

The Role of Faculty Guest Speakers and Research Lab Visits in STEM Major Selection: A Qualitative Inquiry

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Abstract

Science, Technology, Engineering, and Math (STEM) recruitment programs are growing at post-secondary institutions in response to the national shortage of trained workers in STEM fields. Many programs prove effective in recruiting students into STEM majors with research indicating the benefits of experiential learning activities in program outcomes. This study qualitatively examined the experiences of first-year undergraduate students in a STEM-focused career planning class within a STEM recruitment program. Findings illuminated the importance of STEM faculty guest lectures and research lab visits in providing meaningful opportunities to learn more about specific STEM fields and to make career decisions. Recommendations for programmatic improvements are also made based on critical feedback on the structure and content of these experiential activities.

Keywords: STEM education, career development, career readiness, undecided students, faculty engagement, research labs

Introduction

The National Academy of Sciences (2011) and the National Science Foundation (2013) both agree that whereas science, technology, engineering, and math (STEM) fields advance and grow, a lack of qualified workers exists to fill job positions within these fields, which is commonly referred to as the STEM Crisis. Chen (2014) reported that nearly half of bachelor's degree students in STEM majors left their STEM major, either through changing their major or though leaving college altogether. However, other reports indicate that STEM attrition could be as high as 70 percent (Koenig, Schen, Edwards, & Bao, 2012). Chen (2014) also highlighted gender differences in STEM attrition, noting that females were more likely to change their major, whereas males were more likely to drop out of college. Although the precise number is disputed, disparities also exist in STEM retention for ethnic minority groups, (National Science Foundation, 2013; Palmer, Maramba, & Dancy, 2011). Thus, numerous researchers have called for more investigations related to contextual factors that may cause or correlate with attrition rates in populations underrepresented in STEM fields (Gayles & Ampaw, 2014; Litzler, Samuelson, & Lorah, 2014; Mansfield, Welton, & Grogan, 2014).

Due to these disparities, post-secondary institutions around the United States have created programs to bolster retention rates within STEM majors and ultimately to increase STEM degree attainment (Bouwma-Gearhart, Perry, & Presley, 2014; Defraigne, Williams, & Ceci, 2014; Schneider, Bickel, & Morrison-Shetlar, 2015). These programs expose students to research, mentorship, and faculty engagement; while large-scale STEM recruitment programs often involve participation from multiple university stakeholders, such as administration, faculty, and graduate students (Schneider et al., 2015). The purpose of this qualitative study was to explore the experiences of STEM-interested first-year undergraduate students with two particular aspects of one such STEM initiative: hearing career presentations by STEM faculty members and visiting the research labs of those faculty members. Specifically, we wanted to gain insight on whether these experiences informed students' career awareness and career decision making and ultimately how these experiences helped these initially-undecided students select a major.

Theoretical Framework

To explore these experiences, we turned to Kolb and Kolb's (2008) Experiential Learning Model. Based on Kolb's (1984) original work, this cyclical model provides an explanation of how individuals translate experiences and reflections on those experiences into new actions or behaviors. The model contains four phases: (a) concrete experience, (b) reflective observation, (c) abstract conceptualization, and (d) active experimentation. The concrete experience refers to a new experience or encounter that provides new information (Kolb, 1984). In the reflective observation phase, individuals attempt to make meaning of the concrete experience after reflecting on many different aspects of an experience (McAuliffe, 2011). The abstract conceptualization phase involves drawing conclusions about the experience by integrating the knowledge gained into prior knowledge and prior experiences (Kolb, 1984; McAuliffe, 2011). In the active experimentation phase, individuals act on the new knowledge or develop a plan to try it out in the world around them (Kolb, 1984). McAuliffe (2011) argued that most learning begins in the concrete experience stage, although Kolb (1984) posited that the cycle can begin at any point.

In the present study, the participants shared two experiences within a STEM-focused career planning class. First, students in the career planning class had the opportunity to hear from a series of faculty speakers who talked about their career fields and their research. Although these guest lectures represented a more vicarious exposure to various career fields, the students did have the opportunity to ask questions to the speakers and have direct interactions with them. After each of the four class periods devoted to guest speakers, students wrote reaction papers with the goal of reflecting on what they liked and did not like within the speakers' lectures (i.e., reflective observation) and considering whether the speakers' careers could be a good fit for them or were worthy of more exploration (i.e., abstract conceptualization). The faculty speakers also hosted lab visits during which students could gain firsthand experience of research tasks within certain fields. Students could select which labs they wanted to attend (i.e., active experimentation) and their experience in the labs serves as another concrete experience. The lab visits varied with regard to what the faculty researchers and their lab assistants chose to include within the experience; some researchers provided a facility tour and demonstration of equipment within the lab, whereas others provided a hands-on activity for students that related to the research within the specific discipline. Students engaged in reflections about the labs and used what they learned in their experience as they made decisions about majors. The goal of the study

was to better understand how students' individual experiences with the faculty speakers and lab visits did or did not help them in selecting a major. As such, Kolb's model may provide insight on their individual processes.

Review of Relevant Literature

Parks, Rich, and Getch (2012) explained the importance of experiential learning opportunities in career development and exploration, as these experiences help students visualize themselves in a career. First-hand exposure to tasks related to a profession builds self-efficacy, which also factors into selecting one's preferred work environment (Bandura, 1997). In one qualitative study of a STEM recruitment program, students reported that early exposure to research labs was a positive experience that bolstered their interest in STEM fields and allowed them to build valuable skills that they would use later in their undergraduate programs (Schneider et al., 2015). Previous research has shown that students who were part of a research early in their undergraduate careers were more likely to be retained in STEM (Bahr & Norton, 2006; Balster, Pfund, Rediske, & Branchaw, 2010; Hathaway, Nagda, & Gregerman, 2002). However, each of these studies explored students who had already declared STEM majors and were engaged in more long-term research projects.

Balster et al. (2010) noted that students may struggle with starting undergraduate research, particularly with identifying a research mentor. Schneider et al. (2015) posited that students engaging with faculty members and being exposed to their research early in their undergraduate careers positively impacts retention in STEM fields. In addition, engaging with STEM faculty members and participating in research can be especially valuable for racial and ethnic minority students and female students (Foltz, Gannon, & Kirschmann, 2014; Gayles & Ampaw, 2014). However, these studies did not investigate the in-depth experiences of these students to ascertain why these activities were meaningful.

Whereas the literature is rife with studies touting the benefits of undergraduate research experiences and faculty engagement for students majoring in STEM (Foltz et al., 2014; Gayles & Ampaw, 2014; Schneider et al., 2015), there is a dearth of literature investigating these same activities with non-declared and undecided students who are considering STEM majors. The lack of research conducted regarding these opportunities warrants further investigation, particularly related to the value and meaning that students may or may not find in these activities. As such, we aimed to explore preliminarily the experiences of first-year undergraduates with faculty guest lectures and research lab visits, which are part of a STEM-focused career planning class. More specifically, we were interested in how these experiences may have informed students' career decision-making.

Methods

Research Design

We utilized qualitative phenomenology as the framework for the current investigation. The purpose of phenomenological research is "to describe the depth and meaning of participants' lived experiences" in regard to a particular phenomenon (Hays & Wood, 2011, p. 289). The phenomenon being explored was the experiential learning components (STEM faculty guest

lectures and STEM lab visits) of a STEM-focused career planning class. In essence, we wanted to understand students' reflections on if and how these experiences informed their career decision-making as it pertained to selecting a STEM major. We interviewed participants in a focus group because this format provided an avenue for open discussion of a topic while gaining insight on possible group consensus (Creswell, 2013; Morgan & Krueger, 1993); moreover, focus groups can help facilitate "indefinite triangulation" of data (Frey & Fontana, 1993, p. 24). Morgan and Krueger (1993) also recommended focus groups as a means of data collection when there is a distinct power differential between participants and the researcher.

The Living Learning Community

The living-learning community (LLC) of which the participants are members was funded through the National Science Foundation and is operated within a large urban university in the Southeastern United States. The LLC is a STEM recruitment and retention program that aims to increase the number of STEM degree recipients by (a) recruiting undeclared first year college students with Math SAT scores of 550 or higher; (b) enroll students in a career planning class specific for STEM explorations; and (c) engaging these students in retention efforts towards successful degree completion (Dagley et al., 2016). The primary intervention of the program is the STEM-focused career planning course, which aims to help students who have not yet solidified their undergraduate majors but have at least a minimal interest in pursuing a career in STEM. Prior research on this particular course has established its efficacy in helping students become more solidified in their decisions about majors and careers (Belser, Prescod, Daire, Dagley, & Young, 2017; Belser, Prescod, Daire, Dagley, & Young, 2018; Belser, Shillingford, Daire, Prescod, & Dagley, 2018; Prescod, Daire, Young, Dagley, Georgiopoulos, 2018).

The career planning course was divided into three phases. In the first phase (about five weeks), students took a series of career assessments to build a personal profile, including interests, career values, motivated skills, personality type, and levels of negative career thinking. During this phase, the course instructor and the course teaching assistants engaged students in conversations to help them better understand their assessment results. The second phase of the course (about four weeks) included the faculty presentations and research lab visits that were the subject of this inquiry; students heard from all of the guest speakers and then had the opportunity to select which lab visits to attend. As with the first phase involving career assessments, the students participated in small group discussions after the faculty presentations and after the lab visits to help process their experiences and relate them back to the career assessment results. In the third and final phase (about five weeks), the course instructor helped students use the information gained from the assessments and their learning about the STEM world of work from the faculty presentations and lab visits to make decisions about a major and to action plan for their time in college. This final phase involved conducting an informational interview in a field of choice, drafting a resume and cover letter, developing a detailed career action plan, and researching majors and careers of interest. In the final week of the course, students presented their career action plans and major decisions to their peers in the class.

Sampling

We used purposeful sampling to obtain focus group participants (Creswell, 2013). All 71 students who had been enrolled in a STEM-focused undergraduate career planning course during

the 2014-2015 academic year were invited. Of the 71 potential students, 45 identified as White, 10 identified as Hispanic, 9 identified as Black/African American, 4 identified as Asian/Pacific Islander, and 3 identified as other; in addition, 39 were male and 32 were female, with an mean age of 18. Our participation criteria included recent enrollment in the career planning course and selection of a STEM major. Recruitment procedures included sending email invitations, posting flyers in the students' tutoring center, and word-of-mouth advertising in the students' math courses. As an incentive for participating, we provided dinner for those who participated.

Our sampling methods yielded seven participants for the focus group, including four males and three females; the total number of participants in the study was within Polkinghorne's (1989) recommendation of 5 to 25 participants for phenomenological research. All participants were still in their first year at the university and ranged in age from 18-19 years-old. Three identified as Hispanic, two identified as White, and two identified as African American. At the time the participants were enrolled in the course, they had not yet decided on a major, but by the time of this study, the participants had declared majors. Their intended majors included Biology, Mechanical Engineering, Industrial Engineering, Aerospace Engineering, and Computer Science.

Procedure

This investigation was covered under the university's institutional review board (IRB) approval as part of a larger federally funded research project. As stated earlier, our primary data collection method was a focus group interview. Prior to the start of the focus group, participants completed an anonymous demographic questionnaire. The focus group facilitator, who was not a member of the research team and who had no prior contact with the participants, followed a semi-structured interview protocol with five open-ended questions: (a) What aspects of the faculty guest lectures were most meaningful to your career decision-making? (b) What aspects of the faculty guest lectures were least meaningful to your career decision-making? (c) What aspects of the research lab visits were most meaningful to your career decision making? (d) What aspects of the research lab visits were least meaningful to your career decision making? and (e) What other comments do you have for the leaders of this program? The facilitator also used follow-up questions throughout the interview to clarify participants' responses and elicit additional information. The interview lasted approximately one hour and was audio-recorded.

Three researchers transcribed the recording and reviewed the completed transcript for accuracy. The first and second authors individually reviewed the transcript to identify emerging codes and then came together to discuss which codes should be collapsed or condensed, allowing for consensus on the final codes (Glesne, 2006). Each code was a word or phrase that captured the meaning of a statement or passage from the transcript (Creswell, 2013). We then drafted operational definitions for each code and cross-referenced the codes to passages in the transcript. Once completed, the first and second authors individually reviewed the codes along with the transcript to group codes into broader themes. As with the coding process, we met together to discuss and reach consensus about the identified themes and to draft operational definitions of each theme. Three of the researchers reviewed the transcript, codes, and themes for accuracy.

Trustworthiness

The researchers took multiple steps to ensure trustworthiness of the current study. First, bracketing prior experiences and assumptions is crucial to phenomenological research (Creswell, 2013; Gall, Gall, & Borg, 2007; Hays & Wood, 2011; Moustakas, 1994). All members of the research team drafted individual positionality statements before beginning the research project to document these prior experiences and assumptions (Maxwell, 2013). For example, two researchers discussed their experiences as instructors for the career planning course and how this may have informed their analysis of the data; additionally, four researchers had prior contact with the study participants in the career planning class. We revisited these assumptions during data analysis and employed additional methods to increase trustworthiness.

We built steps to ensure trustworthiness into the design and implementation of the focus group, as well as in the data analysis process (Creswell, 2013; Gall et al., 2007). The lead researcher drafted and revised the focus group questions after members of the research team reviewed them to ensure that they could be easily understood and did not imply bias. Because all members of the research team either had prior contact with the participants or were part of the recruitment program in which the participants were enrolled, we chose to have the focus group led by a doctoral student who had no prior contact with the students or with the program; the use of an external interviewer was explained to participants during the recruitment process and prior to the start of the focus group. After the completion of the focus group, three members of the research team compared the interview recording with the transcript to ensure accuracy. The first author sent the focus group transcript to the seven participants via email to as a form of member checking. Also, the other members of the research team who were not involved in data analysis reviewed the identified codes and themes with the transcript as an additional check.

Results

During our data analysis, we identified 13 significant codes within participants' responses in the transcript. When we reviewed and group the codes, six key themes emerged regarding participants experiences with the faculty guest lectures and the STEM lab visits. Three themes (Broadened Understanding of Options within STEM, New Information Helpful with Decision Making, and Students Impacted by Faculty Passion) related to more positive or meaningful experiences students had, whereas one theme (Provided Narrow View of Specific STEM Fields) related to more negative experiences described by students. Two themes (Students Best Engaged through Hands-On Experience and Overall Meaningful, yet Imperfect, Experience) related more to students' feedback about the structure of the guest lectures and lab visits. Table 1 displays the final Themes and Coding Categories derived from the data.

Table 1: Themes and Codes

Themes	Codes
Broadened Understanding of Options within STEM	Broad/wide range of STEM fields Provided practical knowledge and information about STEM fields Interdisciplinary collaborations emphasized

New Information Helpful with Decision Making	Informed major decision making Sparked an interest
Students Impacted by Faculty Passion	Presenting with enthusiasm Passion for career field
Students Best Engaged through Hands-On Experience	Hands-on activity was meaningful Experience was engaging
Provided Narrow View of Specific STEM Fields	Some desired STEM fields were not included Content focused on advanced information rather than introductory information
Overall Meaningful, yet Imperfect, Experience	Feedback for faculty Course content valuable

Broadened Understanding of Options within STEM

Throughout the focus group interview, students discussed gaining knowledge about a variety of STEM fields and/or the interdisciplinary nature of working in STEM. Additionally, the participants referenced specific faculty presentations and lab visits that helped them learn more about the world of work within STEM. Specific categories that emerged within this theme were (a) Broad/wide range of STEM fields, (b) Provided practical knowledge and information about STEM fields, and (c) Interdisciplinary collaborations emphasized. Each category is discussed in the following sections.

Broad/wide range of STEM fields. Three participants discussed the completeness of what fields of study within STEM were presented to them during the guest lectures and through the lab visits. Participants majoring in engineering primarily expressed this sentiment, due to the various sub-disciplines within engineering that were represented; these students also acknowledged other disciplines, such as biology and chemistry, being represented.

I did learn a lot and there were a lot of different...there are like a lot of different types of engineering, so like they had to have like...they had to have civil and mechanical and like aerospace or whatever. And there were like some biology like, at least one, at least one for sure and...um...I thought he was good. He told me a lot about like biology, like things like, he had me think of things I hadn't like thought of before. (White male, 18 y.o., Mechanical Engineering)

I would have to agree with that. Um, in the fact that there are a lot of types of engineering, so I think it's almost necessary to have multiple lecturers or...um...yeah, guest lectures on...um...different types of engineering that we can get an understanding of what kind of engineering you want to do rather than just like... Okay I want to do engineering, but I don't know what kind. So that's why I think there has to be multiple different types of engineering lecturers. And...um...I think it was well-rounded because

there were, like we've mentioned, um... biology and chemistry...um...lectures. (White male, 18 y.o., Industrial Engineering)

These quotes are representative of participants' overall notion that the guest presenters did cover a wide variety of STEM fields and that this helped them learn about and consider fields they may not have previously considered. Participants with majors outside of engineering acknowledged the diversity in presenter disciplines, especially related to engineering, but also shared contrary opinions that will be discussed within a later category.

Provided practical knowledge and information about STEM fields. All of the focus group participants also discussed gaining new knowledge about the contents of particular fields. This was particularly evident through students sharing how they learned new information about a field of interest or about a previously unfamiliar field, such as industrial engineering, which was an almost unanimous example of the latter. Participants also discussed gaining knowledge about the STEM world of work, particularly related to tips and strategies that the guest lecturers mentioned about how students can set themselves up to be successful in STEM fields. One primary tip that multiple students discussed was the importance of gaining experience early.

Some of them, some of them more than others kind of showed me that it's not so much about your educational background as much as your experience and like, you don't have to like have a doctorate degree to be successful if you have like, you know, if you have...uh... experience behind you like in a job or in some kind of...I don't know... internship or researching. (Hispanic female, 19 y.o., Biology)

The students reported finding meaning in the real-world information that they gained from the guest lectures and lab visits. For some students, actually seeing the research labs helped them conceptualize what individuals in that field might actually do.

I went to the physics lab with Dr. Colwell and the chemistry lab with um...yeah and the civil engineering lab and they were all really cool and I think I learned a lot about what they do day to day more so than I did from the lectures. (White male, 18 y.o., Mechanical Engineering)

Both of these quotes illustrate the nuanced information that participants were able to gain about each field that came as a result of interacting with professionals in the field, rather than simply reading about the field in a print or online resource.

Interdisciplinary collaborations emphasized. Three participants commented on learning about interdisciplinary work and research within STEM, noting that the faculty members helped them understand how STEM fields are related and how STEM fields work with other STEM fields and with non-STEM fields.

Some of them touched on what are the interdisciplinary parts of STEM majors, in which, like, for example, the game design field that I want to go into...um...some of the stuff that they work on also can cross into the biomedical industry (African American female, 18 y.o., Digital Media—Game Design / Computer Science)

Students also appreciated learning about new initiatives driving interdisciplinary work among STEM professionals. One student noted,

I feel like I learned a lot of different things from them, which I like. Not only seeing an individual field and learning about so many things, but I learned like the importance of being like interdisciplinary. (Hispanic female, 19 y.o., Biology)

For participants, learning about relationships between STEM fields and interdisciplinary work helped them see that deciding on a STEM major does not confine them to one field or type of work due to the many ways to collaborate with other STEM fields.

New Information Helpful with Decision Making

Illustrating the second theme, six students noted the impact of the faculty guest lectures and lab visits on their major/career decision making and/or described their experiences as eye opening or helpful. Some students were able to use their new knowledge to confirm a major they were previously considering, to narrow down major options, or to select a major. Codes that emerged were (a) Informed major decision making, and (b) Sparked an interest.

Informed major decision making. Five students revealed that the guest lectures and/or lab visits informed their process of selecting a major. For some students, these opportunities helped them explore potential majors and rule out others:

So I think it was a very... it was very worth my time taking that class and seeing what I would like to do as my major. (White male, 18 y.o., Industrial Engineering)

And even if they weren't exactly relevant to what you wanted to do, it was good to know what it was to make sure it was something you didn't want to do or wanted to do. (Hispanic male, 18 y.o., Mechanical Engineering)

For other students, the guest lectures and lab visits reaffirmed what they previously believed about majors they had been considering, especially because of having access to people to whom they could directly address their questions.

Oh Dr. M [alias] did because she is mostly tied to animals and what she does is tied to conservation so it kind of reassured what I wanted to do maybe if I do want to do research. So it reinforced what I had already known. (Hispanic female, 19 y.o., Biology)

These three quotes represented the group's overall consensus that meeting the STEM speakers and visiting research labs gave them a much more up close look at each field, which in turn helped them decide if the field could be a good fit or not.

Sparked an interest. Four students highlighted specific moments that were meaningful or that sparked an interest. For some students, this moment was learning about a new major that grabbed their attention, whereas for others, it was a moment within the research lab.

When [the computer science professor] started talking about...um...not just his computer science research as a whole, but his gaming research... like that was really my aha moment. Like, I loved everything he said. I was very enraptured. (African American female, 18 y.o., Digital Media—Game Design / Computer Science)

When I heard the guest lecture about industrial engineering, it really made me think like, “Wow! I really want to do this.”... And I went to her lab, and it was like, “Wow! I still really want to do this.” (White male, 18 y.o., Industrial Engineering)

These two quotes illustrate this category well. From the experience of hearing from STEM faculty and visiting their labs, students had “aha” moments in which they were able to see a field of interest in a new and exciting way or were able to learn about fields they found particularly interesting yet had no prior knowledge.

Students Impacted by Faculty Passion

At various points during the focus group, students discussed the positive impact of seeing how much the faculty members enjoyed their work. For students, this demonstrated the possibility of STEM professionals being satisfied working within their discipline. Categories that emerged were (a) Presenting with enthusiasm, and (b) Passion for career field.

Presenting with enthusiasm. The students appreciated the enthusiasm for their work that the faculty members displayed. Witnessing this enthusiasm was exciting, helped build interest around a particular field, and kept students interested during the lectures and lab visits.

I think the industrial engineering lady—I had never heard of industrial engineering before that—but she just made me so excited and interested in the subject. Like, when she first came on and started talking, I was like, “Why is this lady so happy?” (African American female, 19 y.o., Biology)

In contrast, those faculty members who did not present with enthusiasm were not highly regarded by the participants. Because the guest speakers were, for some participants, the first professionals they had encountered in certain fields, the presenter’s level of enthusiasm impacted students’ first impressions about the field; enthusiastic presenters left a stronger first impression.

Passion for career field. Participants found it particularly meaningful when the faculty members (or their graduate students) demonstrated passion for their field and their research. To students, this indicated that faculty members liked what they do and enjoyed discussing it with students. The following quotes help illustrate participants’ reflection on the faculty members’ passion:

So it was good that I could see him being passionate and teaching and doing something that he was interested in that I could be interested in, and it confirmed my suspicion that it was a good choice of field to go into. (White Male, 18 y.o., Mechanical Engineering)

I don’t really think the content of the lab influenced me. I think more so the passion of the people in the lab influence me more. Like I went to the chemistry lab and the

professor or doctor or whatever wasn't there but his graduate student assistants were there. And like one thing I could tell about them is they were so passionate. (African American female, 19 y.o., Biology)

Participants noted that meeting people who were passionate about their field helped them look beyond whether they were just interested in a field to whether they could possibly be happy in a field.

Students Best Engaged through Hands-On Experience

From students' responses, the structure and format of each lab visit was different, with some emphasizing an active learning approach and others simply providing a tour and a talk. When students discussed their lab visit experiences, they described labs that had a hands-on activity as meaningful, whereas labs without a hands-on activity were not meaningful. Resulting categories included (a) Hands-on activity was meaningful, and (b) Experience was engaging.

Hands-on activity was meaningful. Four students recalled specific activities from the lab visits that were meaningful. Typically, the labs that involved an activity were recounted in more detail. Referring to a forensics lab visit, one student added,

I thought when he had, like, three experiments that we could do—like testing samples for blood, seeing if what was contained on the napkin was blood or if it was like Kool-Aid or something. And like, using certain chemicals that would, um, read back on a pH strip, um, and seeing what the sample is based on the results. I thought that was cool. (White male, 18 y.o., Industrial Engineering)

Another student described a computer science lab that included multimedia and active learning:

They showed us a video which I felt really in tune to because it was basically talking about everyone who was a programmer for a STEM major and the programming side and stuff like that. And I felt really in tune to that video and it was very nice um, but then after that they took us to a back room where they do their AI research and code the robots and everything, and I loved that because I like the AI game. (African American female, 18 y.o., Digital Media—Game Design / Computer Science)

Other lab visits that did not include a hands-on activity were not highly regarded by students. Some labs substituted another lecture about the profession for an activity, and students did not appreciate another rehashing of similar information.

I think it was more like, 'Who has questions?' So we barely got to see even what they do in the labs, the graduate students. It was just... It wasn't helpful. (Hispanic female, 19 y.o., Biology)

Everyone at the lab kind of made a consensus that he was boring. (Hispanic male, 18 y.o., Mechanical Engineering)

The four quotes show that students went to the lab visits hoping for a meaningful experience that would help them get a better understanding of what people in the field actually do. Lab visits that accomplished this goal were appreciated, but lab visits that did not provide a concrete experience left students with more questions or disinterested in the field.

Experience was engaging. Multiple participants commented that the guest lectures and lab visits were interesting and engaging. Students particularly found the lab visits enjoyable. One student spoke of his experience with a professor from the discipline he ultimately chose:

I actually stayed after in her lab and I had her explain to me what that formula meant and I was really intrigued. I was like wow, how can you take certain variables and put them in an equation and have that relate to real life and life situations and time. Like real time affecting certain outcomes. I thought that was just mind-blowing. That was so cool.
(White male, 18 y.o., Industrial Engineering)

In this example, the student connected with the faculty member and with the material and developed a curiosity to learn more about the field. Multiple students reported a similar experience in which they saw their field(s) of interest come to life into something they could see themselves doing.

Provided Narrow View of Specific STEM Fields

One theme that emerged from the data related to students' negative thoughts about their experiences. Whereas students did indicate that the guest lectures and lab visits helped broaden their understanding of options within STEM, some students noted that some STEM fields were not represented during the faculty guest lectures and lab visits. Moreover, some commented that certain faculty members provided more technical information about their research, rather than practical information about their field. The following categories within this theme will be presented in the following sections: (a) Some desired STEM fields were not included, and (b) Content focused on advanced information rather than introductory information.

Some desired STEM fields were not included. As stated, four students asserted their disappointment that some STEM fields were not represented in the guest lectures and lab visits. For some students, these unrepresented or underrepresented fields were the majors or possible minors that they were considering.

So they didn't really talk about medicine at all, which kind of disappointed me, but they did talk about biology a lot, the lecturers that came in, but they talked mostly about research. (Hispanic male, 19 y.o., Aerospace Engineering)

We didn't get to see any, like, mathematical people. Whether it is research or not, like at all, and that's something that I was like thinking of for a while—at least for my major.
(Hispanic female, 19 y.o., Biology)

The participants' comments highlighted their frustration that an endeavor meant to expose them to a broad array of STEM fields left out some significant areas within STEM and overrepresented some other areas.

Content focused on advanced information rather than introductory information.

Five participants commented that the faculty members focused too extensively on their research or other highly technical aspects of their fields, rather than basic information that would help students make a decision about their major. For many of them, conducting research is not their primary goal in selecting a STEM major.

When the biologist came up, I was like, ‘Yeah, someone’s gonna talk about what I want to know about.’ And she just talked about her disease research. So at first, it was a little bit interesting, but it just went on and on and on. And I’m definitely not interested in the research part of biology... So probably the most meaningless thing for me was hearing about all these people go on and on about their research. (African American female, 19 y.o., Biology)

I was like leaning more towards medicine at the time, and I remember thinking to myself that most of the guest lecturers only talked about their research. They didn’t talk about practice. (Hispanic male, 19 y.o., Aerospace Engineering)

Similar to the previous category, students did not appreciate that faculty members emphasized their specific research instead of providing a more generalized overview of what someone does in their field. A common complaint was that students wanted more real-world applications presented in a manner that is accessible to someone not already in that field.

We would just like to know what typically you would do in that field, rather than what you do to try and get in that field as in research. (White male, 18 y.o., Industrial Engineering)

To this day, I still don’t know what an aerospace engineer does actually. Like, on a day-to-day basis, or a mechanical engineer, or an industrial engineer. I wanna know what they do, like, do they go to any office? Or are they outside? Are they...what are they looking at, what are they doing? I don’t know that. (Hispanic male, 18 y.o., Aerospace Engineering)

She was talking about like how giving an example of Uber and how you could calculate how far you’re traveling or which person is the best driver, what price you should charge them if you’re getting groceries or whatever...some kind of mobile app. She was like writing a formula on the board. That was probably the least helpful because I didn’t really understand any of those things in the formula...I don’t know. It wasn’t numbers, it was some type of engineering formula I did not understand. (African American female, 19 y.o., Biology)

For participants, the guest lectures were an opportunity to hear a general introduction to different fields and then an overview of the faculty members’ specific roles in the fields; however, because presenters’ shared more about their individual research, students did not get a good sense of what some fields look like on a broader scope.

Overall Meaningful, yet Imperfect, Experience

The final theme that emerged from the data related to students overall reflections on their experience and the feedback they would give to those in charge of the program. Students discussed areas for improving the experiential activities but noted that the experiences and the course overall were meaningful. Categories that emerged were (a) Feedback for faculty and (b) Course content valuable.

Feedback for faculty. Four participants indicated they would like to hear more general information about the different STEM fields and less about individual faculty members' research. Students also advised program administrators to invite a wider variety of STEM professionals, such as more representatives from the workforce and more from fields that were not included.

Stop focusing on engineering so much—no harm to engineering students, but it's a STEM program. So there's like science, technology, engineering, and math. I would like some more science especially, but at least throw in some more S, T, and M in there!
(African American female, 19 y.o., Biology)

So if they're gonna have guest lectures, then advise them to be a lot more broad, um, within their presentations about what they're talking about. Because we don't know not only what they do, but what leads up to their career, like their education and stuff like that. All of this stuff we have to, to make a decision, we have to research on our own, and that information is not easily accessible. (Hispanic male, 19 y.o., Aerospace Engineering)

Kind of stress to the professors the importance of not focusing too much on the research and, you know, going out of their way to actually go see what their field would be like.
(Hispanic male, 18 y.o., Mechanical Engineering)

Participants' feedback for faculty reiterated various points about fields that needed to be included and what information would be most helpful for presenters to include.

Course content valuable. Five students noted that the career planning class was a useful supplement to the information presented by the STEM faculty members, and in some ways class activities were more helpful than the experiential activities.

I've decided my major now, and I'm definitely not going to change it. But looking back, it [the lectures] didn't really help me much other than just gaining knowledge of what the... what those people did cause I also didn't know what an industrial engineer did. I didn't know what a civil engineer did, and now I know, but didn't really help my decision all that much. Other aspects of the class did. (Hispanic male, 19 y.o., Aerospace Engineering)

I think overall it was, like, the class was successful in what it was trying to do. And like, even if there were some problems with like the lectures and the labs and everything like that, like overall it's- it's still taught me a lot more. (White male, 18 y.o., Mechanical Engineering)

Other students agreed that they were grateful for the information and experiences they did get through the career planning course.

Discussion

Our data analysis revealed six key themes: (a) Broadened Understanding of Options within STEM, (b) New Information Helpful with Decision Making, (c) Students Impacted by Faculty Passion Students, (d) Best Engaged through Hands-On Experience, (e) Provided Narrow View of Specific STEM Fields, and (f) Overall Meaningful, yet Imperfect, Experience. In general, participants described their experiences as positive and meaningful, such as learning about new fields of study, having an engaging experience within a research lab, and hearing from professionals who are visibly passionate about what they do. Additionally, these experiences, after reflection in class, helped students with their major selection and career decision-making processes, in that they identified which majors and careers might be a good fit for them and which might not be a good fit. This notion was in line with research by Parks et al. (2012) indicating that experiential or action-oriented learning can increase one's efficacy for a given profession; however, with the present study, the participants were not using these experiences to confirm their major selection, but rather to help them choose a major.

The participants' experiences support our framework of viewing the faculty guest lectures and lab visits as two different cycles through Kolb and Kolb's (2008) Experiential Learning Model. The guest lectures first served as a concrete, albeit passive, experience that provided students with knowledge about various STEM fields. The reflective observation and abstract conceptualization phases occurred through the students' engagement with in-class and written reflections, as well as their own introspection about what they liked and didn't like about each speaker. Based on these reflective activities, students were able to decide if they enjoyed the presentation enough to attend a lab visit where they could learn more about the field (i.e., active experimentation). The students' critiques of the guest lectures indicated that getting a broad overview of each field and then some specifics about each faculty member's work would be most helpful in the process. Additionally, when students did not see certain STEM fields represented, they were not able to engage with those fields in the same experiential manner as they were with others.

Similarly, the active experimentation phase from the first cycle led students to another concrete experience—the research lab visits. Again, the structure of the class provided an opportunity for written and discussion-based reflection on what they liked and did not like and whether or not they could see themselves entering each field. Because students had already chosen which labs to attend based on hearing an introduction to various STEM fields from the guest lectures, participants did not mind that lab visits were more specific and grounded in faculty members' research activities. In fact, faculty members who engaged students in a hands-on activity related to their research actually were described as more helpful in this phase. Finally, based on students' statements, the active experimentation phase in this cycle related more to selecting a major, with some students gaining enough information from both experiences to make a decision and some needing more information before being able to choose a major.

Whereas the reactions to different faculty members were mixed, students expressed an overall appreciation for gaining new information and first-hand accounts about career fields that they would not have received from a print or online career resource. This idea supports McAuliffe's (2011) position that learning often begins in the concrete phase of Kolb's (1984) experiential learning model. Participants appreciated gaining basic information from both experiences as this helped them expand their knowledge of and clarify misconceptions of certain STEM fields and make a more well-informed evaluation of that field. This builds upon prior research indicating that connections with STEM faculty members, especially with regard to their research, positively supported students' retention in STEM majors (Foltz et al., 2014; Gayles & Ampaw, 2014; Schneider et al., 2015). In the case of this study, it provides preliminary support extending the benefits of engaging undergraduates with STEM faculty beyond improved retention in STEM majors also to the process of recruiting and capturing students into these majors.

Our findings also have implications for programs aimed at recruiting and retaining students in STEM disciplines. As mentioned, experiential learning components can be a valuable addition to these programs (Schneider et al., 2015). However, the participants shared that certain qualities can make these experiences more valuable, whereas other qualities detract from the value of the experience. Specifically, students were satisfied when an array of career fields were represented and were dissatisfied when there was not a representative from their career field of interest. In creating similar programs, administrators should seek to ensure that faculty members or professionals from a wide variety of STEM fields are included. Moreover, students appreciated when the faculty members provided practical information about both their respective fields (e.g. day-to-day tasks) and their research projects, instead of presenting primarily on their research projects. Based on the overall findings from participants' experiences, we have concluded that these activities may work best if students first get to hear from a comprehensive set of presenters who can provide a general overview of a wide array of STEM fields. The research lab visits can then serve as an opportunity for students to get more in-depth knowledge or engagement with fields of interest.

Our findings were similar to that of Schneider et al. (2015), in which STEM undergraduates claimed that exposure to research was meaningful but could become overwhelming. As the participants in the present study were undecided about their future majors, learning about research was helpful but took time away from them learning more details about the various professions and disciplines, which was the students' primary purpose for being in the career planning class. The lab visits that students completed were meant to expound upon the faculty members' discussion of their research by bringing it more to life within its natural setting. Students provided more positive reviews of lab visits with a hands-on activity that helped students see what happens in a research lab within a specific field; this may speak to Bandura's (1997) assertion that first-hand experiences support self-efficacy and students' ability to visualize themselves in a career. However, whereas exposing undergraduates to research can aid in retention in STEM majors (Bahr & Norton, 2006; Balster, Pfund, Rediske, & Branchaw, 2010; Hathaway, Nagda, & Gregerman, 2002), lab experiences that are disorganized, not meaningful, or too technical for students not currently STEM majors may convolute the career decision making process or turn students off to fields altogether.

Limitations

As a small phenomenological investigation, this study did have several limitations. One is the potential for researcher bias, especially since multiple members of the research team were directly involved in teaching the career planning class in which participants were enrolled; however, to mitigate the potential effects of these circumstances, the research team took numerous steps to bolster the trustworthiness of the study. Although the number of participants fell within recommendations by qualitative experts, having only seven participants was a limitation to our ability to ascertain a holistic perspective from our participants. Another key limitation is that the participants in the study only recently engaged in the experiential learning activities in question. As such, the students were only able to speak to how these experiences related to their recent decision making process and not about whether they stuck by that decision over time.

Conclusion

The current investigation examined the experiences of first-year undergraduate students participating in a STEM recruitment program at a major research university. Specifically, we sought to understand how the students' experiences with STEM faculty guest lectures and STEM research lab visits related to their process of selecting a STEM major and career path. Through a focus group interview, participants revealed that these experiences were meaningful and did help them with selecting a major but that certain aspects of these activities limited what they gained from participating. We related our findings to previous research on experiential learning in career decision making and presented implications for similar STEM recruitment programs.

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