Undergraduate Women in the STEM Fields and the Use of Academic Library Resources and Services

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Degree

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Dedication

This dissertation is dedicated to my Grandmother Caesar Shields Barrington. I remember the times when she would read to me as a small child and the set of Sesame Street books that she gave me. While it has been over two decades since she passed, I still remember how much value she placed on learning how to read and education. My grandmother was the one who helped to build a strong foundation for me by reading to me and giving me books to read. It is partly because of her that I love libraries and being around books to this day. This dissertation is dedicated to her and I know that she would be proud of me.

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Abstract

Women majoring in the Science, Technology, and Engineering and Mathematics (STEM) fields are few in number. This research will be conducted in an effort to understand the use of academic library resources and services by undergraduate women in the STEM fields. Data collection methods consisted of three focus groups and five interviews with undergraduate women in the STEM fields, and three focus groups and two interviews with academic librarians and library staff familiar with library resources and services in each of the STEM fields conducted at a Research Intensive University in the USA. Grounded theory principles provided a basis for the analysis of the collected conversations. The findings from this study indicate that the academic library is providing support to undergraduate women in STEM because they depend on and use the physical space. However, the undergraduate women in STEM want more support from faculty and staff in their departments. A collaborative effort is needed from the undergraduate women in STEM, faculty and staff and the librarians in order to provide the support that is needed.

Keywords: STEM, women, underrepresented, academic library

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CHAPTER 1

IMPORTANCE OF THE STUDY

Before I could walk into my Honors Algebra II class, I was stopped outside the classroom and the teacher said, “I looked at your record, and I don’t think you should be in this class.” I was absolutely crushed and honestly do not remember what happened the rest of the day. This was just the second week of classes my junior year in high school, and I thought I was keeping up. I did well in Algebra I and Geometry, so I thought that I would take Honors Algebra II since my other classes were honors classes. Of course, I knew that math was not my strong subject because I had struggled with math, but I never let that stop me because I have always been determined to face any challenge in front of me. Naturally, I told my parents what the teacher said. They had a conference with her, and I was removed from her class. That episode happened to be a blessing in disguise because I was reunited with my Algebra I teacher who rapped about math, making it exciting. She was a tough teacher, but also excellent at teaching math; and I excelled in her class. To this day, I remember this inspirational teacher.

Two years later, my younger brother happened to be in Honors Algebra II with the same teacher; and when my parents went to the school for parent-teacher conferences, she was surprised to learn that we were related. My younger brother has always been better at math than I and probably always will be; but I am able to accept that fact and move on. Yet, I still do not know why that teacher decided to pull my record and confront me. Maybe it was because I did not raise my hand to answer a question; but to be honest; I rarely did in any class even if I knew the answer. Maybe the teacher thought I would not be successful in the class. I have no clue, and I have never been one to over analyze a situation. However, I do know that approaching a student in that manner is unacceptable. I mention this incident because women are discouraged

early on from entering into science, technology, engineering, and mathematics (STEM) fields before even enrolling in college. While that experience was not the reason I did not major in a STEM field, it does come to mind when I read about how girls are often discouraged from pursing STEM majors.

Purpose of this Study

STEM, which is the acronym for science, technology, engineering and mathematics, was first coined as an educational term by the National Science Foundation in the early 2000s (Dugger, 2010). For the purpose of this study, agriculture is included because the majority of agriculture majors take science and technology courses. *Agriculture* is defined as "the art and science of cultivating the soil, growing crops and raising livestock" (National Geographic, 2007, para 1). This study specifically focuses on the role of academic librarians and whether they can provide support for undergraduate women in STEM. Research in this area is lacking but is needed because women are needed in the STEM fields to provide their opinions, voices and expertise. Furthermore, women need more support in the STEM fields, and that support needs to come sooner rather than later. Women are often less likely than men to have a strong mentoring experience, a problem when trying to recruit and retain women in STEM (Gadek, 2013). Mentorship plays an extremely important role in increasing the number of women in STEM and keeping women engaged in the growing number of job opportunities available in the STEM fields (U.S. Department of Education, 2013). Women need not only mentors but also role models so they can see that there are women in the STEM fields who are working professionally (Brury, Siy, & Cheryan, 2011). The academic library is place where students, including undergraduate women in STEM, can receive technical support; research support; and to some extent, academic

support. This study's findings provide more insight into what academic libraries and librarians can do to support undergraduate women in STEM.

Problem Statement

Underrepresentation of Women in the STEM fields

Women and minorities are less likely than males to pursue an undergraduate degree in STEM (National Science Board, 2007). Differing educational backgrounds plays a role in college freshmen making undergraduate choices, as well as their ability and desire to persist in a STEM major (Griffith, 2010). The number of STEM degrees awarded to women and racial/ethnic minorities continues to be relatively low, which is an issue considering the anticipated growth of job opportunities (Perna et al., 2010). For reasons of global competitiveness and social justice, higher education institutions must make more of an effort to recruit and retain women and racial/ethnic minorities in the STEM fields. (Lewis, 2001). Since women and racial/ethnic minorities are underrepresented in the STEM fields they are also missing out on potential career opportunities.

The underrepresentation in STEM is the biggest issue women face when pursuing leadership positions in the United States, and this gender gap has been obvious for decades (Charles and Bradley, 2002; England, 2010; NAS 2005). Gender disparities have been extremely evident in engineering, physical science, and computer science, which are areas that the U.S. government has recognized as needing to improve in terms of innovation and competitiveness (Goan, Cunningham, & Caroll, 2006). The disproportionate gender gap in STEM is evident not only at the professional level but also with students receiving undergraduate degrees in STEM (Huang,

Taddes, &Walter, 2000). Focusing on the gender gap in STEM, Xie and Shauman (2003) found that

> while many have wondered why U.S. women continue to shun certain STEM fields, it is essential to understand what characterizes the process of the attainment of a STEM Baccalaureate, which is strategic focus, 'given that the undergraduate STEM education is viewed as the latest point for a standard entry into STEM (as a profession)' (p. 96).

Setting the Context

According to the U.S. Bureau of Labor Statistics, Science, Technology, Engineering, and Mathematics (STEM) fields are expected to add 2.7 million new jobs by 2018, an enormous prospect for those who are prepared and a huge missed opportunity for those who are not. According to Leary (2012), improving STEM education specifically in the United States became a priority for the government after the release of the 2005 congressionally mandated report, "Rising above the Gathering Storm." In the 2010 follow-up report, the National Academy of Engineering and the Institute of Medicine noted that underrepresented women and racial/ethnic minorities in the STEM fields includes large group of Americans that could fill upcoming job openings in the STEM fields.

Women could benefit from new job opportunities in STEM, but the problem is recruiting and retaining women so that they will be able to bring creativity and competitiveness to the workforce (Del Giudice, 2014). When women are not involved in science and engineering, the experiences, needs, and desires unique to women may be overlooked (Hill, Corbett, & St. Rose 2010). One reason women are needed in the STEM fields is that women might not otherwise get the same quality of health care that men receive (Del Giudice, 2014). For example, men and women who suffer from heart disease exhibit different symptoms; however, when women are treated in emergency rooms for heart disease, they are often misdiagnosed, whereas more testing

for heart disease symptoms are done for men (Fisher, 2010). Since women tend to suffer more from certain medications' side effects, more clinical trials are needed using medications. Women also have suffered disproportionately more side effects from various medications (ranging from statins to sleep aids) because the recommended doses were based on clinical trials that focused largely on average-size men (Fisher, 2010).

Though women are needed in the STEM fields, the pay gap between women and men is often a reason women search for jobs in other fields (St. Rose, 2010). While the pay gap for women in the STEM fields decreased from 59 cents for every dollar earned by men in 1960 to 77 cents in 2008, women are still making less than men (Institute for Women's Policy Research, 2010). According to Pollock (2013,) the average salary of women in the STEM fields is nearly $4,000 lower than men's. Another factor affecting women's salaries in the STEM fields is that men in the science and engineering fields tend to be employed full-time while women are often more likely to take part-time positions or are forced to work outside of their fields because men have the majority of the full-time positions (National Science Foundation, 2004).

In addition to the pay gap, women also have to deal with being outnumbered by men in all STEM fields (Valentine, 2012). Male students are more likely than females to pursue a degree and career in STEM (Valentine, 2012). The gender gap in STEM interest has remained steady for the past two decades and continues increasing at an alarming rate with less than 15 percent of females (compared to 50 percent of males) in high school interested in pursuing a career in STEM (Miller, 2010). Men account for 73 percent of those employed in all science and engineering fields while women account for 27 percent (NSF, 2007). The ratio of women to men in the STEM fields was also noted by the U.S. Department of Commerce, Economics and Statistics Administration in 2009, when there were "2.5 million college-educated working

women with STEM degrees, compared to 6.7 million men" (5). Corbett (2013) focused specifically on women in engineering and found that women accounted for less than 10 percent of those working in electrical and mechanical engineering.

Paradigmatic Approach

Researchers' philosophical assumptions shape the way research is conducted, how researchers view reality, and what can be known about reality (Pinch and Bijker, 1987). The philosophical assumptions of each researcher also determine how a researcher will attempt to test those realities (Pinch and Bijker, 1987). According to Lincoln and Guba (1994), the researcher brings certain assumptions and beliefs from each paradigm to a project with regard to questions about ontology (views on the nature of reality) and epistemology (the nature of the relationship between the knower and what can be known). This study took interpretive approach with the intention of understanding "the world of human experience" (Cohen & Manion, 1994, p.36), suggesting that "reality is socially constructed" (Mertens, 2005, p.12). This study's focus on understanding the experience of undergraduate women in the STEM fields made the interpretivist approach the best to use for this study.

Research Methods

Qualitative research is a term used for investigative methodologies described as ethnographic, naturalistic, anthropological, field, or participant-observer research (Punch, 2005). This type of research focuses on learning about subjects in their natural setting (Lincoln & Guba, 1985). Since data is often gathered through open-ended questions the researcher is an important part of the investigation (Jacob, 1988). Qualitative research's goal is always to give the participants an opportunity to share their experiences and stories (Creswell, 2007).

In an effort to learn about the lived experiences of undergraduate women in STEM, the researcher used qualitative methodologies. This case study involved focus groups and interviews with undergraduate women in STEM and academic librarians and library staff familiar with the STEM library resources and services available for undergraduates. Another method, focus groups are a small group discussion led by the researcher and often used to learn more about participants' opinions related to a specific topic (Berkowitz, 2013). According to Morgan (1997), a focus group lasts an average of 90 minutes and usually consists of 4 to 10 participants. Focus groups help the researcher learn more about the experiences of the participants in a group setting (Patton, 1990). Yet another method researchers use to learn more about participants' experiences is interviews. Individual, in-depth interviews allow the researcher to delve deeply into social and personal matters, whereas focus groups allow the researcher to understand wider range of experiences because the participants are in a group setting (DiCicco-Bloom and Crabtree, 2006).

For this study, three focus groups and five interviews were conducted with undergraduate women majoring in each of the STEM fields. Each focus group consisted of 3 undergraduate women in STEM. Three focus groups and one interview were also conducted with academic librarians and library staff familiar with STEM library resources and services for undergraduates. Each focus group consisted of 4 or 5 academic librarians and library staff. All the focus groups and interviews were digitally recorded.

Historical Perspective of Women in STEM

According to a 2011 report by the Economics and Statistics Administration (EAS), 40 percent (2.7 million) of men with STEM college degrees have jobs in the STEM fields, whereas only 26 percent (0.6 million) of women with STEM degrees have jobs in the STEM fields. In 1976, women represented only 7.5% of faculty in physical sciences and less than 1% in

engineering (Dearman & Plisko, 1979). While women were underrepresented as faculty members in STEM, women's enrollment in undergraduate engineering programs rose in the 1970's and 1980's to a peak of 19.5% in 1994 (Babco, 1994). Though engineering programs saw a rise in the number of women enrolling in undergraduate programs, the number of women earning computer science degrees dropped in the 1980's from 37% to 20% by the 1990's (Einsenberg, 2000). The reason women are underrepresented at the undergraduate level in computer science may be attributed to the fact that at the secondary level girls do not participate in computer science activities as much as boys do (Fisher, Margolis, & Miller, 2000). Theories about the causes for women being underrepresented in STEM have been explored by numerous scholars (Ceci, Williams, & Barnett, 2009). These theories range from biological factors (e.g., effects of the brain's organization, evolutionary pressures, and prenatal hormones) to social factors (e.g., effects of cultural beliefs, discrimination, and stereotypes) (Eals & Silverman, 1994; Finegan, Niccols, & Sitarenios, 1992).Perhaps these theories could shed more light on how to increase the number of women in STEM.

According to Gibbons (2011), scholars should focus their attention on women after they have completed high school to work on increasing the number of women in STEM. Not all women in STEM enroll in four-year degree programs; therefore, attention should also be given to women in two-year STEM programs. In 2007, women accounted for 58% of the total enrollment in two-year degree programs, but only 15% of the A.S. degrees in engineering technology were awarded to women (Milgram, 2010). However, in 2010 women in four-year degree programs earned 18% of the engineering degrees (Gibbons, 2011). While the degrees women earned in two-year programs slightly increased, women are still underrepresented in the STEM fields.

Milgram (2011) asserted women's absence from STEM careers affects those fields because women can otherwise shape and influence the STEM fields by bringing a perspective different from men's. Having women in STEM can not only help influence young girls to enter the field by seeing role models but also benefit society. Women can provide their expertise by making sure that other women are involved in clinical trials for various types of medical research (Gibbons, 2011). The need for more women in STEM is also an issue as the number of job opportunities available increases. According to Drury, Siy, and Cheryan (2011),

> A July 2011 report from the U.S. Department of Commerce shows that, over the past 10 years, growth in STEM jobs was three times as fast as growth in non-STEM jobs, even in difficult economic times. Increasing the participation of women in STEM involves increasing the retention of women who are already in STEM fields and increasing the recruitment of women who may enter the STEM pipeline. (p.15)

Universities must not only retain women in STEM but also increase the number of women because women and their expertise are needed in the STEM field.

The stereotype of professionals in STEM is one of the main reasons retaining women in STEM is an issue. Professionals in STEM are often characterized as being unsociable, Caucasian males wearing lab coats. Instead, women need to see female role models in STEM (Barbercheck, 2001). STEM stereotypes are also an issue because of the perception that STEM is a profession only for men (Cheryan, Plaut, Davies, & Steele, 2009; Dickman, Brown, Johnson, & Clark, 2010). Increasing women's visibility in STEM would alter the perception of women in the field and show more balance between men and women, increasing enrollment and retention of women (Murphy et al., 2007; Walton & Cohen, 2007). Because they strongly influence how women view the STEM fields, the stereotypes must change to increase the number of women in STEM.

Another factor affecting the way women view STEM fields is parental influence. Saucerman and Vasquez (2014) argued that parents' influence about STEM could have a larger effect on children at an early age:

> The result of studies on differences in parental explanations of scientific principles to children [Levine et. al, 2010; Crowley, Callanana, Tenenbaum & Allen, 2001; Crowley & Siegler, 1999] suggest that it is possible that without any conscious intention by parents, young girls are entering school with less exposure to and understanding of mathematical and scientific principles than their male counterparts (p. 48).

Gunderson et al. (2011) identified several environmental factors, including how parents and teachers influence girls' and boys' attitudes about math in particular at a young age. In 2001, the National Science Foundation (NSF) launched the ADVANCE: Institutional Transformation Program to "catalyze change that will transform academic environments in ways that enhance the participation and advancement of women in science and engineering." (National Science Foundation, 2001, p. 14). Prior to the ADVANCE program, most efforts at increasing the number of women faculty in academic STEM focused on "fixing the women"; the ADVANCE program put money and focus on "fixing the institutions instead" (Rosser, 2004, p. 58). According to the NSF (2011), the number of women in several STEM fields (such as agriculture, earth science and mathematics) has increased slightly. Even with an increase of women in several STEM fields, discrimination and sexual harassment were some of the major problems women faced in the 20th century (Gornick, 1990; Rossiter 1982, 1995). According to McCullough in 2011, research on the issues affecting women in STEM showed discrimination continuing to be a problem along with the fact the women were not always supported in such lifestyle choices as deciding to start a family. Xu (2008) found that the lack of support and resources in STEM are also reasons women decide to leave their careers in STEM. If women

were encouraged more and had mentors, they would not feel the pressure to leave their careers in STEM (McCullough, 2011). Lack of support for women in STEM continues to be an issue; and without more support and encouragement from mentors, role models, and STEM faculty, women will continue facing the same challenges.

Even with the challenges women in STEM face at the undergraduate level, the number of women who earned degrees in the science and mathematics fields was impressive; however, the number of women at the graduate level dropped drastically (Etzkowitz et.al, 1994). At the undergraduate level, low self-confidence and not being accepted in STEM departments are issues (Brainard and Carlin, 1997). While women's underrepresentation in STEM may be attributed to a variety of factors, women need encouragement and support in the STEM fields (EAS, 2011). With the anticipated job growth in the STEM fields and the need for America to continue to be competitive with other countries, women are needed in the STEM fields to take advantage of these opportunities (EAS, 2011).

The National Science Foundation and Women in the STEM fields

The National Science Foundation (NSF) (2014) has always been dedicated to providing program funding at institutions working to increase the number of women in STEM. If the United States is to continue being globally competitive in STEM, women's participation and talent are needed (NSF, 2014). By providing funding for programs working to increase the number of women in STEM, the NSF will also potentially attract more women to the STEM fields.

However, according to Trower and Chait's 2002 study, the "persistent underrepresentation of women faculty, especially in leadership positions, affects students'

relationships with possible mentors, participation as members of research and education teams, and self-identification as potential researchers' (p. 45). As a result, the NSF (2014) continues funding programs not only to recruit women in the STEM fields but also to retain them. One example of such a program was the NSF Professional Opportunities for Women in Research and Education (POWRE), which was established in 1997 (NSF, 1997).

POWRE's two main objectives were the following:

> To provide opportunities for further career advancement, professional growth, and increased prominence of women in engineering and in the disciplines of science supported by NSF; and to encourage more women to pursue careers in science and engineering by providing greater visibility for women scientists and engineers in academic institutions and in the industry (NSF, 1997, p. 16).

Most POWRE recipients were successful women in STEM with positions at good institutions where they had received funding from various government and science foundations, so they were already established in the STEM fields (Rosser, 2004). Thus, POWRE proved to be a good program for women in STEM.

In 2001, the ADVANCE program replaced POWRE, but the mission of trying to increase the number of women in STEM continued. Nine universities were awarded $3.75 million grants during the ADVANCE program's first year (NSF, 2001). While the ADVANCE program targets professors, students also benefit from seeing women teaching science, engineering, and technology courses (Coffill, 2010). NSF continues to support ADVANCE projects and has invested over $130 million supporting more than 100 institutions of higher education and STEM-related not-for-profit organizations in 41 states, the District of Columbia, and Puerto Rico (NSF, 2013).

The NSF (2001) also funds the Research on Gender in Science and Engineering (GSE) program, which s targets girls and women in STEM. The "GSE program supports research, the diffusion of research-based innovations, and extension services in education that will lead to a larger and more diverse domestic science and engineering workforce" (NSF, 2007, para 1). The program's name has changed numerous times, but the objectives have continued to be the same since the program began in 1993 (NSF, 2013). This program's best outcome has been providing opportunities previously unavailable for both girls and women to participate in STEM (NSF, 2007). The efforts of NSF and other programs working to increase the number of women and racial/ethnic minorities in the STEM fields have been effective (Russell, Hancock, & McCullough, 2007).

The Academic Library and Librarians

The "core purpose of the academic library is its physical and symbolic presences as a place where scholarship is supported and respected" (Gensler, 2014, p.). In as much as the academic library provides users access to information, the physical space of the library is also valued as a place for building community in colleges and universities, a place where students from every discipline can study, meet, and socialize (Lippincott, 2014). (Lippincott, 2014). Academic libraries have information on various topics to meet users' needs, and academic librarians assist users with searching for information (Dickenson, 2006).

Academic librarians assist students and faculty with their research needs. Academic librarians keep the library functioning by making sure that students and faculty have access to the library resources and services they need (ACRL, 2013). Academic librarians also offer information services and classes to teach students about how to use library resources (Lippincott, 2014). Furthermore, academic librarians a provide consultations, which can be scheduled

individually or as a group to better assist users with learning how to search for information using the library catalog and databases, to cite sources, and to avoid plagiarism (Cooper, 2011). In addition, academic librarians connect with library users by being library liaisons, assigned to a department to inform the faculty and students about what is available for their department and to provide the needed resources and services (Logue, 2007). Thus, academic librarians play a vital role in the library, working not only to assist users with their academic information needs but also to provide library instruction sessions access to library resources and develop library collections (Alsop et al., 2007).

Undergraduates and the Academic Library

With so much information now available online, it is easy for undergraduates to write papers and search for academic literature without using any library resources (Mill, 2008). They are more likely to use online resources than academic library resources such as journals and books (Jones & Madden, 2002). This trend of not undergraduates' not using library resources is of concern for both researchers and academic librarians because the students are probably using information that may not be credible (Jones & Madden, 2002). Thus, library instruction sessions are clearly needed to inform undergraduates of available library resources, why they should uses the resources, and how to use them.

According to Ahmad, Abiodullah, and Irum (2011), the academic library is a place where undergraduates can expand their knowledge by learning about available the academic information if they know how to properly use the library resources. However, Omehia and Boma (2008) found that among various academic disciplines, there are differences in how much undergraduates use the library services. For example, undergraduates in the social sciences and humanities tend to use the library the most while undergraduates in the sciences use the library

the least. The amount of support institutions provide for academic library services also influences how engaged students are with using resources and services (Pike et al., 2006). Thus, numerous factors must be considered when discussing undergraduates and academic library use.

Research Questions

To address the use of academic library resources and services by undergraduate women in the STEM fields and the support provided by academic libraries the following research questions are being posed:

RQ1: What role does the academic library have in assisting undergraduate women in the STEM fields?

RQ2: How can academic libraries better support undergraduate women in the STEM fields?

CHAPTER 2

LITERATURE REVIEW

This research builds on several rich and voluminous bodies of literature about information seeking and women in STEM. This literature review begins with a brief overview of the academic library, particularly in regard to providing STEM undergraduates with information skills. The next portion of the review focuses on STEM library services for scientists and engineers. The third section focuses on information-seeking behaviors in the STEM fields. Women's information-seeking behavior is important; therefore, this review focuses on how women seek information in their professional lives. However, literature is limited because this area has not been thoroughly explored, thus identifying the need for this research. This literature review is not intended to be exhaustive but to provide an overview of a piece of the picture about the research that has been published related to this study and to identify gaps in the literature that need to be addressed.

Academic Library Services

Academic libraries are typically the center of college campuses because they have information, resources, and services for students and faculty from every department on campus. According to the Association of College and Research Libraries (ACRL, 2006) "part of the library's function has always been to guide users to information and to provide members of the academic community with tools for thoughtful inquiry" (para 9). Along with guiding users to information, libraries also provide users with access to "scholarly resources through licensing agreements with electronic journals, databases, and other digital resources" (ACRL, 2006, para 13). The present study focuses on the use of library resources and services by undergraduates in

the STEM fields; therefore, it is necessary to begin with an overview of the kinds of academic library services provided.

According to the Association of College and Research Libraries (2013),

> Effective undergraduate library services must support the undergraduate programs of the institution. To facilitate academic success, library services to undergraduates must provide access to a broad range of information resources. Reference and referral services, orientation activities, and instruction sessions that teach students the critical thinking skills necessary for using library resources are basic services provided by undergraduate library personnel. Undergraduate library services provide a gateway to all future library inquiry, not only preparing students for graduate work and research, but also teaching them to use information sources as citizens, as consumers, as professionals, and for recreational purposes (para 18).

The library services that are provided for undergraduates are reference services, instruction services, and resources and collections (ACRL, 2013).

Reference Services

Reference services are provided so that library users can receive answers to questions about finding academic information and get help searching for academic information (Tychkoson, 2001). These services include the reference desk as well as virtual reference services (email, instant messaging, and text messaging) (King & Christensen-Lee, 2014). Traditional reference services consist of a reference librarian sitting behind a desk in the reference department to answer questions students and faculty have about searching for academic information (Tychkoson, 2001). However, academic libraries are evolving and changing the way in which reference services are offered by providing virtual and mobile reference services (Detmering & Sproles, 2012). Virtual reference services give librarians the opportunity to answer reference questions online for anonymous users who prefer not to ask questions in person (Ronan, Reakes, & Ochoa, 2006). By answering questions via email, instant messaging, and text

messaging, librarians provide reference services beyond the physical library (Chow & Croxton, 2014). As more students prefer to ask for library assistance using virtual and mobile services, academic libraries must provide these services.

Beaton (2012) explored how academic libraries could incorporate Skype and Twitter into virtual reference services to provide more options for librarians to reach library users. While most libraries use text, e-mail, and chat for virtual reference, all libraries have not adopted the use of Skype and Twitter as virtual reference services. Beacon argued that by using Skype, librarians would be able to see the library users and actually show them how to find information. . When library users send an e-mail or text or use the chat feature, librarians are unable to see the users; but with Skype, librarians would be able to see the library users and show them steps to take. Approximately 20 institutions have incorporated Skype into their virtual reference services, which is extremely helpful when assisting library users with technical problems. Beacon also discussed the use of Twitter as a reference service. Most libraries use Twitter to advertise library events, but it can also be used to answer users' questions. Beacon acknowledged arguments against using Twitter for virtual reference but noted it should at least be discussed as an option. There are always pros and cons to incorporating a new tool and updating reference services, but libraries must also consider ways to reach more library users to assist them with their needs.

In another study on reference services, Kilzer (2011) focused on where reference transactions take place which is important when considering how library users' needs are evolving. The expectations of library users continue to change because they want access to more information electronically and immediately; therefore, reference librarians have to adapt as well to meet users' needs. The first theme Kilzer mentioned is the need to have "partnerships and

collaborations between librarians and faculty" because "librarians are embedded in curriculum, classroom teaching, and course design" (p. 294). Librarians are able to work with the faculty to members by scheduling time to teach the students about using the reference services during various courses. Reference as a place was another theme identified by Kilzer, because the place where reference transactions take place also affects how librarians are able to connect with library users. Traditionally, librarians at the reference desk have provided all of the reference services because that is where all reference transactions took place. Although this practice still occurs, librarians also have consultations with small groups in the library. Kilzer argued that "by offering a physical location for questions, librarians can satisfy the user's need for personal attention and assistance" (p. 293). However, virtual reference services are offered so that users do not have to physically go to the library. Kilzer believes that "the importance of the virtual interaction spaces are also places where reference transactions take place which should not be ignored" (p. 293). The place where reference services occur is important but so are the librarians who provide these services. Kilzer also discussed incorporating personal librarians into medium-sized academic libraries. Assigning personal librarians to assist students was a part of a program a Drexel University in 2010 where all of the incoming freshmen were sent letters introducing them to their personal librarians. The librarians informed the students about library services and their willingness to provide research help. The students also received emails from the librarians, and 298 of the 2,800 students went to the library to meet their personal librarians while 45 responded to the emails from their personal librarians. Drexel University Library continues to offer the Personal Librarian program. A similar program was started at Yale Medical Library to connect new students with a librarian so they knew a librarian was available to provide personal assistance with library resources and research. The last theme, library spaces and partnerships,

focuses on the need for a space in libraries where reference librarians can provide consultations. As academic libraries are renovated, the reference desk is starting to disappear. While the majority of print material is being eliminated, there should still be space where reference services can be provided. As reference services change to meet user needs, librarians must also adapt to those changes.

Instruction Services

Academic libraries also provide instruction services. Instruction includes teaching students information literacy skills, such as using library databases to search for information, knowing who to contact for answers to research questions, and using library collections (ACRL, 2013). Librarians in instructional services provide classes for students, teaching them how to search databases using keywords, the title of a journal or book, or the author's name to find information. During instruction sessions, students are provided with contact information for subject librarians who provide students with research assistance in a particular area. Students also learn about the library's digital, electronic, and print collections such as electronic journals, e-books, digital art collections, and books along with how to gain access to all of those collections. Underscoring the importance of the academic library's mission to provide instruction services, Piper and Tag (2011) noted that "the perception of the library as a partner in the educational mission of the university is improved when librarians teach" (p. 321). Librarians are making useful contributions to the undergraduate experience and are finding ways to measure those contributions. For example, library instruction courses are being developed as part of the undergraduate curriculum. At Long Island University (LIU), librarians taught short 10-15 minute sessions during Core Seminar 20 and English 16 courses (Stowe, 2013). The students were given pre- and post-tests to gauge their learning and demonstrated improvement in basic

library skills (Stowe, 2013). Carson et al. (2011) interviewed faculty at Purdue University and the University of Illinois at Urbana-Champaign and the performance of students enrolled in a geoinformatics course using pre and post-tests at Purdue University to determine data-literacy needs. The faculty on the other hand were concerned with learning more about data ethics: "when to share data, who owns data, and how to appropriately acknowledge data" (p. 21). The analysis of the geoinfomatics course showed that students had to learn "the basics" of information technology before learning how to manipulate data (p.21). According to Bryan and Karshmer (2013), the skills that librarians are teaching students will not only be useful to the students while they are in college searching for academic information but also long term when they are professionals.

Collections and Resources

Building collections and providing access to resources are the final services discussed. Ultimately, "the library's primary task is to select, maintain, and provide access to relevant and representative information resources" (International Federation of Library Associations, 2001, p.1). Academic libraries must have collections and resources to meet undergraduate education's changing curriculum needs (ACRL, 2013). Furthermore, resources and collections in academic libraries should be up-to-date to (ACRL, 2013). Libraries must also consider how much the collections and resources are used to determine whether to continue providing them. Library collections are measured by their usability; unfortunately, print resources' usability has been declining for well over two decades (Calvert, 2015). With the steady decline in the use of print resources, many academic libraries are increasing their electronic resources and collections, which undergraduates prefer (Levine-Clark, 2014). Since undergraduates prefer to search for academic information online, libraries are trying to provide students access to more databases

online, electronic journals, and e-books (ACRL, 2013). With constant changes in the use of collections and resources, libraries must keep up so that students have access to what they need from the library.

STEM Library Services in Academic Libraries

As indicated in chapter 1, STEM education is discussed; therefore, academic libraries play a vital role in providing services for undergraduate STEM students, including those in traditional science and e-science. These services are needed because undergraduates must learn how to conduct research and how to access information. Zilinski and Nelson (2014) noted that "undergraduate STEM curricula is increasingly focused on research-based group projects that develop professional skills, building the professional portfolio needed for early career scientists, technologists, and engineers" (p. 1). Therefore, librarians must have the skills needed to provide services undergraduates will use. According to the American Research and College Libraries' (2007) proficiency standards, instruction librarians must be aware of the curriculum. Academic librarians must also determine what people do professionally so they can provide services that will prepare students for becoming professionals. In summary, the academic library's purpose is to "provide students, faculty and community patrons with a place to do their research and advance their knowledge" (Simmonds & Andaleeb, 2001, p. 627). As places where undergraduates and faculty can go for their research needs, academic libraries should offer research data services, which help undergraduates and professionals in STEM. Undergraduates need the skillset of knowing how to find academic research which will prepare them for their professional careers. Thus, libraries need to provide these services because the STEM fields typically rely on data to conduct research and this is true for traditional science and e-Science.

According to Tenopir, Birch and Allard (2012),

> Research data services are services that a library offers to researchers in relation to managing data and can include informational services (e.g., consulting with faculty, staff, or students on data management plans or metadata standards; providing reference support for finding and citing data sets; or providing web guides and finding aids for data or data sets), as well as technical services (e.g., providing technical support for data repositories, preparing data sets for a repository, deaccessioning or deselecting data sets from a repository, or creating metadata for data sets). (p. 7)

According to Hey and Hey (2006), e-Science is the "set of tools and technologies required to support collaborative, networked science" (p.517). Research data services (RDS) or e-Science services are offered in "research libraries related to data management and encourage data sharing" (Tenopir et al., 2014, p. 85). Nielsen and Hjorland (2014) defined data as "raw materials of information processing and knowledge acquisition" (p. 223). RDS are needed to support data curation (Cheek & Bradigan, 2010). Tenopir et al. (2012) surveyed librarians possibly engaged in offering RDS and found that the majority of the librarians believed they had the knowledge and skills necessary to provide RDS. Librarians also believe that RDS are important and the visibility of these services should be increased (Tenopir et al., 2012). In surveying library directors, Tenopir et al. (2014) found that the services libraries offer are more of an extension of reference services than actual RDS. RDS include access to not only data but also academic journals.

According to Nielsen and Hjorland (2014),

> Scholarly journals are important to data curation because they often have explicit rules not just for codifying the scientific style including rules of documenting citations and scientific claims but also for developing policies that govern the manner in which researchers store primary data and grant access to said data (p. 231).

Different policies among scientific journals determine how much data scientists can make public (Nielsen & Hjorland, 2014). However, some journals do "provide archiving options for datasets using The Dataverse Network, which is an application designed to facilitate the publishing, sharing, referencing, extracting and analyzing of research data" (p. 232). RDS are needed not only to prepare undergraduates with the skills needed to search for information as professionals but also to assist professionals in STEM with their academic information needs.

Librarians are key to providing RDS, so they must be trained to provide these services. Some studies solely focus on the role that academic librarians play in providing RDS. For example, in surveying 63 health sciences and science and technology librarians, Creamer, Moreales and Crespo (2012) found "only a small percentage of the librarians actually engaged in the digital curation and management of large data sets" (p. 21). The participants' libraries were planning to create a data- management policy, but the librarians needed more technical training before the library actually offered RDS. Hey and Hey (2006) studied e-Science and its implications for the library community by exploring the challenges e-Science poses for libraries. These authors concluded that in order to address the data management issues with science data "scientists and librarians need to collaborate and work on developing digital repositories (p. 526).

Academic librarians must be lifelong learners in order to continue providing RDS to researchers and scientists. Thus, librarians also must develop the necessary skills to provide RDS, which STEM undergraduates and professionals need when conducting research. Some academic libraries have begun incorporating RDS. Carlson (2012) interviewed librarians using the Data Curation Profile Toolkit (DCPT Toolkit), "developed by the Purdue Libraries as a way

for librarians to conduct data interviews with an individual researcher or small lab group and construct data curation profiles of their own"(p. 8). To provide support services to researchers, librarians also need to work on building new relationships with faculty that are more like "partnerships and promote repository services, content recruitment, and provide assistance in submitting or accessing content" (p.18). Newton, Miller and Bracke (2010) studied academic librarians' role in collection development to build a data repository prototype at Purdue University. The task force's evidence showed that the librarians need additional skills to collect data sets for a repository and to provide researchers with necessary data management services. Research data services are needed in academic libraries for STEM undergraduates who will become professionals. According to Tenopir, Birch and Allard (2012), the "most important aspects of providing research data services is the ability for the librarian to communicate effectively with researchers about concepts related to data" (p. 11).

Information-Seeking Behavior in the STEM Fields

Academic libraries provide services for undergraduates, including those specifically for STEM. The literature reviewed in this section focuses on how students and professionals in STEM seek information. Identifying information-seeking behavior in the STEM fields is important for informing academic librarians how libraries' services should be tailored to better assist students and professionals in STEM. There is an illustration of how academic library services and STEM library services should fit together (see Figure 1).

Information seeking is a very rich literature recorded in volumes of books and articles. This study's literature review focuses on information seeking in the STEM fields. Information-seeking behavior results from the user's perceived need for information (Tella, 2009). For this

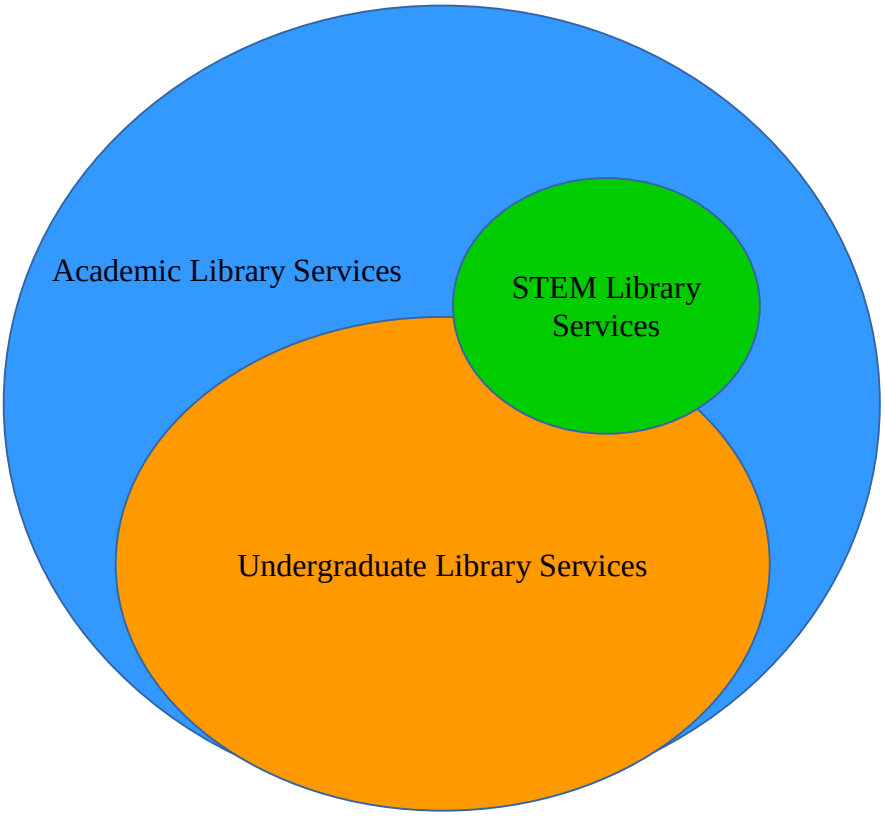


Figure 1: A representation of how academic libraries services for undergraduates and library services for STEM fit together.

study, knowing what STEM professionals do is important so essential skills can be taught to undergraduate students throughout their STEM curriculum. Information-seeking behaviors of scientists is a topic that has been discussed since the 1960s (Wang et al., 2007). Thomas J. Allen and his colleagues were some of the first scholars to identify information channels of engineers and scientists (Tenopir & King, 2004). There were also eight information seeking categories for engineers identified by Ellis and Haugan (1997). The nine information channels and eight categories of information seeking for scientists and engineers are important because professors are not going to have the time to teach students about information channels in the classroom. However, this is where academic librarians can step in and assist students because the information channels and that scientists and engineers use are able to inform academic librarians about the ways in which scientists and engineers search for information. Nine channels were identified:

1. Literature: Books, professional, technical, and trade journals, and other publicly accessible written material.
2. Vendors: Representatives and/or collateral materials of suppliers or potential suppliers of design components.
3. Customer: Representatives and/or collateral materials from the government agency for which the project is performed.
4. External sources: Sources outside the laboratory or organization which do not fall into any of the above three categories.
5. Technical staff: Engineers and scientists in the laboratory who are not assigned directly to the project under consideration.
6. Company research: Any other project performed previously or simultaneously in the laboratory or organization regardless of its source of funding.
7. Group discussion: Ideas that are formulated as the result of discussion among the immediate project group.
8. Experimentation: Ideas resulting from test or experiment or mathematical simulation with no immediate input or information from other sources.
9. Other division: Information obtained from another division of the same company.

(as cited in Tenopir & King, 2004, p. 32).

Ellis and Haugan (1997) found that engineers' information seeking falls into eight categories:

> 1. Surveying (an initial search for an overview of the literature within a new subject field to locate key people in the field)
> 2. Chaining (following chains of different forms of connection between sources to identify new sources of information
> 3. Monitoring (maintaining awareness of developments and technologies by regularly following specific formal and informal information sources)
> 4. Browsing (regular scanning of primary and secondary sources)
> 5. Distinguishing (ranking information sources according to their relative importance to the user)
> 6. Filtering (using search strategies that will make the information retrieved as relevant and precise as possible)
> 7. Extracting (working through sources to locate material of interest to those sources)
> 8. Ending (activities involved with finishing the information-seeking process, usually at the end of an R&D project).
>
> (as cited in Tenopir & King, 2004, p. 59)

The information channels and information-seeking categories listed above are also important for academic libraries because libraries can offer services to better assist scientist and engineers since they know how they search for information. Engineers prefer to find information by consulting with their colleagues or by using search engines. According to Tenopir and King (2004), engineers "favor informal channels and do-it-yourself information seeking" (p. 61), which is why they tend to seek information from their colleagues. The fact that engineers rely more on information from their colleagues than from the library was also found in past studies (Hertzum, 2000; Tenopir & King, 2004; Voneggern & Jourdain, 1996). Allard, Levine and Tenopir (2009) used naturalistic observations and structured interviews to study engineers' information-seeking behavior and found that engineers use the Internet (with Google being the

favored search engine) to search for academic articles and for solutions to problems. Although engineers consult with their colleagues to find information, they also search the Internet as a way to find information. In terms of reading "most engineers preferred to read electronic files" (p. 450). Reading is important for engineers and scientists as they have to keep up with the changes in their fields (Hemminger et al., 2007). These findings were similar to those of Allard, Levine and Tenopir (2009), who found that "readings improved the quality of teaching, research, and other activities for which reading was done" (43). In the STEM fields, students and professionals prefer to find information on their own, consult colleagues, use search engines, and keep up with changes in their field by reading electronic articles. Thus, turning to librarians for assistance in finding information is not the first option when seeking information.

Brown (1999) surveyed astronomers, chemists, mathematicians, and physicists at the University of Oklahoma to learn about their information-seeking behavior. Only 49 of the 80 faculty members in Chemistry-Biochemistry, Mathematics and Physics-Astronomy completed the 20-question survey about library resources and services. The majority of the responses were from Chemistry-Biochemistry with "41% of the faculty represented, 31% of the faculty from Physics-Astronomy was represented, and 29% of the faculty was represented from Mathematics" (p. 930). Brown's study showed that when conducting research, scientists and mathematicians depend on academic journals but that mathematicians also rely on personal communication, conference attendance, and preprints. To stay aware of their field's current trends, scientists again rely on reading academic journals while mathematicians rely more on personal communication and conference attendance. In terms of visiting the physical library, the Chemistry-Biochemistry and Physics-Astronomy "faculty reported that they visit the library daily if not weekly" (p. 937). This use could be due in part to the fact that Oklahoma University

has Chemistry-Mathematics and Physics-Astronomy branch libraries. The Chemistry-Mathematics Library is located within the same complex as the Chemistry-Biochemistry and Mathematics departments while the Physics-Astronomy Library is located within the Physics-Astronomy complex. However, the mathematicians do not physically visit the library as often as the astronomers, chemists, and physicists. The survey also showed that while the scientists like having access to electronic journals, they actually prefer using print journals. However, the findings from more recent studies show that scientists prefer using electronic journals; this use could be due in part to the fact that many academic libraries are removing print journals and only providing access to electronic journals. Personal communication continues to be one of the ways in which STEM professionals continue to seek information.

Hamid and Nicholas (2008) also studied the information-seeking behavior of physicists and astronomers using interviews and surveys. This study was conducted at University College London with 129 staff members and 113 PhD students from the Department of Physics and Astronomy. Findings showed "differences in the subfields of physics and astronomy in terms of their reliance on different methods used for keeping up-to-date as well as methods used for finding articles" (p. 16). When deciding what journal articles to read, the staff and PhD students in astronomy and astrophysics rely on databases, Google, recommendations from colleagues, and e-mail alerts. To stay up-to-date with the current trends in their fields, physicists and astronomers attend conferences in their field, browse electronic journals, and talk with their colleagues. The authors, who are also professors, relied more on "word of mouth and interpersonal communications such as conferences to stay up-to-date with the trends in their field while PhD students preferred to use email alerting services" (p. 20). This study's findings were similar to

what Brown (1999) found in that personal communication and attending conferences are important when staying up-to-date on trends in the field.

Using surveys, Sapa, Krakowska, and Janiak (2014) studied the information-seeking behavior of 29 professional mathematicians and 153 mathematics students at Jageillonian University's Institute of Mathematics in Krakow, Poland. The researchers found that when searching for educational activities online, professional mathematicians and students search journal articles, textbooks, and course books. However, students search for textbooks first while professional mathematicians search for journal articles. Furthermore, the researchers found that professionals rely on the library website and other scholarly websites related to their field while students prefer using academic social networking sites. Both professional mathematicians and students use Google the most when searching for educational information. When using search engines, databases, or library catalogs for such information, professional mathematicians tend to prefer searching by the author while students use keywords. Both professional mathematicians and students prefer using search engines when initially searching for academic and teaching information online.

Athukorala et al. (2010) studied the information-seeking behaviors of computer scientists at the University of Helsinki. This study involved 6 participants, 3 females and 3 males, who were post-doctoral researchers up to senior level PhD researchers with 2 to 18 years of experience conducting academic research. Researchers interviewed the participants, observed them, and asked them to write diary entries to learn about their information-seeking behavior. The findings show that computer scientists search for academic literature to "keep up to date with that is going on in their field, explore new topics, review current literature and as a way to collaborate with other researchers in their field" (p. 10). Participants stated they search for

academic literature to prepare for their lectures and as readings for students. To keep up with trends in computer science, the participants prefer to "browse conference/journals pages or the home pages of other researchers rather than using literature search tools" (p. 10). However, the participants also use other information sources, such as basic search engines, to find information about topics that they are unfamiliar with and to prepare for lectures. This finding is similar to Tenopir and King's (2004) finding with engineers because they also use informal channels to search for information. When computer scientists search for information they have found before and want to receive "updates from related forums, well-known and related authors, collaborators, and fellow researchers, they want a search tool that provides both collaboration and sharing tasks" (p. 10). According to Tenopir and King (2004), a tool is needed that has numerous functions for sharing information, searching, and collaborating to meet the computer scientists' information-seeking requirements. Engineers and scientists could also use such a tool. Reliance on informal channels and electronic resources to find information is a recurring theme in the literature. Having access to electronic resources is also an important part of information seeking for STEM agricultural and biological science scholars, who rely on electronic databases and indexes because of the convenience and speed in searching for information (Kuruppu & Gruber, 2006). Many of the faculty and graduate students acknowledged their method of searching for information is to use keyword searches (Kuruppu & Gruber, 2006). In Nui et al.'s (2011) study, 2,063 academic scientists from 5 large research institutions were surveyed to learn more about their information-seeking behavior. The majority of participants preferred using electronic resources. Scientists much like engineers also prefer to use electronic resources.

The Internet has changed the way in which scientists and engineers can search for information, making it more accessible and readily available (Fidel & Green, 2004). Just like

electronic resources available through the library, the Internet provides scientists and engineers a convenient way to seek information. Hemminger et al. (2007) studied the information-seeking behavior of academic science researchers at the University of North Carolina at Chapel Hill and found that the participants preferred using the Internet to search for information because of its convenience, even though the library was in walking distance for the majority of the participants. The participants used academic journals, databases, and personal communication to find information. Fidel and Green (2004) interviewed 32 engineers from a manufacturing company to study how they seek information and found that engineers use information sources that they are familiar with, that provide the needed level of detail, that save time, that are physically close, that provide keyword searching, and that are available and accessible. Haines et al. (2010) used semi-structured interviews with science researchers at a university's medical school to study their information-seeking behavior and found that they used online resources when beginning their searches. Some of the participants searched PubMed while others started with Google and liked using the keyword searching. The participants also consulted their colleagues for information. Using the library was often seen as a "last resort if the information was not readily available online" (p. 76). Convenience and speed were two factors that scientists and engineers considered when searching for information. Since engineers and scientists have access to the Internet from their offices, they were able to quickly search for information using Google or other search engines.

Women's Information-Seeking Behavior

Women's information-seeking behavior has been studied in a variety of contexts: however, women STEM professionals have not been the subject of many of these studies. This may be in part because women are underrepresented in STEM; therefore, studies with engineers

and scientists have few women participants. Therefore, this section of the literature review includes general observations about women's information-seeking behavior in a professional context. Academic librarians also assist women with seeking information and would benefit from knowing how women search for information. The studies in this section will answer the following question: Do women seek information in different ways than men do? While a considerable amount of literature explores how women seek health or personal information, this review does not focus on health and personal information seeking, nor does it explore women in the professional environment. However, this section does examine literature on how women seek information for their professional lives as lawyers and musicians.

According to Wiklund (1998), men and women have "different opportunities in the academic community which affects women's access to information, particularly information available through informal personal contacts" (p. 7). Women tend to search for information online using a "more effortful and conscientious approach while men's Web searching tends to be more selective in nature" (Hupfer & Detlor, 2006, p. 1107).Women also tend to feel less confident than men with their ability to control their searching (Hupfer & Detlor, 2006). Past studies (GUV, 1997; Katz & Aspen, 1996; Moraha-Martin, 1998) have found that "gender is a major predictor in Internet use and attitude as women have more difficulty searching for information online" (Ford, Miller, & Moss, 2001, p. 1052). As a result of computer anxiety, women are not as confident searching for information online as men (Joiner, 2005). Women spend more time online sending e-mails and conducting research than men (Srinivasan & Dholakia, 2005). When women are searching for information online, they are often researching government, health and travel information (Dholakia, 2006). Women typically use the Internet

for personal communication purposes, such as sending e-mail and chatting with family and friends (Joiner et al., 2012).

However, Kuhlthau and Tama (2001) studied the information seeking by women in their professional lives by interviewed eight lawyers, four males and four females. The study's results were reported based on the whole group rather than by gender. When lawyers start searching for information for their cases, they think in terms of putting together a puzzle. Lawyers use legal resources to construct theories, but they also "prefer to use print resources rather than computer databases for more complex tasks" (p. 32). By using print resources, lawyers believe they can better understand their material. Since they keep paper files, lawyers see the progression of cases and can refer to completed cases. Lawyers believe that some computer sources are not always user friendly. However, lawyers use external electronic resources such as email, listservs, and the Internet. While email was not viewed highly among the lawyers interviewed, listservs are used for external information; and though the lawyers do not depend on the Internet as a primary source, they do believe that the "Internet is good for accessing general information rather than legal sources" (p. 57). Based on this study, lawyers rely on legal resources, such as print resources rather than computer databases, and their assistants to find information. When seeking external information, that does not relate to their professional work the lawyers prefer to use listservs and the Internet.

Another study examined amateur musicians' information needs and information-seeking behavior. Narveson (1999) interviewed nine amateur musicians, six females and three males. The majority of the participants search for community orchestras and bands when they begin searching for places where they can play their music. Word of mouth is also important, and many of the musicians talk to other musicians and search for social gatherings where they can play

their music. Some of the musicians "use the Internet to find other musicians to play with or read advertisements posted to a newsgroup" (p. 12). When the musicians are searching for music to play, they go to music stores, purchase music from vendors, search a music library's music catalogs, or listen to music on the radio and try to play by ear. When searching for information on instruments, supplies and repairs, the musicians use word of mouth, search the Internet, and go to music festivals. However, when seeking information on music instruction and technique, they rely on the Internet, listen to recordings, or learn music by playing with various groups. Musicians use different resources based on their information needs, but each participant had the same information-seeking habits. While word of mouth and the Internet are important resources for musicians, they rarely use libraries.

Women's information-seeking behavior was discussed in general and in the studies about women's professional lives. However, in both studies discussed, the women were combined with the men, rather than being singled out. Women seek information in different ways than men; therefore, more focus should be placed on their information-seeking behavior.

Information-Seeking Behavior of Women in STEM

Information-seeking behavior of women in STEM has not been thoroughly discussed in literature. Awareness of this behavior is important so that libraries can provide the necessary library services. Thus, to provide better library services for women in STEM, more research should focus on women in STEM and their information-seeking behavior.

A few studies have specifically explored women in STEM and their information-seeking behavior. Tenopir and King (2004) found that few studies focus on gender differences and information seeking in engineering. When seeking information, women tend to be "less

confident in their knowledge of sources and services" than men (p. 71). Furthermore, Tenopir and King noted that Goodman Research Group, Inc.'s 2002 study found that mentorship also plays a role in information seeking for women in engineering. Engineers tend to use more "informal networks to find information, and women need informal networks of communication and support much more than male engineers" (p. 86). However, there is a gap in the literature regarding the importance of mentors' assisting women in STEM with information searches.

When searching for academic information, women in STEM, much like men, rely heavily on electronic resources. While studying academic scientists' information-seeking behavior, Hemminger et al. (2011) found that there were gender differences because the majority of the medical science researchers who participated in the study were women and they made up one-third of the basic science researchers. In terms of information sources, the majority of the participants use academic "journals, web pages, databases and personal communication" for finding information (p. 2208). Since the majority of the medical science researchers were women, they were found to be more likely to "exchange print copies of journal articles with colleagues" (p. 2211). Based on this study, reading journal articles, searching web pages and databases, and personally communicating are the main ways women in STEM seek information.

In another study on the information-seeking behavior of women in STEM, Choo and Marton (2003) explored how 24 women in IT searched for information online. Using a Web tracker application and interviews, these researchers identified 80 episodes of information-seeking divided into 4 categories: undirected viewing, conditioned viewing, informal search, and formal search. Most of the 80 episodes fell into the category of conditioned viewing, meaning the participants returned to websites they visited regularly and had bookmarked. The second most-popular category was informal searches, whereby participants used certain keywords to

search for products or companies usually using Google or "specific search engines that were specific to the website" (p. 275). The third category involved formal searches, in which participants searched for information for professional uses, such as to write papers or reports. During formal searches, participants followed specific steps and often spent hours or days searching for information. The last category was undirected searches which were used to scan websites without a "specific information need in mind" (p. 274). This study showed that when searching for information, women in IT tend to visit certain websites regularly to search for information.

The information resources women in STEM used were typically the same as those used by men. In terms of information resources, Hemminger et al. (2011) found that the availability of electronic articles and search engines has changed the way science researchers search for information. This is an apparent trend, especially as more science researchers, both women and men, continue using "non-journal content such as online scientific databases, like GenBank, or Web Pages of research labs" (p. 2214). Science researchers prefer to conduct their searches for academic information from their offices. With the reliance on electronic resources continuing to increase, the need to physically visit the library has declined (Hemminger et al., 2011). Nui et al.'s (2010) findings on academic researchers' information-seeking behavior mention gender, but differences in the way males and females search for information are not discussed. The participants represented different departments, "including natural science, engineering and medical science but the findings showed that the participants spend the majority of their day reading information from all sources to support their work" (p. 873). According to several studies (Allard, Levine, & and Tenopir, 2009; Hemminger et al., 2011; Nui et al., 2010), scientists and engineers use electronic resources and colleagues as the availability to more

academic information online allows both men and women to conduct their searches (Allard, Levine, & Tenopir, 2009; Hemminger et al., 2011; Nui et al., 2010). While women are included in literature on information seeking in STEM, they are not always singled out. Thus, more research is needed to focus solely on women in STEM and their information-seeking behavior.

Summary

Academic libraries provide various services for undergraduates such as reference services, which consist of reference librarians sitting at a desk where students can ask questions and receive help with research. Virtual reference services, such as email, instant messaging and text messaging, give students the opportunity to ask questions anonymously and receive answers from librarians. Instruction services are provided to teach undergraduates basic library skills so they know how to search for academic information, what library resources to use to find academic information, and where to find library resources. Libraries' collections and resources are available to assist students with their studies.

STEM library services such as RDS are for not only managing and sharing data but also assisting scientists, engineers, and other STEM researchers with accessing academic journals. While some academic libraries provide these services, librarians do not always have the necessary skill set and knowledge. As RDS are needed in academic libraries, librarians must have the training and ability to provide scientists, engineers, and other STEM researchers with necessary assistance.

Focusing on how STEM students and professionals, women, and women in STEM, seek information is also important. Engineers and scientists rely on their colleagues first when searching for information and then move to search engines and electronic resources. The Internet

has changed the way STEM students and professionals seek information because they can conveniently conduct their own searches online from their offices or homes. While the physical library is usually within walking distance, electronic resources' availability online has decreased the need to visit the library and ask librarians for assistance when searching for information.

Women seek information differently than men Women are not always as confident with their ability to search for information online. Most literature on women and information-seeking focuses on seeking health information or information related to their personal lives instead of their professional lives. Literature on how women seek information professionally shows that lawyers prefer to use print resources and their assistants to find information. However, musicians rely on word of mouth and the Internet for their information needs. More research should address how women seek information in their professional lives.

Specifically, information-seeking behavior of women in STEM needs further discussion. Women in STEM rely on electronic resources, search engines, journal articles, and personal communication much like men in STEM. However, women need mentors for guidance in connecting with various information resources. While there is an abundance of literature on why women in STEM need mentors, this literature rarely mentions mentors helping women with finding information resources. Furthermore, while women's information-seeking behavior in explained in detail in some literature, most literature does not address women specifically or just combines men and women when discussing information-seeking behavior. A gap exists in the literature in terms of focusing on women in STEM and how they seek information.

The present study of how undergraduate women in STEM relate to the academic library is particularly important in light of the above literature in several ways. First, as noted in the literature, the resources that undergraduates want have changed libraries' need to understand

how undergraduates perceive the library in light of their information needs and expectations of library services. Second, the literature suggests that STEM students have specific information needs and library requirements; thus, a first-hand look at how STEM undergraduates perceive those needs and requirements could be beneficial. Third, the literature suggests that women in STEM have needs different from their male counterparts. Thus, a first-hand look at the relationship undergraduate women in STEM have with their campus academic library is needed to ground the literature in the everyday realities of those students who will become STEM practitioners.

CHAPTER 3

PARADIGMATIC PERSPECTIVE AND RESEARCH DESIGN

Qualitative Research

This chapter examines the paradigmatic perspective, design, and methods employed in this study. Qualitative research's purpose is to understand and describe a phenomenon of interest from the perspective of participant's eyes; the participants are the only ones who can legitimately judge the results credibility. (Lincoln & Guba, 1985). This is an important goal in that an individual's meaning systems drive much of human behavior. Thus, if we are to understand human behavior, such as how undergraduate female STEM majors relate to the academic library, we need to access those meaning systems and bring them forward in our research.

This study advances from an interpretivist paradigm. Interpretivists view reality as socially constructed, multiple realities, and contextually bound (Cohen & Crabtree, 2006). These "multiple realities are mental constructions, socially and experientially based, local and specific, dependent for their form and content on the persons who hold them" (Lincoln & Guba, 1994, p.110). Because realities are multiple and socially constructed, research must be based on the actual lived experiences of the participants to capture their realities. According to Berger and Luckmann (1967) rather than constructing reality itself, the researcher constructs an understanding of reality, a model or theory which guides perception and behavior.

The interpretivist perspective is one of several that takes phenomenology as its intellectual precedent. Phenomenology is derived from philosophy and psychology and is largely based on the work done by German philosophers Husserl and Heidegger (Connelly, 2015). Basically, phenomenology suggests that humans are agents creating social worlds (Ainlay,

1986). “Phenomenological sociologists investigate social products as humanly meaningful acts, whether these products are termed attitudes, behaviors, families, aging, ethnic groups, classes, societies, or otherwise” (as cited in Orleans, n.d., para 27, Armstrong, 1979; Gubrium & Holstein, 1987; Herek, 1986; Petersen, 1987; Starr, 1982). Schwartz and Jacob (1979) believe that the “sociological production of these fictive entities is understood within the context of their accomplishments, that is the interview setting, the observational location, the data-collection situation, the field, the research instrument, and so forth” (as cited in Orleans, n.d., para 27).

“Social phenomenology’s central task is to demonstrate reciprocal interactions among the processes of human action, situational structuring, and reality construction” (Orleans, n.d., para 12). The term *reflexivity* is used by phenomenologists to characterize the beliefs and perspectives determining the way research is conducted. According to Mauthner and Doucet (2003), “within discussions of reflexivity, attention is often drawn to the importance of recognizing the social location of the researcher as well as the ways in which our emotional responses to respondents can shape our interpretations of their accounts” (p. 418).

Phenomenology analyzes the natural attitude, which is the way ordinary individuals participate in the world (Berger & Luckmann, 1967). “Language, culture, and common sense are experienced in the natural attitude as an external world’s objective features learned by actors in the course of their lives” (Orleans, n.d., para 13). At the same time “humans are open to patterned social experience and strive toward meaningful involvement in a knowable world” (Orleans, n.d., para 14). Therefore, “phenomenologist attempt to understand the way that the world appears to others” (Trochim, 2006, para 4).

To better understand the use of library resources and services by undergraduate women in the STEM fields, the researcher conducted focus groups with these women and academic

librarians/library staff familiar with library resources for undergraduates in the STEM fields. Eighteen undergraduate women in the STEM fields and 16 academic librarians/library staff participated in this study.

Role of Theory in Qualitative Research

Rather than testing apriori theory, the goal of paradigmatically qualitative work is to "describe, analyze, and interpret the constructive aspects of the social world" (Mcleod, 2001, p.133). The paradigm demands an inductive rather than a deductive approach to analysis and theorizing (Gray, 2014). Since qualitative research is inductive, it is evaluated based on the absence of specific, substantive prior theories (Mitchell & Cody, 1993). Prior theories would likely mask the data, preventing the researcher from understanding how participants create their own meanings and construct their own realities of a given phenomenon (Schutz, 1967).

The goal of paradigmatically qualitative research is to uncover the multiple realities of participants has implications for research design, methods, analysis and evaluative criteria. First, the research must employ data collection methods that allow participants to freely express and explain how they view their worlds. The data in a qualitative study are the participants' actual words; thus, measures must be taken to correctly record what participants say and understand what those words mean to them. Analysis must be inductive and focus on diagnosing how participants logically structure their worlds. Such analysis involves studying the transcripts of conversations with participants, looking for themes important to participants' understanding of their realities. Theorizing may happen by examining how themes develop into patterns across participants, then looking for contextual explanations for specific articulations of reality (Punch, 2005). An inductive approach using emergent methodologies allows the data to "speak for themselves" through the emergent categories and themes (Litchman, 2013, p. 376). According to

Kawamura (2011), "It is an inductive process of building from the data to broad themes to a generalized model or theory" (p. 22). According to Glaser and Strauss (1967), grounded theory is the discovery of theory from the data, and this is the most common approach interpretive researchers use. After a theory has been created based on the phenomena being studied, that theory should help make connections to the data to understand the phenomena (Lett, 1990).

The Present Study

This study sought to address the following research questions:

- What role does the academic library have in assisting undergraduate women in the STEM fields?
- How can academic libraries better support undergraduate women in the STEM fields?

In order to explore these questions, a case study was conducted at a research- intensive University in the USA so that all of the participants had access to the same resources and services in the libraries. Case studies "intensely examined an individual or small participant pool, drawing conclusions only about that participant or group and only in that specific context" (Jenicek, 2011, p. 106). This case study provided the researcher with the opportunity to determine the topic's boundaries, depending on the extent of the research topic (Robson, 1993; Miles & Huberman, 1984). *Case study* refers to the "collection and presentation of detailed information about a particular participant or small group, frequently including the accounts of the participants themselves" (Ruggiero, 2006, p. 87). Robson (1993) defined a *case study* as "a strategy for doing research which involves empirical investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence" (p. 146). According

to Hsieh (2005), a case study is flexible. The "researchers do not focus on discovering a universal, generalizable truth, nor do they typically look for a cause-effect relationship; instead, emphasis is placed on exploration and description" (Colorado State University Writing Guide, 2013, para 2). The researcher may identify significant variables emerging during the research and suggest related studies, or the researcher may suggest further general questions generated from the study (Merriam, 1985; Berkenkotter, Huckin, & Ackerman, 1998).

Participants

Participants are recruited for a study based on the study's purpose (Creswell, 2007). Since this study had a clearly defined population, only undergraduate women in the STEM fields and academic librarians and library staff familiar with STEM resources and services were recruited to participate. All participants in this study were recruited from the same research-intensive university in the USA where the pilot study was conducted. No incentives were offered to the participants.

Undergraduate Women in STEM

According to Elliot (2013), when recruiting participants researchers much customize their approach to focus on how to tap into the population of interest. To recruit undergraduate women in the STEM fields, this study's researcher met with an administrator who works with faculty in the STEM fields for assistance with contacting potential participants. The administrator also suggested including participants from the Agriculture and Veterinarian programs because the majority of the classes for their majors are in science and technology. The researcher was provided with the names of faculty members in each of the STEM fields to contact. An email was sent to each faculty member, asking if any undergraduate women who would be willing to

participate in a focus group on their use of library resources and services. The faculty members sent the researcher the names and email addresses of potential participants to contact within one to two weeks. The researcher immediately contacted each potential participant via email asking if she would be willing to participate in a focus group on undergraduate women and their use of library resources and services. According to Creswell (2007), participants should be willing to honestly share information or "their story" (p. 133). In total, the researcher received the names of eighteen potential participants (see Table 1). All the participants responded within a day or two indicating that they would to participate in the study. Participants received another email asking for days and times when they would be available to meet. After each participant responded as to when they could meet, the researcher began coordinating focus group meeting times, depending on when the majority of the participants were available.

Table 1

Undergraduate Women in STEM

Student	Code	Classification	Major
Student 1	S1	Senior	Chemical Engineering
Student 2	S2	Junior	Microbiology
Student 3	S3	Senior	Chemical Engineering
Student 4	S4	Senior	Biological Sciences
Student 5	S5	Junior	Food Science
Student 6	S6	Senior	Food Science
Student 7	S7	Senior	Food Science
Student 8	S8	Sophomore	Mathematics and Education
Student 9	S9	Senior	Mathematics
Student 10	S10	Senior	Mathematics and Biochemistry and Molecular Biology (BCMB)
Student 11	S11	Senior	Mathematics
Student 12	S12	Freshman	Computer Science
Student 13	S13	Senior	Urban Forestry
Student 14	S14	Senior	Urban Forestry
Student 15	S15	Freshman	Civil Engineering
Student 16	S16	Freshman	Animal science
Student 17	S17	Junior	Food Science
Student 18	S18	Sophomore	Biochemistry and Molecular Biology (BCMB)

Academic Librarians/Library Staff

All of the academic librarians/library staff members were recruited from the same Research Intensive University in the USA as the undergraduate women in STEM. To recruit academic librarians and library staff, the researcher was provided with potential participants' names from participants in the pilot study. The researcher also met with the Dean of the Libraries, who recommended more librarians to contact and who suggested contacting the Student Success librarians because they work closely with undergraduates from all majors. The researcher decided to include medical librarians because they are familiar with resources and services in the STEM fields and work with STEM majors. The agriculture and veterinarian librarians and staff were recruited because they also have knowledge of STEM resources and services in the library, they work in a branch library on the campus, and participants from the pilot study suggested recruiting them for this study. Potential participants were contacted via email and asked to participate in a focus group based on their job titles (e.g., subject librarians and branch librarians) and knowledge about the STEM resources and services available for undergraduates in the library. The 16 academic librarians and library staff members represented subject librarians from each of the STEM fields as well as librarians who are familiar with STEM resources and who work closely with undergraduates (see Table 2).

Table 2

Academic Librarians/Library Staff

Librarian number	Code	Subject area
Librarian 1	L1	Earth Science
Librarian 2	L2	Instructional Specialist
Librarian 3	L3	Engineering
Librarian 4	L4	Instructional Specialist
Librarian 5	L5	Natural Science and Mathematics
Librarian 6	L6	Natural Science
Librarian 7	L7	Student Success – First Year Students
Librarian 8	L8	Outreach
Librarian 9	L9	Health Sciences
Librarian 10	L10	Student Success – Transfer students
Librarian 11	L11	Agriculture
Librarian 12	L12	Graduate Research Assistant – Agriculture
Librarian 13	L13	Medical Librarian
Librarian 14	L14	Medical Librarian
Librarian 15	L15	Medical Librarian
Librarian 16	L16	Medical Librarian

Data-Collection Methods

This study used focus groups and interviews because both methods allowed the researcher to gain a better understanding of the phenomena being studied. According to Valentine (1993), "using both focus groups and interviews allows the researcher to exploit the merits of both methods, thereby producing a richer source of data than either might have provided alone" (p. 301).

Focus Groups

A "focus group is a good tool to use because it requires a relatively small amount of time from a much smaller number of people than with many other social science methods" (National Oceanic and Atmospheric Administration, 2009. p.1). According to Blank (2008), focus groups answer questions about a particular topic and can lead to new ideas. The "goal of conducting focus groups is to investigate concerns, experiences, or attitudes/beliefs related to a clearly defined topic" (Barnett, 2002, para 4). According to Weare (2013),

> In academic libraries, focus group research has significant potential as a method of gathering qualitative data to help librarians and library administrators understand how student needs and determine the extent to which the library is meeting those needs. Qualitative data will help librarians identify student needs and determine the extent to which the library is meeting those needs. Focus groups can also be a useful tool of services, as well as evaluate the effectiveness of library programs designed to support student learning. In addition to the new knowledge that focus groups may generate, focus groups can have a significant by-product: the creation of good will among users. Asking students what they want and need can help strengthen their perception of the library as an organization that listens to and understands their needs. (48)

Thus, focus groups are one way to learn about the participants' use of library resources and services.

Interviews

The researcher used interviews for this study because some of the participants were not available to participate in a focus group. The "long interview is one of the most powerful methods in the qualitative armory and gives the researcher the opportunity to step into the mind of others, to see and experience the world as they do themselves" (McCraken, 1988, p. 9). The qualitative interview's purpose is to learn about how the lived experiences of the participants which determine how they view the world (McCracken, 1988). An "interview can range from loose conversations to structured exchanges in which all interviewees are asked the same questions" (Duke Initiative on Survey Methodology, n.d., para 4). Ultimately, the objective of the qualitative interview is to give participants an opportunity to tell their own stories in their own words so the researcher must keep a "low" and unobtrusive profile (McCraken, 1988). By conducting interviews, the researcher in this study was able to learn about the participants' lived experiences.

Data Collection

Undergraduate Women in STEM

After the participants agreed to participate in the study, the researcher first scheduled focus groups based on the similarities in the participants' availability. Finding the similarities in schedules allowed the researcher to group as many of the participants as possible for the focus groups. Typically, the ideal size of a focus group varies from 6 to 12 participants. However, because the participants had various schedules, only three focus groups were scheduled with the undergraduate women in STEM with each focus group consisting of three participants (see Table

3). All the focus groups were conducted in quiet rooms that the researcher reserved on campus so the participants could speak freely about their experiences (Weare, 2013). The first focus group consisted of S1, S2 and S3 and was conducted in the main library. The only focus group not conducted in the main library was the second one, consisting of S5, S6 and S7; instead, it was conducted in a conference room on the Agriculture and Veterinarian Campus. The third focus group consisted of S8, S9, and S10. The day before the focus groups and interviews were conducted, the researcher sent the participants an email reminding them of each session's day, time, and location. On the day of the focus groups and interviews, each participant was given an Informed Consent form to read and sign and was also asked if she could be digitally recorded during the session. Each focus group and interview began with the researcher greeting the participants, thanking them for agreeing to participate in the study, and providing introductions. Each participant introduced herself and stated her classification and major.

A discussion guide for a case study "usually has a list of key questions the researcher would like to cover, with some useful prompts to encourage the participants to talk about their experiences" (Patton and Cochran, 2002, p. 12). According to Merriam (2009), good discussion-guide question should be "open-ended and yield descriptive data, even stories about the phenomenon" (p. 98). Developing a discussion guide requires a clear topical focus and a good understanding of the topic at hand (Cohen & Crabtree, 2006). Questions should be designed to "elicit the participant's experiences" (Turner, 2010, p. 1). Any questions that can be answered with "yes" or "no" should be avoided (Creswell, 2007, p.55). The discussion guide's questions should be as neutral as possible, clearly worded, and open-ended (McNamara, 2013). Once the discussion guide is completed, the researcher may also have the questions evaluated to ensure

Table 3

Focus Groups with Undergraduate Women in STEM

Focus Groups/Interviews	Students	Location	Length of Focus Group and Interviews
Focus Group 1	Student 1 Student 2 Student 3	Quiet room in the main library	42:12
Focus Group 2	Student 5 Student 6 Student 7	Conference room on the Agriculture campus	40:15
Focus Group 3	Student 8 Student 9 Student 10	Quiet room in the main library	41:43
Interview 1	Student 4	Quiet room in the main library	21:02
Interview 2	Student 11 Student 12	Quiet room in the main library	20:23
Interview 3	Student 13 Student 14	Quiet room in the main library	25:02
Interview 4	Student 15	Quiet room in the main library	20:00
Interview 5	Student 16	Quiet room in the main library	23:09
Interview 6	Student 17	Quiet room in the main library	22:06
Interview 7	Student 18	Quiet room in the main library	20:16

they are clearly worded. In this study, the first questions were open-ended about the participants' majors and how these participants decided to major in a STEM field (see Appendix B for the complete Discussion Guide):

- What are some of the influencing factors that helped you decide to major in this field?
- What insights might you want to share for other undergraduate women that major in STEM?

The second set of questions were about the library's role and the participants' use of library resources and services. The participants were asked how often they use these resources and services and which ones they used. Participants were also asked if there were any library resources and services that they needed that were not available and if they believed the library had coordinated its efforts with their departments:

- What resources, materials, services and programs in the library have you used?
- What are the resources that were not available through the library that you think the library should have?

Lastly, the participants were asked how the library has played a role in their academic lives. By asking the participants a probing question using *how*, the researcher was able to get more explanation about how the library specifically played a role in the participants' lives:

- How has the library played a role in your academic life?

According to Creswell (2007), asking such probing questions gives the participants the chance to fully explain their thoughts.

Each focus group and interview session ended with the researcher once again thanking the participants for participating in the study. The focus groups lasted 40 to 45 minutes, and each

interview lasted approximately 25 minutes. Seven interviews were conducted; two interviews involved two participants each, and the remaining five interviews involved individual participants... The researcher sent an email to each participant to verify the day and time for the focus groups and interviews. After the participants responded, the researcher reserved a quiet room in the main library on campus where all of the focus groups and interviews were conducted. Each participant received an email with the date, time and location of the focus groups and interviews.

Academic Librarians/Library Staff

The researcher contacted the potential participants asking if they would be willing to participant in a focus group on undergraduate women in STEM and on the use of academic library resources services. Each potential participant responded and within one to four days agreed to participate. The researcher then sent each participant an email asking for days and times they would be available to meet. The participants responded within one to three days, and the researcher was then able to group participants according to their availability. However, one medical librarian coordinated the schedules of all four medical librarians and sent the researcher the days and times that worked best for the group. Based on the participants' responses, the researcher scheduled three focus groups (see Table 4). The first focus group consisted of L1, L2, L3, L4 and L5. The second focus group consisted of L13, L14, L15, and L16. The third focus group consisted of L6, L7, L8, and L9. Due to various schedules, two interviews were scheduled with the librarians. The first interview session was conducted with L11 and L12, and the second interview was conducted with L10.

Table 4

Focus Groups and Interviews with Academic Librarians/Library Staff

Focus Groups/Interviews	Librarian	Location	Length
Focus Group 1	Librarian 1 Librarian 2 Librarian 3 Librarian 4 Librarian 5	Quiet room in the main library	30:14
Focus Group 2	Librarian 13 Librarian 14 Librarian 15 Librarian 16	Conference room in the Medical Center Library	45:00
Focus Group 3	Librarian 6 Librarian 7 Librarian 8 Librarian 9	Quiet room in the main library	25:07
Interview 1	Librarian 11 Librarian 12	Quiet room in the main library	20:37
Interview 2	Librarian 10	Quiet room in the main library	15:06

The researcher responded to the participants, asking if they would be available on the day and time listed in the email. All of the participants responded, confirming they would be available on the day and time indicated; then the researcher reserved a quiet room in the main library to conduct the focus groups and interviews. Next, the researcher sent each participant an email with the date, time, and location of the focus group or interview. The focus group with L13, L14, L15 and L16 was conducted in the medical library, and one of the librarians reserved a quiet room in the library to meet.

The researcher sent an email to each participant the day before the focus group or interview with the day, time and location of the focus group or interview. On the day of the focus groups and interviews each librarian was given an Informed Consent Form to read and sign. The librarians were also asked if they had any problems with a digital recorder being used to record the sessions. The focus groups and interviews began with the researcher greeting the librarians and each of the librarians introducing themselves and talking about their positions in the library. After the introductions, prompting questions were asked about the library resources and services in general (see Appendix C for the complete discussion guide). The following are sample questions:

- Tell me about resources and services at your library. (What resources and services do undergraduate students use? What resources and services do the students use? What type of questions are you asked about the resources and services offered by the library? Which resources and services do students use the most?)

The librarians were also asked whether they communicate with the faculty and staff in each of the STEM fields to gather suggestions about library resources and services to offer for undergraduate women in STEM:

- What has your experience been working with the faculty and staff in the STEM fields on campus to determine what resources and services the library can offer for undergraduate students?

The next questions were more specific about what type of academic library resources and services were available for undergraduate female students in STEM:

- Tell me about the resources and services for undergraduate women in the STEM fields at your library. (What resources and services does the library provide? What resources and services do the undergraduate women in STEM use? What type of questions are you asked about the resources and services for undergraduate women in the STEM fields? What type of resources and services do women in STEM use the most?

- What resources or services do you think the library should offer specifically for undergraduate women in the STEM fields?

At the end of the focus groups and interviews, the librarians were thanked for participating. Each focus group lasted approximately 25 to 45 minutes and the interviews lasted approximately 15 to 20 minutes.

Analysis

According to McCraken (1988), the object of analysis is determining patterns of intertheme consistency and contradiction. The researcher in this study transcribed all of the focus groups and interviews. Data transcription should be done on the day of the interviews which is what the researcher did immediately after each interview and focus group (Creswell, 2003). The transcripts from all of the focus groups and interviews were analyzed using the inductive thematic analysis described by Braun and Clarke (2006). The researcher carefully read the transcripts to identify potential themes and any interesting features. Transcripts from the focus groups and interviews with the undergraduate women in STEM were analyzed first. The researcher read these transcripts four times. Next, the transcripts from the focus groups and

interview with the academic librarians/library staff were analyzed. Then the codes generated were sorted into potential themes. During this phase, the researcher had to make sense of what was uncovered by compiling the data into themes (Turner, 2010). Quotations from each of the participants were taken and codes (L1, S1, etc.) were assigned to each participant to ensure confidentiality.

To identify people's multiple realities, the focus group and interview transcripts were analyzed to identify themes. Inductive analysis was used to allow patterns, themes, and categories to emerge from the data (Patton, 1987). Van Manen (1990) defined a theme as the "focus or point of a passage; articulating something particularly essential or revealing about the experience described" (p. 40). On the transcripts, the researcher noted the recurring themes. Moreover, Silverman (1993) described a recurring theme as patterns demonstrated across \ several people's experiences.

The themes were labeled using an emic approach. According to Lett (1990), emic constructs are accounts, descriptions, analyses expressed in terms of conceptual schemes and categories regarded as meaningful and appropriate by the participants in the group being studied. In taking an emic approach, the researcher tries to put aside prior theories and assumptions in order to let the participants and data "speak" and to allow themes, patterns, and concepts to emerge (Litchman, 2013).

Criteria for a Good Study

According to Lincoln and Guba (1985), a research study's trustworthiness is important in evaluating its worth. Trustworthiness involves establishing credibility, transferability, dependability, and confirmability. According to Lincoln and Guba (1985),

> Credibility is an evaluation of whether or not the research findings represent a 'credible' or believable from the perspective of the participant in the research. Transferability is the degree to which the findings of this study can apply or transfer beyond the bound of the project. Dependability emphasized the need for the researcher to account for the ever-changing context within which research occurs. Confirmability refers to the degree to which the results could be confirmed or corroborated by others. (p.56)

Qualitative data tend to make the most sense to people who are comfortable with the idea of generating multiple perspectives rather than absolute truth (Patton, 1999). According to Patton (1999), good research should include the credibility of the research which has three elements:

> 1) The researcher should use rigorous techniques and methods for gathering high-quality data that is carefully analyzed, with attention to issues of validity, reliability, and triangulation.
>
> 2) The credibility of the researcher, which is dependent on training, experience, track record, status, and presentation of self. The principle is to report any personal and professional information that may have affected data collection, analysis, and interpretation.
>
> 3) The philosophical belief in the phenomenological paradigm, that is, a fundamental appreciation of naturalistic inquiry, qualitative methods, inductive analysis, and holistic thinking (p. 1190).

For this study, the researcher took every step possible to ensure the criteria for a good research study was followed by asking the participants for permission to audio record their focus groups and interviews in order to get verbatim responses to the questions asked. The researcher transcribed the focus groups and interviews and used codes to protect the participants' identity. A fourth-year PhD student, the researcher has taken two qualitative research graduate courses and learned to design and conduct a good qualitative study. Taking two qualitative methods classes, the researcher developed the necessary skills to conduct focus groups and long interviews, to formulate interview guides, and to analyze data.

Prior to the main study, the researcher also conducted a pilot study at a research-intensive university to practice data-collection strategies, including interviewing and analyzing. Three focus groups were conducted for the pilot study. The first focus group consisted of four female academic librarians; the second focus group consisted of four undergraduate women in the STEM fields; and the third focus group consisted of two academic librarians and two undergraduate women in the STEM fields. For the pilot study, focus groups were used to understand the experiences from the participant's perspectives (McNamara, 2013).

CHAPTER 4

FINDINGS

This study's goal was to address the following questions:

- What role does the academic library have in assisting undergraduate women in the STEM fields?
- How can academic libraries better support undergraduate women in the STEM fields?

This chapter focuses on the findings that were derived from the narratives provided by 18 undergraduate women in STEM and 16 academic librarians/library staff members who agreed to participate in this study. The findings in this chapter are divided into two sections. The first section focuses on the findings from the undergraduate women in STEM, and the second section focuses on the findings from the academic librarians/library staff.

Undergraduate Women in STEM

In expressing relationships with the academic library, three major themes emerged from the focus groups and interviews with undergraduate women in STEM: "Library use," "Professors provide the materials we need," and "We need departmental support." Each will be explored below and supported by direct quotes from the participants to illustrate from where the themes emerged.

Library Use

After analyzing the transcripts from the focus groups and interviews with the undergraduate women in STEM, use of the academic library is apparent. While resources such as books and academic journals are not their main reason for using the library, the fact is that

undergraduate women in STEM need the academic library. It is definitely a place undergraduate women in STEM depend on, but that dependence has to do more with the physical space than the resources available. Use of the academic library by undergraduate women in STEM has been divided into three main themes and four sub-themes.

We Use the Space

When talking about how they use the library, the participants view it as a quiet place to study. The majority of the participants talked about going to the library every day and using the physical space. The library is a place where the participants can gather to study alone and in groups; thus, it is almost like a second home because of the amount of time they spend there. The participants' views of the library are summarized by the following quotes:

> *For me the library is kind of like my second home. I'm here all the time especially this year; it's just really tough for me to study at home so the library is the perfect place. During the day, I stay on the first floor because that is the quiet floor, and there is not a lot of talking like on the second floor. I do like the fourth floor and sometimes the second floor when I come on the weekends because it is a little bit quieter, so I'll come and get work done.*
>
> S2, junior, Microbiology major

> *I go to the library every single day 'cause it is the only place I can really study which is probably a mental thing.*
>
> S6, senior, Food Science major

> *Being in the library gets you in a different mindset because you are no longer chillin' in your room doing your work, kind of in a not a classroom, but a quiet structure where you need to actually do your work.*
>
> S8, sophomore, Math major

One participant not only talked about using the physical space in the library, but also mentioned that the library is also a safe place to meet with other students:

> *When I would be studying all night, um having a place to meet with students like especially if um they are students that you don't really know them, you don't want to bring them to your dorm or to your apartment. Having a place like the library to meet allows you to meet with students even if you don't know them.*
>
> S4, senior, Biological Sciences

While the participants talked about using the physical space in the library in general, the study rooms were frequently mentioned because the participants enjoy using them. Some participants mentioned they preferred to study in groups rather than alone, and having the option to use study rooms was seen as a benefit:

> *I find most of my time is spent in the library with study groups.*
>
> S7, senior, Food Science major

> *I do utilize the study rooms because I usually don't come in here alone, so it's normally like two or three of us that go into a study room cause it's a lot quieter that sitting in the main library.*
>
> S17, junior, Food Science and Technology major

> *I really like how they have set up different group study rooms and quiet study floors, so there are places where people can talk and places where they know they should be quiet so people can focus.*
>
> S11, senior, Mathematics major

> *Um, I have used the study rooms for personal usage, and I have also uh like signed out the rooms for meetings that I held for one of the organizations that I am in.*
>
> S4, senior, Biological Sciences major

Suggestion for improving the physical space

Since the participants visit the library often, they had suggestions for improving the space to better meet their needs:

> *Um, I know there are certain rooms, I guess it's the East or South Commons something like that, those rooms on that side have more dry-erase boards than those on the same side as Starbucks. The rooms on the opposite side of Starbucks*

> *have more dry-erase boards than those on the same side as Starbucks. I don't know why they do, but they just do; but I think um when it comes down to using them for group study, it's more difficult.*
>
> -S9, senior, Mathematics major

> *I think they have chalkboards in some of the group rooms, and nobody carries around chalk. Whenever it's like exam period, it's really hard to get in here regardless of what you are studying for; so more whiteboards and more writing utensils would be great.*
>
> S10, senior, Mathematics and BCMB major

Even with all of the space available in the main library some of the participants thought there should be more:

> *It is always full in here, and there have been a few times when I went to the group study floor and it was full; it was too many people. I go to the Commons and like the rooms they're full; so like if you want to do group work, like hardcore group work, you might have to go to a study room in a dorm instead of the library. I think that the library is always so full and so packed, so they should definitely refine that area.*
>
> S15, freshman, Civil Engineering major

> *It would actually be nice to have a little more space like tables here for laptops and stuff because I've had groups here; and of course around this time of year, it's always crowded. Everybody is trying to use the computers; everybody is having study groups; and so if there were more tables around, we could have more groups and that would be nice.*
>
> S18, sophomore, BCMB major

Free from Distractions

The library not only provides space where the participants can study, but also is a place free from distractions. Having the space in the library to study eliminates distractions and allows participants to focus, as is evident by the participants' responses:

> *Um, I think it would have been really hard not to have the library because you know it allowed me to have a change of scenery.*
>
> S4, senior, Biological Sciences

> *I really enjoy it as a space to just study and go over things. I mean sometimes at home you get distracted, but I think having the library is essential.*
>
> S5, junior, Food Science major

> *Well pretty much for me, it's like there are study rooms in our dorm and different things like that and that's nice sometimes; but sometimes it's like I have to get away from all the distractions.*
>
> S1, senior, Chemical Engineering major

> *Well, I definitely think if you are going to be in math you need to be in the library to do your homework. I think that you can do it [study] wherever you live and listen to music; but at the end of the day, you're going to be having a test in front of you where you don't have music, so you need to be in the library where it's quiet and you can focus on that material. Math is a hard concept; and if you don't have that quietness and fully having all your focus on the math you are going to miss aspects of it, so it's important to be in the library just for the structure it gives you.*
>
> S8, sophomore, Mathematics major

In some instances, some of the participants talked not only about being able to focus, but also how their grades and retention improved by studying in the library.

> *Um, it plays a very important role, like in terms of making the grade and being able to focus. College is very eventful I must say, and it's essential as far as being able to get your work done and being able to have the right resources to complete assignments.*
>
> S16, freshman, Animal Science major

> *If you are going to study anywhere, study here cause it's just not the same atmosphere if you are at your house. My first semester here, I tried studying in my room; and I didn't do too well and I tried the library and it just exponentially helped my grades and helps understanding. You can't blare music or watch Netflix. You need to actually do your work and look at it and focus, so it's nice to have a place where you can go do that cause I know dorms and other apartments try to set up an atmosphere like that, and it's just not the same.*
>
> S8, sophomore, Mathematics major

> *I was just telling one my friends last week, I can tell when I don't come to the library that I've slacked off as far as studying or retaining information. If I do*

come to the library three or four days during the week, I can tell a huge difference like sitting in class and knowing what the teacher is talking about.

-S17, junior, Food Science and Technology major

Technology

The technology that is available in the library is another reason why the participants visit the library. Having computers and printers readily available is convenient. The following quotes summarize the use of technology:

All of the technology is pretty nice, and I know they have Macs and Windows and different types of computers depending on what you are comfortable with.

S12, freshman, Computer Science major

It's really cool that if you don't have a computer you have um like Macs that you can rent out. I think that's really like helpful especially because my computer messes up sometimes so I have to um get one.

S16, freshman, Animal Science major

I use the journal resources, but I usually use the computers and print stuff for my classes when I am in the library.

S11, senior, Mathematics major

I have used the printers before when I needed to print something, and those have come in handy; but I have a printer at home, but those come in handy when I am in a clutch and I don't have any ink or any paper and they are convenient.

S2, junior, Microbiology major

I don't think I found a computer yet that hasn't met my needs. They are always updated, and I am usually able to find an open computer to use when I need it.

S13, senior, Urban Forestry major

Any software that I need to use is always available on the computers, and they are up to date. Usually, I just need to use Microsoft; and I think that is on all of the computers.

S15, freshman, Civil engineering major

Convenient Way to Search for Information

The resources the participants use the most in the library are online, such as the databases and the library catalog. Having the ability to access journal articles is convenient for the participants. However, the participants primarily talked about using online resources in general rather than specific assignments for their major. The following quotes summarize the use of online resources:

> *I mostly use the online library, the catalog; like you can go onto the library's website and look up articles or papers and different things like that or if we need an example of how uh some other groups wrote things up.*
>
> S1, senior, Chemical engineering major

> *Um, the online databases are like the things that I use and that's all that I use. You always have to be looking up some article or something to do a presentation about, so it's really helpful to go straight to PubMed or like some biology database and just look something up and just get whatever paper you can.*
>
> S3, senior, Chemical engineering major

> *If I do not have to use a hard copy of anything like a book and I can do it all online, then I usually stay in the comfort of my dorm; but if it's something I need to see physically, I will come down to the library.*
>
> -S15, freshman, Civil Engineering major

> *I guess online journals have been a major component of what I have utilized at the library, even going back to like sophomore year. Whenever I am doing research of any kind, that's been an important resource.*
>
> S2, junior, Microbiology major

> *I am not a big fan of being on campus all the time because I live off campus, so I usually can login from home and look up journals on the website.*
>
> S11, senior, Math major

> *I did a Summer Bridge Program here for three weeks, and we had to do a lot of research papers; so I was in the library very often because I actually had to use their online database. I was able to do my research through there and like find*

online journals and like academic journals and the articles through their database.

S16, freshman, Animal Science major

I typically use the online resources. It's a little more convenient for me since I don't have time to spend wandering around the library.

S17, junior, Food Science & Technology

Professors Provide the Material We Need

While the participants use the online resources for their general education classes, they were always clear that their professors provided the material needed for their major. For the majority of the participants, based on what they said about materials for their major, the library is not the go-to place for textbooks or information needed to complete assignments:

Most of what we need is in our textbooks, so we don't really need to go to the library and look up too much outside except for the Senior Design Project.

S1, senior, Chemical engineering major

I don't know that I have ever seen them do anything specifically for math, but I feel like they should work with all of the departments to have all of the material that we need.

S8, sophomore, Mathematics major

I honestly didn't know that the library was a big resource for mathematics. I go to the library for my Gen Ed courses, and I would get books and stuff for science; and I have honestly never been to the library for anything math related.

S10, senior, Mathematics major

I came to the library to look up books and articles you can say on the history of math for one math course. Uh, couldn't find a lot, but I was searching; and I think that is the only time I have ever used the library resources in relation to math.

S9, senior, Math major

I can honestly say that it's hard trying to find books on food science, so I do not depend on the library for that; I just use my lecture notes and the articles that my professors give me.

S17, junior, Food Science & Technology

Our concentration is kind of new, and um our advisor did request and make sure that certain books were in there for use; but it's only two books. I know our advisor took the initiative to make sure we had what we needed in there; but as a whole, I still think they kind of don't know that we exist.

S14, senior, Urban Forestry major

I have never had a teacher say to go to the library for food science material, and there is not much on food science in the library; so I basically depend on lecture notes.

S6, senior, Food Science major

It seems like they have a broad range of topics in the library; but at the same time in our department, it's pretty much you know you need these textbooks and you can buy them. The library is not the resource for that because they don't carry whatever texts are used for those classes.

S5, senior, Chemical Engineering major

I think other than just an overall deficit of food science-related material um, I've been able to find what I need for other classes; but yeah, it would be nice to have a little more emphasis placed on food science materials. The materials that I need for food science are given to me by the professors, and I use the notes from lectures.

S7, senior, Food Science major

However, two participants mentioned that the library does have some textbooks available for their major:

The library has certain books; so if I forgot my BCMB book, I can go to like the front desk and ask if they have the book on hand and rent it out for a couple of hours.

S2, junior, Microbiology major

Most of the time, my professors will um, they do put copies of our textbooks in the library. You can rent them out for two hours at a time, and that really helps

because sometimes books don't come in on time; and as a student, I'm on a budget and you have wait.

S4, senior, Biological Science major

We Need Departmental Support

The need for more departmental support was a recurring theme. When the participants were asked about the resources or services that the library could provide to better support women in STEM, there was a constant call for more support from their departments and not the library. While the participants mentioned possibly having study groups for women in STEM held in the library and guest speakers coming to the library, they believe events should be organized by their departments:

I think women I don't know, I would say seminars or like educational sessions to inform women on how they can be involved in a STEM field could be held in the library, but should be organized by the departments.

S13, senior, Urban Forestry major

Um, more of an outreach from the department as far as, um, I guess helping females, um, in those programs because as we know there is not a large number of females in the STEM group. I think like departments should take the initiative to kind of help the females and make sure that like they're comfortable and they're not struggling. I know quite a few females just feel intimidated being in such a, I don't know, setting with so many males around them.

S17, junior, Food Science & Technology

I don't know if this already exists on campus, but like departments could have organized study groups specifically for STEM or women in STEM.

S12, freshman, Computer Science major

Um, I think the biggest issue with keeping women in the STEM fields is like role models and things like that, so I guess if the library had something to do with displaying more women in the STEM fields as role models. I think that should be done more with the departments, but I guess the library could do that.

-S10, senior, Mathematics major

I guess it would be nice to have like, um, maybe like a weekly group or something because I know that they have a lot of study rooms upstairs and in the Commons. So I think it would be cool if like we were able to divide it by the different parts of STEM and like have weekly meet-ups, and we would work on different topics I guess.

-S16, freshman, Animal Science major

There are so many teachers, especially in the lower classes, that are just there to weed you out and they are there to discourage you from what you came for and it's good because you can think about if this is really what you want or if there is something else. Then again, there's also people that are there that just wanna weaken the odds of you getting to a certain place, so that was really hard for me.

S2, junior, Microbiology

Academic Librarians/Library Staff

While there are subject librarians for the various STEM fields, the librarians mentioned they have various titles and roles. Librarians 1-10 are librarians in the main library and also work at the reference desk. Librarians 11 and 12 work in an Agriculture and Veterinarian Library, one of the branch libraries on campus. Librarians 13-16 work in the Medical Library, a branch library located off the main campus.

To explain the services and resources provided for undergraduate women in STEM, four major themes emerged from the focus groups and interviews with the academic librarians/library staff: "Basic library help," "Outreach," "Recommendations/collaboration," and "Gender differences." Each theme is explored below and supported by participants' direct quotes to illustrate where the themes emerged.

Basic Library Help

In addition to their primary roles, all the librarians work at the reference desk and talked about receiving basic library questions. They discussed assisting students by answering general

questions about how to find journal articles or how to gain access to databases. The following quotes summarize services the librarians provide to students in the library:

> *I am expected to know how to answer a lot of different questions, but a lot them that we get over and over are to help with the citations.*
>
> L1, Natural Science librarian

> *I do a lot of work mainly with undergraduates in that capacity, and so we do a lot of general work with general databases and using newspaper databases or the ProQuest Databases and those types of resources*.
>
> L3, Engineering librarian

> *The typical questions that I get at the reference desk are that 'I need to find a citation' or 'someone told me to look at this conference proceeding.'*
>
> L4, Instructional librarian

> *I mean it's like what L7 said. When they come in, we will work with them and teach them how to use the databases and search for certain things, and I mean that's what we are here for. Some people do not realize that, you know, we can help with that stuff; and when they come in, they are really grateful that we sat down with them.*
>
> L10, Medical librarian

> *We do a lot of appointment-based consultations, and I think that's one of our strengths. It doesn't matter if you are a two-year or a grad student because if that's what you need and want, you get it.*
>
> L4, Health Sciences librarian

> *Um, for a lot of the students, it's their first time using the library resources and understanding what a database is and that it can be a specialized search engine instead of Google. We tend to focus a lot on working with students to help them search for information using general databases.*
>
> L10, Student Success librarian

Outreach

The librarians did not mention offering any programs in the library specifically for female students, but they did talk about doing outreach in the departments to which they are

assigned. Some of the other outreach programs were mentioned when the librarians were asked about what programs the library offers for undergraduate women in the STEM fields:

> *A lot of us, the STEM librarians, do outreach in our departments; but I wouldn't say that we have something in the library that is specifically for STEM or females in STEM. The Health Sciences Librarian has a ton of consultations, teaching, and one-on-one with nurses; and there's a lot of stuff going on.*
>
> L2, Instructional librarian

> *I think that over there at the Ag Vet Library, I think that we have got a librarian that works with the Vet School. She is very proactive.*
>
> L1, Natural Science librarian

> *I will say that (L2) and I participated this weekend in a STEM program for high school students. It's an outreach program for potential students that may be coming here, but they are not here yet; and so I did notice that there were more females in the population than males.*
>
> L3, Engineering librarian

> *We are going to have a research day here and there will be some student nurses involved with the nurses who are going back to school.*
>
> L8, Medical librarian

> *We are also a very outward facing library, meaning we do have an Outreach Librarian, you know; and she focuses on the actual off-campus community as well as the campus community. We also do a lot of, um, activities and partnerships with the campus community.*
>
> L7, Student Success librarian

> *We did invite the spouses group to come in and have a special evening with us and show them how to use the databases. Some of them were going to go back to school, and some of them wanted to help their spouses; so we did invite them and try to set that up.*
>
> L16, Medical librarian

> *We have the annual STEM symposium for high schools because that's my role in community learning services. High schools are something that I try to focus on for student preparedness; and so in about April or March, we usually have a symposium, where we invite students from around the state to come to the*

> *campus. As part of that, we invite STEM faculty from around the campus to participate.*
>
> L6, Outreach librarian

One librarian talked about outreach programs that ended due to lack of attendance:

> *We used to have quite a few library programs and try to reach out to students, but we can't ever get anyone over here for our programs. It just dropped off because the attendance was not worth all of the time and effort we put into it just for a few people.*
>
> L5, Natural Science and Mathematics librarian

Another librarian discussed outreach attempts that have not been successful, but recognizes that outreach can be effective:

> *I think the most effective outreach would have to be more individualized because then it is more targeted. For instance, when we tried to reach out to do some stuff with one group of students on campus, we tried to do some stuff, and it hasn't been that successful. The more you can find pockets of people and appeal to things that are in their group, then those could be effective.*
>
> L11, Agriculture librarian

Recommendations/Collaborations

The librarians discussed instances when some faculty members would offer recommendations about library materials to purchase. At the same time, the librarians also talked about being willing to collaborate with faculty in the STEM departments to plan programs or events:

> *I think it varies very widely, so the easy answer is that we work closely with faculty and take recommendations and things based on recommendations and consult with faculty whenever possible. The more complicated answer is that we do that with the faculty who are more willing to engage in that or interested in it, and then have to make guesses in more broader [sic]things with faculty. Sometimes they are very engaged, and the faculty come by and drop off things and are like, 'I'd like this, or I'd like that.' The other librarian who is not here and does a lot of the ordering for the veterinarian side of things works more with her faculty because it's a much smaller college. She is able to develop relationships with those individuals; but even there, saying you work closely with faculty hides the fact that 80% of faculty you don't work closely with. For one*

> *reason or another, 80% of the faculty are not interested, don't know you're there, and you haven't had a chance to have that outreach to them.*
>
> L11, Agriculture librarian

> *You always have some faculty that are more proactive and communicate more than others and the students ask themselves for things that they need.*
>
> L4, Natural Science librarian

> *We absolutely have references from faculty members; and so we, uh, each have departmental liaisons that work with and are really in contact with those faculty. We are also involved with the graduate students; we have worked with the Nursing Society and each librarian is on a Nursing Council.*
>
> L16, Medical librarian

In terms of collaborating with the STEM departments, the librarians mentioned they were willing to collaborate with the faculty in the departments:

> *To do the big program, it's got to be collaborative; and I think it's got to be more from the department. Then we might jog up lots of things that come out of departments, and it might be better that way.*
>
> L9, Health sciences librarian

> *We would definitely work with the faculty in the STEM disciplines; but it would have to be a partnership, not just the library but with the faculty in those disciplines.*
>
> L10, Student success librarian

One librarian even discussed teaching classes in one department:

> *I do go to some of the introductory classes and graduate classes over in the College of Engineering and help them identify topic areas for their papers and help them find materials in Web of Science. I teach some of the specialized classes, like the standards class and material science and a few others. I would say that most of my teaching is done outside of the library and in the College of Engineering building.*
>
> L3, Engineering librarian

Gender Differences

When asked about gender differences between males and females in STEM in terms of library resources and services used, the librarians did not feel there were any specific differences:

> *I have watched some the students that I worked with last year when they are studying, and the girls and guys are in groups working together and using the whiteboards; so I do not see any differences.*
>
> L1, Natural Science librarian

> *I don't think we really have a difference. There may be some books that might be tailored more towards one or the other, but we really haven't had a demand for that type of thing. I don't really see any difference by the books that we buy because they are not really gender specific.*
>
> L9, Medical librarian

> *On the undergraduate level, I really do not see any differences between what the girls use and what the guys use, just some differences in the general questions that they ask.*
>
> L2, Instructional librarian

> *Our most popular service is the chat reference, and we will get engineering standards questions; but of course it is anonymous, so we can't tell who is asking us and if there are more males or females.*
>
> L4, Instructional librarian

However, two of the librarians mentioned that female students tend to ask them more questions, but they were not sure if that was because they were female librarians or because they were the librarians sitting at the reference desk:

> *When students in engineering come to me, the male students ask to use the same resources as the female students. Sometimes they need help with topic selections for papers and the guys too. I think that being a female Engineering librarian, sometimes the female students are more likely to come to me if they are having a problem; but maybe that is just me, but I'm not sure if that is true or not.*
>
> L3, Engineering librarian

> *Well, I tend to get more questions from female students whether they are graduate or undergraduate. I don't know if that's just because they are more willing to ask for help. I had a couple of questions once after an instruction session from girls just because I am a woman I guess, but I do tend to get more questions from female students.*
>
> L12, Graduate Research Assistant

In two instances, librarians talked about gender differences in terms of assisting females and males when they are searching for information:

> *Usually what happens is and this isn't always true; but when a guy comes, he asks for something more specific. I'll ask him if he wants me to show him how I found it; and sometimes he will, and I'll go ahead and show him. I get a lot more questions from girls about, 'well I just kind of want you to walk me through this so I can do my research better.'*
>
> L14, Medical librarian

> *I think that the women residences and students are really more interested in how we found it, and they will ask you because they have already been trying; and the men, you know, they don't care.*
>
> L15, Medical librarian

One librarian commented on the fact that women in one program search for information on the role of women;

> *We do have a Pastoral Care Residency, and now there are some issues there where the women who are in that program will be looking at the role of women in society and dealing with how the women have different things related to family systems and to the roles by ethnicity or generation. That's something we'll actually have a group exploring; and the ethics people, that's another one; so it gets into the family systems.*
>
> L16, Medical librarian

This was the only reference to any gender differences, specifically related to resources used.

Summary

In summary, undergraduate women in STEM look to the academic library more for the physical space than for information resources. The library allows the undergraduate women in STEM to escape distractions so they can study and provides them up-to-date technology to use and access to electronic resources, which can conveniently be used on and off campus. They depend on the professors in their departments to provide the academic resources they need for their studies. However, the undergraduate women in STEM also need more support from their departments in terms of guidance and mentors.

The academic librarians/library staff provide basic library help to assist students with their research needs. They also do outreach to connect with the faculty and students on campus and make them aware of what is available in the library. The academic librarians/library staff members are open to recommendations from faculty and students about resources and services that the library can provide and also are willing to collaborate with faculty and students to plan events or assist departments with library materials. There really are no noticeable differences by librarians in terms of resources and services that males and females use in the library. The only gender difference pertained to information seeking. Some librarians noticed that females wanted to know each step to take when searching for information while males just wanted to get the information they needed.

These findings' academic and managerial implications, along with recommendations for future research are discussed in the next chapter. These implications and recommendations will be beneficial to not only library administrators but also practitioners. This information will be useful to the library in terms of identifying providing the resources and services that undergraduate women in STEM need and will use.

CHAPTER 5

DISCUSSION

This chapter explores the implications of the present study's findings for two audiences. First, administrative applications are discussed, with suggestions for how librarians and library administrators can make the library more useful for undergraduate women in STEM. Secondly, academic implications for academic researchers are explored. S5's following comment summarizes the library's importance: "Libraries are great and they will never be obsolete. I think that some people think that libraries will become obsolete since everything has become electronic, but I'm here to negate that because I do not think that is true."

Administrative Insights

Physical Space

The academic library has been described as the learning community's center, providing a place for students and faculty to do their research and advance their knowledge (Simmonds & Andaleeb, 2001; Yusuf &Iwu, 2010). The physical space in the library provides students a place to study, focus, and use technology. According to ACRL (2013), "Undergraduate library facilities should foster the collaborative nature of study, research, and learning." According to students' narratives, having physical space in the library is essential as all of the students talked about their daily use of the library. For example, S7 said, "Just having that space, I mean sometimes these buildings get busy and it's just nice to know that you have a little hole to just focus on what you are doing and quiet time." According to Applegate (2009), a "substantial body of literature is available on using the library as a place but focuses mainly on renovations and new construction in the library" (p. 342). However, undergraduate women in STEM like the

physical space and talked at length about using the space more than any of the library's resources or services. The need for and use of this space shows the ongoing need for academic libraries. After examining library patrons' use of library space, Gayton (2010) concluded that what library patrons "find most useful and appealing are communal spaces that encourage serious studying" (p. 60). Other studies about the use of library space show that library users like the library because it provides a quiet place to study (Vondracek, 2007; Gordon-Hickey & Lemley, 2012).

Responses from the undergraduate women in STEM about the library's physical space can also justify the need for the academic library. An undergraduate library survey conducted at Boston University showed that students use the library as a place to study (Plunket et al., 2013). Since the undergraduate women in STEM use the space in the library, more research is needed in this area. While research on construction and new renovations in academic libraries is important, the focus on why students use the physical space in the library is equally as important. According to Kuh and Gonyea (2003), the "library is the physical manifestation of the core values and activities of academic life" (p. 148).

S6's comments reinforced e the use of library's physical space:

> "It's essential to me for sure because I have a two-hour break every day and sometimes I have longer than that, and I use that time to study and catch up on assignments. If I didn't have that time then, I would be totally overwhelmed by the time I got home; and I don't think my grades would be as good if I didn't have the library to study at."

Based on this study's findings, the library's physical space is what the undergraduate women in STEM use most in the library. These women are in the library daily or weekly to study independently or in groups to use the space.

Information Resources/Indirect Use of the Library

While the academic library is usually seen as the place to find academic information, the undergraduate women in STEM who participated in this study view the library differently. They discussed receiving articles needed for their STEM classes from their professors, rather than accessing them directly from the library themselves. Instead, their professors provide those articles because of access to journals through the library. S1 observed,

> I feel like in chemical engineering we use articles, but they are either given to us by our professors or it's their research. They send us the material that we need, but I feel like we don't do a whole lot of pulling papers and using the library material.

This quote reinforces the need for more library-instruction courses so students can learn about library directly available resources. If the library did not provide access to academic journals, professors would have to spend more time finding ways to gain access to journals to provide articles for the students to read.

One suggestion for academic librarians to work with faculty members and provide a link on course sites to the resources that students need for the semester, thus encouraging students to directly use library resources. This collaboration would be another way for libraries to build a relationship with faculty members in STEM. Also, the resources could be copies from one semester to the next, eliminating the need for professors to print or post the same articles each semester. Furthermore, librarians could post other resources, such as book titles or speeches by women in STEM that the undergraduate women could access. The library's visibility would also be increased if the link to the library's resources indicated that they are provided by the University Library. Increasing the library's visibility would also be useful in showing the need for the library increasing the budget to continue providing necessary STEM resources for

students, and connecting students with other resources such as career opportunities. All of these benefits have academic implications in terms of collaborating and providing more support.

Safe Place

Safety is important for women and the fact that undergraduate women view the academic library as a safe place to meet is important. About "19% of undergraduate women have reported experiencing completed to attempted sexual assault since entering college." (Swanson, 2014, "Get Inclusive"). According to the World Health Organization (2013) violence against women is one of the most pervasive yet least recognized human rights abuse in the world." This is information is important because safety is an issue for women on college campus and in general. The academic library is also viewed a safe place where students can meet as students mentioned. Having a safe place to meet is especially important when meeting with classmates or other students in organizations that they just met and since the academic library is a typically located in a central location on campus with other people around is the perfect place to meet. Academic library facilities provide library users with a "safe, comfortable, well-lit, clean space with adequate and appropriate study, research and collaboration space" (ACRL, 2013).

Libraries have been viewed as safe places for decades. Hooks (2012) discussed how librarians provide both help and safety in public libraries as many librarians become well acquainted with their frequent patrons; the same also applies to academic libraries, specifically for female students. There is the safety of being in a building on campus surrounded by other students, librarians, and faculty. Such safety reinforces the library's importance. Most literature on the library as a safe place specifically focuses on public libraries because they serve the communities. Public libraries usually have information on their websites about safe places or safe zones not only for women but for teens and members of the LGBT community. Academic

libraries are also safe places for students, particularly females, to meet with other students, as indicated in this study. While academic libraries also serve communities at large, their main focus is on students and faculty on campuses; thus, they are not discussed as being safe.

Challenges for STEM Librarians

STEM librarians' information-seeking behavior is also important. Brown and Ortega (2005) surveyed 72 physical science librarians to study their information-seeking behavior. The survey results showed that "personal communication and listservs were the most important resources used by the librarians" (235). Scholarly journals, websites, and professional magazines were the next three resources that librarians used to find academic information. The librarians indicated that "Library and Information Sciences (LIS) literature became less important as they gained more experience in the field with the exception of those who have been in the field for six to ten years" (236). However, 49 percent of the librarians indicated that *College & Research Libraries* (C&RL) was one of the top journals in LIS to read followed by *Issues in Science and Technology Librarianship* (ISTL), which is a trade magazine. Personal communication is the preferred way for physical science librarians to learn more about their practice. Much like their "physical science faculty colleagues, the librarians use the literature to inform their instructional and research activities but read it to learn about best practices in the field" (243). STEM librarians also rely on personal communication with colleagues as their first information-seeking avenue. However, reading journal articles, searching websites, and reading professional magazines are also ways practitioners search for information.

Practitioners' information-seeking behavior is another area that needs to be further discussed in the literature. While most literature focuses on the fact that librarians assist students, faculty, and STEM researchers with finding information, little has been written about how

practitioners seek that information. The literature that is available suggests that practitioners rely on their colleagues, electronic resources, journal articles, and professional magazines.

Working Together

The undergraduate women in STEM and academic librarians/library staff discussed outreach, which is essential for undergraduate women. While the undergraduate women in STEM suggested using the library for programs, in order for that to happen, there must be more outreach from not only librarians but also faculty and staff in STEM. Displaying collections of books, DVDs, pictures, etc. of women in STEM in the library may seem like a small gesture, but seeing women in STEM would help undergraduate women. Academic librarians/library staff discussed how outreach has to go both ways; if librarians are reaching out to faculty and staff, the faculty and staff must be willing to respond. All of the librarians mentioned they are willing to collaborate with faculty and staff in STEM, and this collaboration is important for undergraduate women. With the academic librarians, faculty, and staff working together, programs could be created and events scheduled to support undergraduate women in STEM. According to L11, "What we need are some more librarians with the time to go out and spend time talking to the students." Talking with students is necessary to determine what they need. Outreach should involve not only the librarians, but also the faculty, who have more contact with students. Outreach is another opportunity for librarians and faculty members to work together and discuss ways to reach out and talk with undergraduate women in STEM. Since the students enjoy using the space in the library, meetings could be held in the library to discuss ways to better support students.

According to Malenfant (2010), librarians must communicate with faculty regularly and be an active part of academic life. L4 said,

> "There are so many opportunities for women in STEM via associations and meetings and things like that. While I am not a STEM librarian, there are ways that we could tap in and talk with some of the faculty and students."

This comment shows that the librarians are willing to work with the faculty in the STEM fields. Furthermore, female professors in STEM need to continue offering support to undergraduate women in their departments. L3 observed,

> "I think that, um, there are a lot of mentors in the Engineering College. For example, I was set to go to the STEM symposium and we had a faculty panel, and all the people that volunteered for that were women professors."

Librarians could also work with faculty members and help in hosting an event in the library or in bringing speakers to the library. The librarians could also listen to the suggestions of the undergraduate women in STEM and have programs or events based on what they want and need. One idea would be for the librarians to post on the libraries' website videos of women in STEM giving speeches so that undergraduate women in STEM could see and hear these women talk about their experiences. These videos would also be a way to connect the undergraduate women in STEM to more resources specifically for them.

However, L9 discussed collaborating with faculty members but also not wanting to overstep her boundaries:

> Even if the library decided, 'Ok, next year we're going to do something for nursing students, people offering career advice,' I would partner with the College of Nursing include them 'cause it just um, it almost feels a little weird you know."

Collaboration is key and needed from the STEM faculty and librarians. Library liaisons must also work towards "establishing collaborative partnerships to serve and empower student learners and enhance scholarly productivity" (Silver, 2014, p. 2). Collaboration is also involved in outreach, which would involve not only involve faculty members and librarians but also

students since they are asking for more support. One way the library could reach out to undergraduate women in STEM would be through social networking sites, which most academic libraries have, to meet student on their own turf (Charingo & Barnett-Ellis, 2007). Since most students use social networking sites, these sites could be a good way to announce programs offered in the library that STEM faculty and librarians organize.

Allowing the undergraduate women in STEM to organize and hold study groups in the library would be another way for librarians to collaborate with students. Undergraduate women in STEM could meet in the library; announcements could be posted on the library's Facebook page about the study groups which would be seen by other undergraduate women in STEM. S16 said, "I would really like to have study groups or tutoring like they have for general classes because there should be something specifically for women in STEM because we need that." Once again, this suggestion relates to not only collaboration, but also outreach in terms of connecting with the undergraduate women in STEM and having an area where they can meet for study groups. While collaboration and outreach should involve librarians and students, the faculty and staff in the STEM departments are key in terms of reaching the majority of the undergraduate women in their departments.

Academic Implications

Two main areas of academic implications were identified. The first area focuses on undergraduate women in agriculture and how they "fit into" STEM. Based on this study and as reflected in academic literature, undergraduate women in agriculture feel excluded from STEM. Though not new, the second area of focus deals with support and is still extremely important for women in STEM. Women are underrepresented in the STEM fields and need support in the form of mentorship and guidance.

How Do We Fit In?

Undergraduate women in agriculture believe they are part of STEM but are unsure how they fit in with the rest of the STEM fields. However, the majority of the courses that the undergraduate women in agriculture take are science and technology courses yet they feel as though they are not considered to be a part of STEM. They believe that they are in fact part of STEM but some are unsure of how they fit in with the other STEM majors. S5 said, "I think that we should be added to STEM, because a lot of people in STEM think that we are not because they think of agriculture and they think of farmers and that is all they think about they don't think about food sciences." S17 believes that her major is a part of STEM but was not sure about exactly how she fit in with the other STEM majors when she said,

> Yes, I am a part of STEM, but it's kind of hard to say even though science and technology is included in my major. I guess someone on the outside looking in wouldn't classify us as a STEM major; but doing the work and comparing it to the other STEM majors, it's about the same; so yeah, I am part of STEM.

S16 said, "I do consider myself to be a part of the STEM fields but I don't really know how I would fit in. I've always done like STEM related programs, like I did the Summer Bridge program and that was all about STEM so I do consider myself to be a part of STEM." The agriculture majors are part of STEM but it is not as clear cut as actually being a science, technology, engineering or mathematics major. Most academic literature on women in STEM and specifically on undergraduate women does not mention agriculture majors.

After attending a STEM job fair some of the undergraduate women felt that they were excluded from STEM. S5 talked about her experience at the job fair and said,

> "There was a STEM and engineering fair last week and there were some food companies there for us food science folk, but they were there for engineers. When

> we talked to them about food science some of them didn't know who we were and I'm thinking we do a lot of science too."

S6 followed up by saying, "Yeah, when I was there I had someone ask me if I know what microbiology was and I was like yes, I know what microbiology is." S7 said,

> "I felt like at the STEM fair yes there were some food companies there but they were no necessarily there for food scientists. I mean a lot of it was just logistics and operations and you know to talk to someone about product development or packaging or something like that the representatives that were there from those companies were not interested in that at all."

S6 said, "Which makes you feel like you are not included in STEM." S13 also talked about her experience at the STEM job fair, "There was a STEM job fair last week and if you walked in with a major that wasn't science, technology, engineering or math then they told you this isn't for you so they really stick to what they view as STEM." Even at job fairs for STEM majors where the agriculture students are encouraged to attend there seems to be no place for them and they feel excluded from STEM.

Although S13 and S14 do not necessarily think they are part of STEM, \they know the background for their majors consists of science and technology courses. They also believe they are not a part of STEM because they think that STEM is specifically for science, technology, engineering and mathematics majors. S13 said, "I wouldn't consider myself really STEM because I know it's a kind of science urban forestry; but in the overall aspect, I just think of it STEM as science, technology, engineering and math majors like what it stands for." S14 also said, "I don't know if we are in STEM, but a large amount of what we do is like science classes and that's our background; but it happens to be tree science or botany and technology." While both students think they are not part of STEM, they actually are, and because agriculture majors should be included in STEM literature more often.

Support Us

As noted in chapter one, women in STEM are not getting the support that they need. Many of this study's participants discussed the lack of faculty support and guidance. The participants need support and guidance from STEM faculty members, especially since they are underrepresented in the STEM fields and in their classes compared to males. Academic literature continues focusing on women needing mentors, guidance, and faculty support; but that need is being ignored. Thus, university faculties need to be more involved in providing more support for women in STEM. Research on retaining women in STEM often discusses the need for female role models and mentors (Xu, 2008; EAS, 2011; Leary, 2010). The students really need for the faculty and staff in the STEM departments to provide more support by having alumni to speak or even showing pictures of DVDs of women in the STEM fields who have been successful. At least this would give the undergraduate women some indication of what they could do with their degrees and the opportunity to see women who are successful in STEM.

When asked what the library could do to better support them, students repeatedly mentioned needing departmental support. For example, S2 said,

> I'm a STEM major and I need help and there's not many people that can help me with my biology work, so it would be nice if there were groups in our department and we could meet and study in the library. It feels like I am on my own, and you have to find your own mentor and so maybe the library could offer an opportunity for all women in STEM so we could meet and build a community.

S12 discussed the lack of departmental support:

> My issue with the math department is that they don't take too much interest in the students in general, so that's probably been an issue. You're probably gonna have to make them notice you if you really need help, and that's not right.

Thus, these students, who are not getting the support they need from their departments, desire having mentors and role models or gathering to build a community with other undergraduate women in STEM. Mentoring is one way to encourage students in underrepresented groups in the STEM fields to enter and stay in the field. In the School of the Sciences (SOS) at Stevenson University, the emphasis on mentoring has "contributed to an increased sense of community and collegiality" (Gorman, Durmowicz, Roskes, & Slattery, 2010, p. 1). The majority of the faculty members are women, and student -faculty mentoring is extremely important. The SOS vision "celebrates the transformative role that faculty members play when taking on the role of mentor to students and the students are able to develop strong relationships in a research-rich environment" (p. 9). This is one example of how faculty members are involved with undergraduate women in STEM and mentoring, which should be the case with all universities. The need for support cannot be taken lightly, and more action is needed to help undergraduate women in STEM so they know there are people on campus, including in their departments, willing to help them.

Conclusion

This study's goal was to determine what role the academic library plays in assisting undergraduate women in STEM and if the library can provide more support. This study's findings indicate the academic library plays an important role in supporting undergraduate women in STEM because while they do not depend on the library for resources related to their major, they do depend on the physical space as a quiet, distraction-free place to study with technology readily available.

Thus, academic librarians should have more outreach activities and collaborate more with the STEM departments' faculty and staff to better support undergraduate women in STEM. As

previously indicated, such collaboration must go both ways. The STEM faculty and staff must also be willing to work with librarians in a team effort.

This study is important because it shows that the library's physical space is essential to undergraduate women in STEM. They depend on using the space daily, but do not necessarily perceive the library as an information resource. While undergraduate women in STEM may not view the academic library as a resource, they are also unaware of how they indirectly use the library resources, an area librarians can include in library instruction sessions. Unless students are directly using library resources and services, they often are unaware of when they are indirectly using the library resources and services. All of these findings should be valuable to library administration. Furthermore, for academic researchers, this study has shown that agriculture majors need to be included in literature on women in STEM. Most of the undergraduate women in agriculture who participated in this study know they belong in the discussion on STEM but are not sure how they fit in because they are often excluded. Another area that must continue to be discussed and where more action is needed deals with support for women in STEM. This study shows that women, and specifically undergraduate women in STEM, are still not receiving the support that they need from their departments. Support is in terms or mentors and guidance is important so that they women know what opportunities are available for them, the classes to take, and to see other women who are successful professionals in the STEM fields.

Limitations

This study has a few limitations. Because this is a case study, all of the participants were from the same university; thus, the findings may not apply to other universities. Also, the undergraduate women in STEM represented only a small portion of the campus's population.

While every STEM field was represented, the biggest issue was the fact that there were very few technology majors. Because there are very few technology majors, they were not as well represented as other majors. Urban forestry majors were recruited in particular because they take various science and technology courses so they helped to fill in for the lack of technology majors. Agriculture and veterinarian majors which also included the urban forestry majors were recruited because the majority of the classes they take for their majors are science. Agriculture majors are rarely if ever mentioned in STEM literature though they are definitely are a part of STEM.

There were also limitations with the academic librarians/library staff. First, the subject librarians for each STEM field noted that subject librarian is not their primary title and that their primary focus is not on being a subject librarian. Instead, the majority of the librarians work in the main library and are in contact with students from all majors on campus. . Because they work in branch libraries, the agriculture and medical librarians have more contact with students in their fields. However, since there are not branch libraries on campus for each of the STEM fields, all of the subject librarians in STEM do not have as much interaction with the students in their fields.

Implications for Future Research

There are various areas for future research for undergraduate women in STEM, academic libraries and STEM departments. The use and importance of the physical space by undergraduate women in STEM is one area open for research. The connection between undergraduate women in STEM and using the academic library's physical space can help promote academic libraries' importance. Research studies can focus on what these libraries' physical space means to

students. The undergraduate women in STEM talked about using the physical space in the library and having that space available to use.

Another area for research would be on departmental support in the STEM fields because the undergraduate women indicated they want and need support from their department. More research should be done on ways that faculty and staff members can better support undergraduate women in the STEM fields. These undergraduate women need support and have suggestions, but the faculty and staff members can also provide insight for implementing changes within the departments. After talking with undergraduate women, the faculty and staff could then meet with librarians and discuss how the library can lend support, including providing physical space where events or study groups can be held. The best way to provide support would be through more collaborative efforts among the faculty, staff, and students. According to Bear and Woolley (2011) promoting the role of women in STEM can have positive consequences for scientific productivity by enhancing collaboration's quality.

Outreach connected to collaboration needs to come from the faculty and staff in STEM along with librarians. The faculty and staff in each of the STEM fields could have outreach events for undergraduate women in STEM during their freshman year. By reaching out to them during their freshman year of college that will start to build a foundation and the undergraduate women in STEM will know a support system is available.

Faculty and staff in STEM could also meet with the librarians and discuss library resources available for students. Furthermore, events could be held in the library where women from each of the STEM fields could be available to speak with students as a group and individually. The librarians could also offer suggestions. These are areas open for more research.

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Appendices

Appendix A

THE UNIVERSITY of TENNESSEE
KNOXVILLE
Office of Research & Engagement
INSTITUTIONAL REVIEW BOARD (IRB)

1534 White Ave.
Knoxville, TN 37996-1529
865-974-7697
fax 865-974-7400

October 21, 2014

Rebecca Okelly Davis,
UTK - Comm/Info-Admin

Re: UTK IRB-14-09496 B-XP
Study Title: Women in STEM and the use of Academic Library Resources and Services

Dear Ms. Davis:

On 10/20/2014, the UTK Institutional Review Board (IRB) reviewed your application for **revision** to your previously approved project, referenced above. The IRB has reviewed the revisions to your project and determined that they comply with proper consideration for the rights and welfare of human subjects and the regulatory requirements for the protection of human subjects. Therefore, the Board approved the attached revisions. Approval does not alter the expiration date of this project which is 04/30/2015.

In the event that subjects are to be recruited using solicitation materials, such as brochures, posters, web-based advertisements, etc., these materials must receive prior approval of the IRB. Any revisions in the approved application must also be submitted to and approved by the IRB prior to implementation. In addition, you are responsible for reporting any unanticipated serious adverse events or other problems involving risks to subject or others in the manner required by the local IRB policy.

Finally, **re-approval** of your project is required by the IRB in accord with the conditions specified above. You may not continue the research study beyond the time or other limits specified unless you obtain prior written approval of the IRB.

Sincerely,

Colleen P. Gilrane

Colleen P. Gilrane, Ph.D.
Chair
UTK Institutional Review Board

Appendix B

Interview Guide for Undergraduate Women in STEM

Good Morning/Afternoon,

Thank you for agreeing to participate in this focus group. I am going to start with some basic questions about your major.

Your Major

1. What is your major?
2. What are some of the influencing factors that helped you decide to major in this field?
3. What are your career goals?
4. What have been some significant or memorable experiences in STEM?
5. What have been some challenges that you have faced in STEM?
    1. How did you overcome those challenges?
6. What insights might you want to share for other undergraduate women that major in STEM?
7. What else might you be able to tell me that would help me better understand your experience majoring in one of the STEM fields?

The Role of the Library

8. What has the role of the library been as undergraduate women in the STEM fields?
9. What resources, materials, services and programs in the library have you used?

10. In the past week how often have you used the resources, services and programs in the library?
11. What are the resources that were not available through the library that you think the library should have?
12. Is it clear to you that the library has coordinated its efforts with your department to have resources and services that you need?
13. How has the library played a role in your academic life?
14. What else might you be able to tell me that would help me better understand the role that the academic library plays as undergraduate women in the STEM field?

Appendix C

Interview Guide for Academic Librarians

Good Morning/Afternoon,

Thank you for agreeing to participate in this focus group. I am going to start with some basic questions about working in the library.

1. Tell me about your experience working in the library on campus.
2. Do you have a branch library on your camps for the STEM disciplines?
3. Do the librarians for STEM have backgrounds in STEM?
4. Tell me about resources and services at your library (what resources and services do undergraduate students use, what resources and services do the students use, what type of questions are you asked about the resources and services offered by the library, which resources and services do students use the most)?
5. What do you think about the resources and services and how effective they are?
6. What has your experience been working with the faculty and staff in the STEM fields on campus to determine what resources and services the library can offer for undergraduate students?
7. What type or library resources and services do the faculty and staff in the STEM fields recommend specifically for undergraduate women?
8. Tell me about the resources and services for undergraduate women in the STEM fields at your library (what resources and services do the library provide, what resources and services do the undergraduate women in STEM use, what type of questions are you asked

about the resources and services for undergraduate women in the STEM fields, what type of resources and services do women in STEM use the most)?

9. What resources and services do female undergraduates in STEM ask for or use in the library?
10. What resources or services do you think the library should offer specifically for undergraduate women in the STEM fields?
11. What else might you be able to tell me that would help me better understand the resources and services at your academic research library?

Vita

Rebecca Davis is from Elizabeth City, North Carolina. She received a Bachelor of Arts degree in Political Science from The University of North Carolina at Chapel Hill in 2006. In 2009, Rebecca received a Master of Science in Library Science degree from the University of Kentucky. Rebecca attended The University of Tennessee and received a doctorate degree in Communication and Information.