changed my interests in science by having us create our own design of filter and be able to call it something we created and tried to make very dirty water drinkable with the tools we had.
Didn't Really	15.2	It did"t, really. I do"t like it any more than I did, but I still love science.
Fun	25.7	I *[sic]* learned that science isend *[sic]* just words its *[sic]* fun
No Change	21.6	it *[sic]* did"t for me
Other Identity	9.4	i *[sic]* did"t really change anything because I have my mind set on one career and I do"t think that it will change that quickly.
Relevance	9.9	it let my brain think more and realize science is in everything we see and use!

Table 3. Code, Percent Frequency, and Example of What Changed Participants Interest in Having a Job or Career Using Science

Future research into rural biomedical and STEM education may consider approaches such as design research practice-partnerships to overcome the challenges faced by many rural communities and schools in developing interest in STEM and future biomedical professionals. Finding effective ways to involve the community in the development of RBE is essential to its success. Research may consider how successful partnerships could be fostered and if these successful partnerships lead to (1) an increase in outcome effectiveness, and (2) the number of future biomedical professionals coming from the community.

Finally, the model of RBE to include elements of CTE, STEM, and rural education could be applied to other career paths and content areas. Additional research may explore how RBE, at the elementary level, can benefit other areas such as engineering, computer science, or environmental science and if the model might be applied to non-rural communities that have strong community involvement and close ties to the environmental and community resources present therein.

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Amanda Obery is an assistant professor of elementary math and science education at Central Washington University. She is fortunate to be able to pursue her research interests in STEM education through a number of lenses in the interest of serving the communities she inhabits."

Matt Queen is an associate professor of analytical chemistry at Montana State University Billings. He is passionate about exploring creative avenues for engaging the public in STEM education. "The world is a better place when people aren't afraid to think like a scientist!"