An Examination of Undergraduate Research Gains
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ABSTRACT
Previous research has shown students generally benefit from engaging in undergraduate research experiences. These benefits include professional and personal gains, increased knowledge, improved communication and collaboration skills, and development of a clearer career path (Cetkovic-Cvrlje et al., 2013). To assess students’ perceived benefits from conducting research, we interviewed 19 students who submitted an abstract to Capital University’s Symposium on Undergraduate Scholarship. Results indicated that generally students feel they receive positive academic, professional, and personal benefits from conducting research. Findings showed that frequent interaction with faculty mentors was related to higher ratings of students’ overall mentorship and research experiences. From this assessment, the researchers recommend that faculty provide more encouragement to students, particularly in the initial stages of students’ research projects, and establish routine and frequent communication with their student researchers.

INTRODUCTION
Many would agree the purpose of higher education for students is to receive an education that challenges them and encourages intellectual growth. Mattick and Knight (2007) found that self-directed learning – that is, learning that requires students to take responsibility for their own topics of study – encourages students to work in a manner similar to that of a professional in their field. Further, student-directed learning was found to motivate students to take a deep-level approach to learning.

Evans et al. (2003) explored the concept of deep versus surface learning. Surface learning refers to students’ motivations to learn academic material to meet short-term goals, like passing a test, rather than to truly understand the material. Deep learning refers to students’ fully learning academic material and applying the material to a bigger picture. This kind of learning was found to indicate particular metacognitive strategies students use, such as adaptability and self-regulation. These metacognitive abilities allow students to analyze and critically think about information, as well as extrapolate and apply that information into a more comprehensive knowledge base (Evans et al.). These findings indicated students’ intrinsic motivations for learning influence the quality of their learning experience. Experiences that help motivate students to engage in deep thinking and metacognitive strategies foster high-quality learning which helps students move from a student-level to a professional-level of thinking.

In addition to identifying the relationship between a deep learning approach and high-quality learning, Mattick and Knight (2007) discussed the phenomenon that results from institutions understanding students’ perceptions of the learning process. They found universities are using students’ perceptions of learning to shape curricula rather than designing curricula based on the intent of course instructors. While course curricula should not be entirely constructed based on student perceptions, it seems it is important for universities to consider their students’ perceptions of learning. In accounting for students’ perceptions of the learning process, a university can design curricula to include learning opportunities that are more likely to engage students.

A pedagogy that engages students and promotes high-quality learning is for undergraduate students to conduct research projects. Cetkovic-Cvrlje et al. (2013) found that students who participate in research experiences related to their field of study generally gain a positive perception of their overall learning experience at an institution. Within the context of understanding how institutions of higher education can promote high-quality learning, this is a significant finding that emphasizes the need for quality undergraduate research experiences. If students have a positive perception of the learning process by engaging in a self-directed learning activity like research, deep-level approaches to learning are simultaneously encouraged (Mattick & Knight, 2007).

Cox and Andriot (2009) addressed one component of students’ research experiences by examining the importance of the mentorship aspect of the undergraduate research process. Students who reported having good relationships with mentors gained a higher level of research expertise than students who had poor relationships with their faculty mentor. Taraban and Logue (2012) suggested a positive relationship between the quality of faculty mentorship and the level of deep learning instilled in students conducting research and concluded that faculty-student interactions are important to student research success. Taraban and Logue (2012) suggested further examination of faculty-student interactions to determine what practices work well in these relationships to encourage student learning.

Though studies have examined factors leading to successful research experiences (e.g., Cox and Andriot (2009) compared students’ perceived gains of their research and faculty mentor perceptions of students’ gains), limited research exists about students’ understanding of what they gained from conducting undergraduate research. Therefore, there is a need for more exploration into
what factors students feel create a successful high-quality undergraduate research experience.

For a university to gauge its effectiveness in providing research experiences that encourage high-quality and deep-level learning, assessment is necessary. Sarrico et al. (2010) emphasized that a clear definition of “assessment” must be determined before conducting any quality assessment within universities. Whereas the common “performance evaluation” technique is used to evaluate a specific program or course, quality assessment is more holistic, focusing on internal improvements that are necessary within a university’s functioning systems, such as learning opportunities (Sarrico et al.). It is important to note, as Gansemer-Topf (2013) pointed out, that good assessment requires action, not just research and data collection.

The current study was designed to assess students’ perceived benefits from undergraduate research experiences at Capital University, a small, midwestern liberal arts university. As the university holds a Symposium on Undergraduate Scholarship every spring, faculty coordinators of the symposium desired quality assessment to determine what improvements could be made to enhance students’ experiences and encourage other students to participate in research projects. Specifically, one faculty coordinator wanted to determine “whether or not faculty-drive changes student’s perspectives on undergraduate research” (K. Bell, personal communication, February 6, 2014). Another goal of the faculty coordinators was to better understand how meaningful students feel their undergraduate research experience is and how that can influence engagement between students and faculty (O. Shonia, personal communication, February 12, 2014). Therefore, the present study sought to answer the following research questions:

1. What are the reasons students present their research at Capital University’s Symposium?
2. How do students rate their research mentoring experiences?
3. What would most students desire to improve their research mentoring experiences?
4. What are the academic, professional, and personal benefits to students involved in undergraduate?
5. How do students rate their overall undergraduate research experience?

As these present questions were explored, the researchers expected to find that overall, students benefit in these areas and that the faculty mentoring relationship has a definite influence on students’ perceptions of the benefits. These two areas (benefits and faculty mentoring relationships) were predicted to have an impact on students’ perception of their overall undergraduate research experience.

**METHOD**

**Participants**

The study included 19 undergraduate students who participated in the university’s 2014 Symposium. There were 8 men and 11 women interviewed in this study, with 3 second-year, 10 third-year and 6 fourth-year students. Of the 19 participants, 18 identified as white, and 1 identified as black. The mean grade-point average was 3.68(0.31), and four out of five of the university’s academic schools were represented. There were 8 majors representing the natural sciences, nursing and health school, 7 from the conservatory of music and school of communication, 6 from the school of humanities, and 5 from the school of social sciences and education. There were 26 majors represented, as 7 students had two majors. Of the students interviewed, 11 reported they were planning to pursue graduate or professional school, 6 said they were not going onto graduate school, and 2 were unsure about their future plans.

**Materials**

In the present study, individual interview questions were developed using concepts explored by Cox and Andriot (2009), Taraban and Logue (2012), and Cetkovic-Cvrlje et al. (2013) in order to assess student researchers’ perceived academic, professional and personal benefits. The interview questions included a combination of closed- and open-ended items designed to provide information on perceived benefits, as well as motivations for conducting research, perceived faculty mentor relationships, and overall research experiences.

**Procedure**

The researchers sent an email to the 148 students who submitted an abstract to the university’s Symposium to recruit participants for the interview process. After a second follow-up email was sent to recruit participants, 21 students responded and the researchers were then able to interview 19 of those students. The interviews were conducted at various times during a two-week period. Most interviews were held in a library study room in order to minimize distractions. Two researchers were present at each interview, with one researcher asking questions and the other researcher transcribing the participant’s responses. The researchers read a consent script aloud which outlined the purpose of the study, issues of anonymity and confidentiality, and the opportunity to withdraw from the study at any point. Additionally, the researchers explained to each interviewee that completion of the interview process served as the student’s informed consent. After each interview was completed, the researchers thanked the students and informed them of when the results of the study would be available. Following the interviews, the transcribed answers were coded by the
RESULTS

Looking at research projects conducted by students overall, 5 participants conducted empirical research studies and 4 conducted literature reviews. All other research was of a unique nature not similarly categorized (N = 11). Out of all students surveyed, 58% (N = 11) reported that this was their first undergraduate research symposium experience. The number of students who worked independently and number of students who worked with a team was split, with 9 students working independently and 10 students working with 1 or more other students on research.

When asked about the motivation behind their research, all but one participant said they were independently motivated to engage in their research experience. Of those independently motivated, 7 students explained they were independently motivated because their research was a topic of interest to them and 3 students said they gained personal enjoyment from conducting research. More than half of participants (N = 11) said conducting research was part of a course requirement. Only 7 students said recognition at the Symposium was a factor in their motivation to conduct research. When asked why they were presenting at the Symposium, the most common responses were because they wanted to share findings (N = 10) or because of a course requirement (N = 5).

Regarding faculty mentor experience, on a 1–10 scale (1 = worst, 10 = best), the average rating given by students was 7.52 (1.90). Table 1 shows two categories of students’ ratings of control students felt faculty mentors had over projects, mentor experience, and overall research experience. The first category shows students who met with their faculty mentors once a week or more (N = 11) and the second category represents students who met with their faculty mentors less than once a week (N = 8). Students who met with their faculty mentors once a week or more had higher ratings for each category compared to students who met less than once a week with their faculty mentors; however, only one of these variables showed a statistically significant difference between the groups. Students who met more frequently with their mentor reported that the faculty member had more control over the project, t(17) = 2.332, p = .032. We note that the small group sizes do not meet the assumptions of the statistical test and thus increases the probability of making a Type II error, and yet Cohen’s d was 0.37 for Overall Mentor Experience and 0.70 for Overall Research Experience, indicating that replicating this work with a larger sample is warranted. Pearson’s Product Moment Correlation Coefficient was calculated to examine the relationship between the rating of the Overall Mentor Experience and the rating of the Overall Research Experience and revealed a strong direct relationship between the two, r(18) = .637, p = .003.

<table>
<thead>
<tr>
<th>Frequency of student-mentor meetings</th>
<th>Control Over Project</th>
<th>Overall Mentor Experience</th>
<th>Overall Research Experience</th>
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<tbody>
<tr>
<td>Frequently (Once a week or more)</td>
<td>4.95(2.40)</td>
<td>7.82(1.72)</td>
<td>8.32(1.01)</td>
</tr>
<tr>
<td>Infrequently (Less than once a week)</td>
<td>2.50(1.41)</td>
<td>7.17(1.73)</td>
<td>7.75(0.62)</td>
</tr>
</tbody>
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Students identified the aspects of the research process in which faculty gave the most help and the aspects of the research process in which faculty gave the least help. There was a variety of answers given, but students most often indicated that faculty mentors were most helpful in areas of structure and design of research projects students conducted and papers they wrote. Students reported that faculty mentors were least helpful with communication (students reported consistency issues) and during the initial stages of the project.

The mean ratings for all benefits students felt they made (academic, personal and professional) were higher than 3 on a 1–5 scale (1 = no gains, 5 = significant gains). For academic benefits, students reported receiving the most improvement in ability to formulate a research topic/direction (M = 3.82, SD = 0.82) and the lowest improvement in writing a scholarly paper (M = 3.18, SD = 1.09). The highest professional improvement was preparation for the next steps after graduation (M = 3.84, SD = 1.01). Understanding the expectations of conducting future research in the students’ fields of study was the lowest rated professional improvement (M = 3.79, SD = 1.03). Finally, the highest rated personal benefit was overall confidence to take on future projects (M = 4.16, SD = 0.79), which was the highest average rating of all benefits students reported. The lowest overall personal benefit rating was listening effectively (M = 3.26, SD = 1.09).

Reporting on the confidence they had before conducting research, few students felt completely confident (N = 2), with more reporting feeling pretty or somewhat confident (N = 11) and the rest feeling not confident (N = 6). The final portion of the interview revealed that overall, students rated their research experiences as an 8.08 (0.93) on a 1-10 scale (1 = worst, 10 = best). Additionally, 16 participants said they have a better understanding of research than when they first started, and 18 reported that they could work independently on a research project in the future.
DISCUSSION

The purpose of this study was to obtain students’ perspectives about their undergraduate research experiences. Results supported our hypotheses. Students generally received positive academic, professional, and personal benefits from conducting research. The results reflected that the students’ relationship with their faculty mentor is related to students’ perception of their overall undergraduate research experience.

In general, students reported feeling that they benefitted academically, professionally, and personally. It is interesting to note that students felt they made the most academic benefits in the overall formation of a topic or research direction. This could indicate that students develop a better understanding of how their own interests can be used to create a meaningful research project. Students felt they were better prepared for the next steps after graduation, which could mean students who participated in research have more confidence in the endeavors they are planning to pursue after graduation. Students felt they made greatest personal improvements in their confidence to take on future projects, which is consistent with Cetkovic-Cvrlje et al. (2013) who found that students participating in research gain a positive perception of their learning experience. More confidence in future research projects illustrates a positive perception of their research and was reflected in the high ratings students gave for their overall research experience.

When examining students’ faculty mentoring experiences, the results indicate that there may be a relationship between frequency of faculty-student meetings and students’ overall research experience. The overall faculty mentor experience rating was relatively high and yet students who met with faculty mentors regularly reported a higher mentorship experience rating than students who met irregularly with their faculty mentors. Perhaps even more important is that students who met with faculty mentors more frequently had higher overall research experience ratings than students who did not meet with their faculty mentor regularly. These higher ratings from students who met regularly with mentors are consistent with findings from previous research that suggested that quality mentorship helps enhance the students’ research and learning experience (Cox & Andriot, 2009; Taraban & Logue, 2012).

Students who engaged in undergraduate research generally had independent motivation for doing so. The high mean GPA of the students interviewed, the high level of interest in the topic, and the personal enjoyment of research that these students reported indicates that this sample of students may be using a deep approach to learning as explained by Mattick and Knight (2007). In addition, the fact that many students reported they did not conduct research for recognition corresponds to the findings of Evans et al. (2007) in that students with deep approaches to learning seek knowledge because they want to learn, not just to reach an immediate goal such as passing a test or, in this case, gaining recognition.

Though there were positive experiences and benefits reported, it is critical to look at the experiences that received the lowest ratings in order to better understand how to improve the undergraduate research process. First, the difference in experiences of those students who met frequently with their mentor and those who met infrequently illustrates a need for more structured meeting schedules between faculty mentors and students. Additionally, students reported that consistent communication was an area where faculty mentors were least helpful, which supports the recommendation that meetings should be more frequent and routine. Establishing standards and expectations for both students and faculty mentors may improve undergraduate research experiences.

Looking at the areas where students feel they received the least benefits informs another recommendation. With regard to academic benefits, students felt they gained the least when it came to writing a scholarly paper. This should be addressed in the mentorship experience and could indicate a need for additional workshops and coursework that help students develop the ability to write scholarly papers. In terms of professional benefits, students rated “understanding the expectations of conducting future research in your field” lower than “preparation for after graduation.” Though the difference was minimal, Mattick and Knight (2007) highlighted how important it is that students are able to extrapolate their research experiences to expectations of their professional field. Therefore, it is recommended that faculty mentors emphasize professional application of the undergraduate research experience.

Finally, students felt they received the least benefits in listening effectively. Though it could be considered good that students felt they gained more confidence in conducting research, a low ability to listen effectively is of some concern. It is possible that students already believe that they are good listeners or that they do not connect this skill with success at conducting their research. Additional work is needed to identify the reason for this low rating. Further development and refinement of listening skills could be addressed in the mentoring relationship if frequent communication and meetings are established. Listening skills develop when students interact frequently with others about developing their projects.

The results of this study do have some limitations. First, because of the small sample size, the results may not be generalizable to other samples of students or institutions. Additionally, some participants in this study did know one or more of the researchers which could have influenced the answers given by those students. Because these were self-reports, it is unclear whether the experiences students reported were accurate representations of their gains. It is important to consider that the students in this study could have had vastly
different experiences with research due to majors, mentors, class year, type of research, etc., so it is not possible to identify causes of benefits students did or did not receive.

The results and limitations of this study illustrate a need for future assessment. The next step for assessing students’ undergraduate research experiences would be to conduct similar interviews with the faculty mentors to get their perspective on how their students benefitted from the experience. Future research should assess students after their projects are completed; some students in this sample were still completing their research. Finally, future research should take intentional steps to construct interview questions that are easily understood by interviewees. Refining the assessment process will help colleges and universities better understand students’ research experiences. Improved assessment of research experiences can then lead to improvements that enhance the quality of learning at the post-secondary level.

REFERENCES


