Impact of Informal STEM Learning

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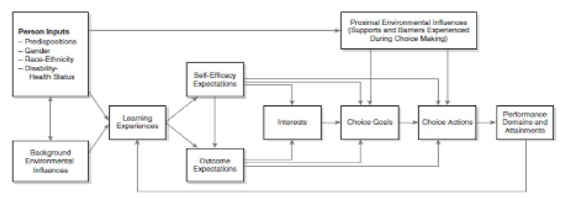
Introduction

Social Cognitive Career Theory (SCCT) has been the conceptual framework for a significant amount of research assessing changes in self-efficacy and interest in learning experiences for students (Lent, Brown & Hackett, 1994). This theory focuses on the development and influences of occupational choice (Brown & Lent, 2006) and helps to explain how one develops occupational interests to make career choices (Lent, Brown & Hackett 2002; Brown & Lent 2006). Variables that affect career development include self-efficacy beliefs, outcome expectations, and personal goals (Brown & Lent, 2006). When students have high self-efficacy and positive outcome expectations, they tend to develop interest in an activity, and subsequent goals that increases involvement in the activity (Brown & Lent, 2006). An informal STEM learning experience can be defined as "lifelong learning in science, technology, engineering, and math (STEM) that takes place across a multitude of designed settings and experiences outside of the formal classroom" (CAISE, 2017). These types of authentic learning experiences might lead to a greater interest, higher self-efficacy and positive outcomes in the areas of STEM, and therefore an increase in STEM academic and career decision-making. This study aims to determine how an informal STEM learning experience impacts interest, self-efficacy, and career intentions in STEM.

Figure 1, *Social Cognitive Theory Adapted from R. W. Lent, S. D. Brown, and G. Hackett (1994).*



Research Question

How does an informal STEM learning experience impact STEM interest, STEM self-efficacy, and STEM career goals?

Acknowledgments:

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Methodology

Qualitative analysis was used to assess how informal learning experiences might impact student STEM interest, STEM self-efficacy, and STEM career goals. The data collected were student interviews. Using case study methodology and data analysis to search out concepts, the data were coded and organized to bring meaning was brought to the segments of data collected (Creswell, 2013). By examining, comparing, and categorizing the data through coding, the participant's views were conceptualized into themes.

Table 1

Data Analysis Approach

Research Question	Data Collected	Data Analysis
How does and informal STEM learning experience impact STEM interest, STEM self-efficacy, and STEM career goals?	Transcribed Student Interviews	Open Catalog Selective Coding Axial Coding Thematic Analysis

Table 2

Codes Referenced in Transcripts

Code	Total Number of Times Referenced in Transcripts
Skill and Knowledge Acquisition	27
Real-World Experiences	21
Communication	16
Confidence	16
Service-Oriented	13

Conclusion & Implications

The results showed the development of a view of STEM careers being associated with service-learning. Informal STEM learning was associated with an increased self-efficacy in communication. Responses showed how real-world experiences led to an increase in participant's self-efficacy. It was perceived that the themes of impact on future, confidence in self-efficacy, and growth in skills and knowledge were all associated with the SCCT construct of self-efficacy. Impact on future and confidence in self-efficacy were perceived benefits of the informal STEM learning experience and were associated with the SCCT construct of STEM Career Goals. Our themes did not associate with the construct STEM Interest. It is possible that participants already had strong STEM interests due to their prior attendance in a STEM academy, and that participation in this informal STEM learning experience did not impact their already strong interest.

Using Social Cognitive Career Theory (SCCT) as conceptual framework, this study will contribute to a body of research surrounding how informal STEM learning experiences can function as a powerful contextual factor to influence career choice behavior among its participants. As we learn more about how to increase these constructs for students, we will begin to increase our STEM workforce. There continues to be a need for increasing access of informal STEM learning experiences for all students, and increasing the diversity of those experiences, in addition to creating connections and coherence between formal and informal STEM learning experiences beginning in early childhood education throughout middle and high/secondary school.

Findings

Three themes emerged after coding. An impact on their future was a theme revealed through the data collected under the real-world experience and service-oriented codes describing a change in how the participants viewed their future careers and plans in relation to service-learning. Confidence in self-efficacy was a benefit of the informal STEM learning experience as its function demonstrates the change in one's belief in self and abilities to achieve goals, which was noted in the following codes: skill and knowledge acquisition, real-world experience, communication, and confidence. Additionally, a growth in skills in knowledge was a significant theme showing an increase in abilities and knowledge due to their participation in the learning experience, associated with skill and knowledge acquisition, real-world experience, and communication.

Table 3

Initial, Naturally Occurring, and Final Codes from Participant Interviews

Initial Codes	Naturally Occurring Codes	Final Codes
Skill and Knowledge Acquisition	Persistence	Skill and Knowledge Acquisition
Real-World Experience	Problem-Solving	Real-World Experience
Confidence	Teamwork	Confidence
Leadership	Service-Oriented	Communication
Communication		Service-Oriented

Table 4

Code Definitions and Illustrative Quotes

Codes	Definition of Code	Illustrative Quote
Skill and Knowledge Acquisition	Gaining skills and knowledge that can be utilized	"I've learned how to effectively to effectively write emails. I've learned how to set up meetings, how to take meeting notes…"
Real-world Experience	Gaining experience that will benefit you in situations outside the classroom	"In this experience, everything is so hands-on and involved and I am able to learn a lot more skills that I wouldn't be able to learn before that I can use for the rest of my life."
Communication	To exchange information efficiently	"Because in order to get things done, I had to communicate effectively."
Confidence	A feeling associated with your personal or professional abilities to accomplish tasks	"I have overcome the lack of confidence by conditioning myself to talking to more people and making more connections."
Service-Oriented	The drive to help others and invest in communities	"…I always wanted to go into a career where I can help as many people as I possibly can. And this experience in particular has strengthened that idea even further."

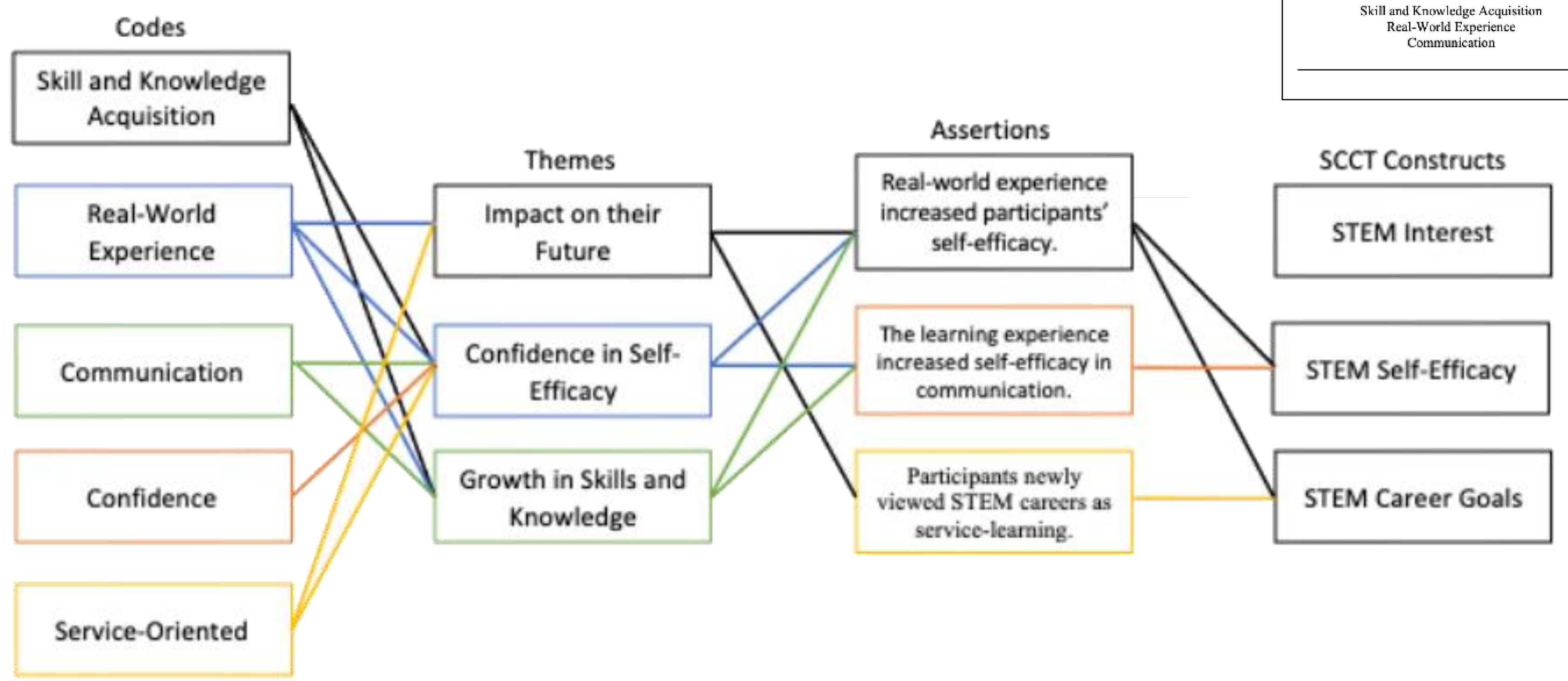
Table 5

Codes Grouped into Themes

Codes	Themes
Real-World Experience Service-Oriented	Impact on Their Future
Skill and Knowledge Acquisition Real-World Experience Communication Confidence	Confidence in Self-Efficacy
Skill and Knowledge Acquisition Real-World Experience Communication	Growth in Skills and Knowledge

Figure 2

Coding Diagram (Codes, Themes, Assertions, and Constructs)



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