UTILIZATION-FOCUSED EVALUATION

OF A STEM ENRICHMENT PROGRAM

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by

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

UTILIZATION-FOCUSED EVALUATION

OF A STEM ENRICHMENT PROGRAM

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and hereby certify that, in their opinion, it is worthy of acceptance.

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DEDICATION

Thank you to my beloved husband. There is no way I could have done this without your love, support, and confidence in me. You are my biggest fan and my best friend. I can't wait to find out what our next adventure together will be.

Thank you to my children. You have sacrificed much during the past few years in order for me to do this. You two are wonderful and I am so thankful for you both.

Thank you to my mother. I so wish you could have been with me to the end of this project. Your children were the love of your life, and you extended that love to our spouses and children. Thank

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UTILIZATION-FOCUSED EVALUATION
OF A STEM ENRICHMENT PROGRAM

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ABSTRACT

The purpose of this study was to determine the impact and utilization of a STEM enrichment program (hereafter referred to as The Program). The Program consisted of two parts. First an educator resource center provided free educational materials throughout The Program's home state. The second part of The Program was a network of education specialists who provided professional development for teachers, modeled lessons with students, and provided presentations for the general public.

The problem addressed by this study was a lack of knowledge regarding the impact of The Program. The Program's director requested a utilization-focused program evaluation to answer thirteen questions. Questions covered Program impact for five areas: overall impact on teachers, overall impact on students, overall impact of materials, overall impact of Program personnel, and overall impact on STEM education.

A mixed-methods case study was designed to gather data. Quantitative data included Program archival data regarding the number of contacts and a survey distributed to teachers who had used The Program's services on at least one occasion. Qualitative data included written comments gathered from the teacher surveys, seven teacher focus groups, and four Program personnel interviews.

Data found an overall positive Program impact in all five areas. Both quantitative and qualitative data showed favorable perceptions by teachers and Program personnel. It is not known if data from this case study can be generalized to other STEM enrichment programs. Future research might include a study to determine if The Program's model could be used to generate new STEM enrichment programs.

UTILIZATION-FOCUSED EVALUATION OF A STEM ENRICHMENT PROGRAM

CHAPTER ONE

Introduction

Student rankings from *The Nation's Report Card: Science 2007* shows United States (U.S.) fourth and eighth graders received high rankings in science achievement compared to other countries around the world (National Center for Education Statistics [NCES], 2009). Only four countries significantly outperformed fourth grade students and nine countries significantly outperformed eighth grade students. However, it is also reported that average U.S. science scores in fourth and eighth grades were not measurably different from 1995 which was the first year of the National Assessment of Educational Progress (NAEP) to 2007, the most current year for which statistics were gathered. The Program for International Student Assessment (PISA) collected data from 57 jurisdictions and ranked US 15-year-olds 17th in science achievement (NCES, 2006). Even with advancement in instructional strategies, science achievement levels underscore the need for reform as scores have flat-lined for 15 years (Braun, Coley, Jia, & Trapini, 2009).

The purpose of this case study is the examination of one science, technology, engineering, and mathematics (STEM) program striving to positively impact science education. Chapter one provides background information about the STEM enrichment program, a conceptual framework which supports the research, a statement of the problem and purpose of the research, the research questions and methodologies used to answer the research questions, the significance of the study, definition of key terms used in the research, and limitations and delimitations of the study.

Background

As a science specialist, this researcher knows first-hand the struggles of today's science classroom. Time and resources continue to be directed toward math and reading in an attempt to raise standardized test scores (Griffith & Scharmann, 2008). A perfect example comes from a fourth grade classroom visit in March 2009. I find most students enjoy science and are eager for hands-on activities. Students can be engaged with presentations designed to encourage curiosity, stimulate through the use of manipulatives, and create minds-on knowledge. However, in this particular instance, students didn't appear interested in the lesson and didn't seem to grasp basic scientific concepts. After about fifteen minutes, I approached their classroom teacher, concerned a broken classroom norm was making the students react negatively to my presence. What he told me came as a shock.

The teacher informed me that during the second week of school he had been teaching a science lesson when his principal walked into his room and seemed surprised by the lesson. Thinking the principal was impressed, the teacher proceeded to explain how the class was discovering scientific method, engaging in hands-on work, and using scientific inquiry. His enthusiasm was soon crushed. The principal informed him that as a fourth grade teacher, he was to teach math, communication arts, and state history. These were the subjects tested in fourth grade. The teacher responded that he did teach those subjects. The principal clarified the misunderstanding by informing the teacher he was to teach math, communication arts, and state history – and only those subjects. Nothing else mattered for fourth grade. The teacher was not allowed to teach science the rest of the year. This entire classroom of children received two science lessons during their fourth grade year. Unfortunately, this appears to be a growing trend. When questioned about how much time is spent teaching science, 14% of fourth grade teachers reported spending little or no time teaching life science or physical science, while 15% of fourth grade teachers reported spending little or no time teaching Earth and space science. Eighth grade teachers reported 53% spend little or no time teaching life science, and 13% spend little or no time teaching physical science (National Assessment of Educational Progress, 2007).

One program, hereafter referred to as The Program, in one Midwestern state has been working since 1999 to improve education in not only science, but mathematics, engineering, and technology as well. The Program is headquartered at a regional university with satellite offices throughout the state, servicing all school districts. Services are free of charge and include delivering STEM presentations and workshops to students and teachers, dissemination of STEM educational products and materials, and working with schools to correlate program resources and materials with state education standards. (Appendix A). The Program works with public and private schools, students, teachers, and the general public to deliver STEM workshops, professional development, demonstrations, and materials designed to "[help] students better learn, and teachers better teach, K-12 science, math, and technology," according to The Program's brochure.

The Program started with three employees in 1999. At that time, service was physically limited to a small geographic portion of the state, with service to the rest of the state via internet, telephone and postal service. The Program expanded in 2004 to include education specialists in three additional locations, and expanded again in 2005 with the addition of two more education specialists. The Program now consisted of five education specialists, one program coordinator, one program coordinator who was also an education specialist, and one program director, along with administrative assistants and student workers. Funding constraints in 2011 reduced staffing to three education specialists, one full-time coordinator, one part-time coordinator (currently working in a 10% capacity), one part-time director, and half of the student worker hours. Each Program education specialist has multiple degrees in education and has received extensive training from the national agency through which it receives funding.

The Program has many supporters throughout the education spectrum. One U.S. Senator remarked, "[The Program] represent[s] perhaps the best and most effective supplement to K-12 science, math, and technology education available anywhere in the nation. All teachers and students, not just those destined for science-based careers, would benefit greatly from their involvement in this wonderful program" (The Program Brochure).

An education service specialist from The Program's federal funding source said, "The . . . [P]rogram has been an exemplary model of K-12 education outreach and has had a tremendous impact on the students and teachers. . ." (personal communication, January 31, 2012).

An official with the State's Department of Elementary and Secondary Education wrote, "At the outset . . . I was convinced that the program would be a good one for statewide enhancement of K-12 teaching and learning in science, mathematics, and technology. In a sense, I was wrong – it is not just "good," but has turned out to be a truly *phenomenal* program, far surpassing all of my expectations and those of my colleagues. It is a high quality program that has proven very effective in its work with both teachers and students. The impact of the . . . Program has been nothing short of astonishing" (personal communication, December 8, 2006).

A STEM instructional coach wrote, "I invited you to our district to do professional development with teachers . . . it met all of the criteria I was looking for . . . Since then I have implemented the program in one way or another in <u>every</u> strand area. It has been the most complete program that fits our needs! . . . . *it has become obvious that the . . . Program has had a dramatic impact as evidenced in our index score increase, teacher engagement, and student feedback"* (personal communication, October 29, 2009).

Finally, an elementary school teacher wrote, "The people who benefit most from the . . . Program are our students. These children now have teachers who are better equipped and highly motivated to teach science and math." (personal communication, October 19, 2009).

Conceptual Framework

Miles and Huberman (1994) write a conceptual framework "explains, either graphically or in narrative form, the main things to be studied – the key factors, concepts, or variables – and the presumed relationships among them" (p. 18). A research paradigm points the researcher towards a conceptual framework, which can then be focused towards a specific research design. This section describes the use of a pragmatic research paradigm, the conceptual framework of communities of practice, and the utilization-focused evaluation study design.

Research Paradigm

Two research paradigms are acceptable for mixed-methods research: pragmatic and transformative. Pragmatism considers research questions to be more important than the research method (Mertens, 2005); therefore, pragmatism is an appropriate foundation for mixed-methods research. Tashakkori and Teddlie (1998) write that pragmatists decide what they want to research and study what they think is important, using appropriate methods to answer research questions. Transformative paradigm is also appropriate for mixed-methods research. Transformative paradigm focuses on social justice issues including gender, politics, disabilities, and marginalized groups. Since this research does not investigate such issues, the transformative paradigm is not the best choice.

The epistemology of pragmatism allows the researcher to study phenomena in the way he or she deems best. The practical nature of pragmatism lends itself to answering questions which lead to solutions and data generation. Pragmatism compliments program evaluation by allowing the researcher to explore questions using different methods. The results satisfy hard-data driven quantitative researchers and researchers who prefer naturalistic data collected in a more qualitative, personal manner (Tashakkori & Teddlie, 1998).

Communities of Practice Theory

Lave and Wenger first discussed the social cognitive learning theory called Communities of Practice (CoPs) in relationship to apprenticeships (Wenger, 2006). CoPs are a group of people, “who share a concern or a passion for something they do and learn how to do it better as they interact regularly” (pg. 1). Three key characteristics distinguish CoPs from other types of communities.

CoPs must have a domain of interest (Wenger). Community members share a more than casual interest in this area. Commitment and competence separate CoPs members from fans or enthusiasts. An example can be drawn using the difference between someone who occasionally purchases a piece of antique furniture and a collector of antiquities. The former buys pieces for pleasure or simply the need for a piece of furniture. He may or may not understand the historical significance of the piece, its true value, or how to conduct proper maintenance. The latter involves himself in every aspect, from cost and value to preservation and history. There is a shared vocabulary and enthusiasm concerning other collectors. Collectors do not know all members of their domain but know when they meet someone new within their domain.

Wenger calls the second part of CoPs community (Wenger, 2006). Domain members engage in shared activities to help each other and learn. Interaction must exist to create a community. Similarity is not enough. Regional universities share many similarities, still if they do not share information and learn from each other, they have not formed a community. Community members work freely and independently using shared information. Membership is completely known in some communities. Regional universities know of each other's existence. Other communities maintain a sense of anonymity. Local artists may know a circle of other artists, but may be unaware of many more members.

Practice is the third part of CoPs (Wenger, 2006). Members of the community must be practitioners. Members build shared resources. Stories, tools, techniques, and tips are shared then used. Members use resources to learn and grow. A team of elementary teachers who meet once per week to share lesson plans are practitioners within their community. Even if a teacher does not directly use the new lesson plans, she gains insight and knowledge through ensuing conversation.

CoPs are very pragmatic in nature. Individual users access information and resources at their own discretion, incorporating what they believe to be beneficial to their individual practice. Further, CoPs use both qualitative and quantitative methods in their practice. Antique collectors keep current with market saturation and pricing data while listening to anecdotal evidence of upcoming purchasing trends. Regional university presidents study enrollment and budget statistics while listening to parental and student concerns. Elementary teachers are accountable for test scores but know each student is more than the sum of their grades and can share evidence of a student's progression beyond the report card.

The Program is a CoP. Each community member in the CoPs shares a common domain of interest – STEM education – and practices the shared repertoire produced by the CoPs. As such, it is appropriate to complete a summative program evaluation investigating The Program's three components: its domain, community, and practice.

Utilization-Focused Evaluation Lens

Utilization-Focused Evaluation (UFE) differs from standard program evaluation in that it is conducted both for and with primary users who have pre-determined specific uses for the information (Patton, 2008). As such, they are particularly pragmatic in nature. Patton differentiates between UFE and traditional program evaluations. Traditional program evaluations collect information about "activities, characteristics, and results of programs to make judgments about the program, improve or further develop program effectiveness, inform decisions about future programming, and/or increase understanding" (pg. 39). UFE is conducted for and with intended primary users: people who are a community of practice.

The purpose of the evaluation must be determined prior to being conducted. There are six reasons to conduct UFEs (Patton, 2008). Evaluation purposes carry different weights in terms of risk to the program being evaluated. Overall summative judgments and accountability purposes are high-risk purposes. Program funding, policy decisions, and political power are often at stake. Formative improvement holds moderate risk in that findings generate feedback directed at program improvement before items become major issues. Monitoring and development are considered low-risk purposes when used for day to day changes, but change to high risk if needed changes are not implemented. Knowledge generation, the purpose of this study, ranges from moderate to low risk (Patton).

Patton (2008) finds seven uses for UFE (Figure 1). UFE findings can also be misused or unused. Misuse occurs when findings are manipulated, distorted, or otherwise corrupted (Patton). Nonuse can be intentional or unintentional.

Type of Use	Purpose
Instrumental	Findings inform a decision or help solve a problem
Conceptual	Influences how key people think about a program but does not lead to decision making
Symbolic	Findings and process are tokens and used rhetorically
Imposed	People in power create mandates based on findings
Overuse	Too much emphasis is placed on findings
Mechanical	Findings placate a need to complete the evaluation process
Process	Findings bring about change in behavior, program, or organization

Figure 1. Seven uses and purposes for utilization-focused evaluations.

Statement of the Problem

The Program has lost its funding and is closing at the end of the current school year. Previously generated

program data has been limited to statistical evidence including number of students encountered, number of teachers at workshops, number of publications distributed, etc. Anecdotal evidence has not been systematically collected and exists only in forms such as the occasional comment on a teacher feedback form, email sent from a grateful educator, or a story in a local newspaper. The Program coordinator responsible for compiling teacher feedback statistics reports less than 5% of the feedback forms received contain useful written comments (personal communication, January 27, 2012). The Program lacks a summative evaluation reflective of its widespread usage, multiple stakeholders, and commitment to STEM education.

Purpose of the Study

The purpose of this study is to determine the impact of The Program on teachers, and students, the impact and utilization of The Program's materials, personnel, and the overall impact of The Program with regards to STEM education. Impact and utilization will be investigated by conducting a Utilization-Focused Evaluation of The Program for the director. Standard program evaluation will not allow the director to have input as to study focus or uses upon completion. UFE allows the director to examine specific program areas and include multiple viewpoints from various stakeholders. The director will then be free to share findings with program personnel, people who have been instrumental in supporting the program, past funders, and potential future funders. This research may help determine if future STEM enrichment programs would benefit by following The Program's model.

Research Questions

The director of a science, technology, engineering, and mathematics program, referred to as The Program desires a summative program evaluation. The Program's funding ends with the current school year and the director feels an evaluation would be beneficial to program partners and stakeholders (personal communication, January 10, 2012). Currently, The Program does not have a summative evaluation tool. The purpose of this research is to conduct a utilization-focused program evaluation summarizing the impact of The Program on STEM education. The following questions guided this mixed-methods research:

1. What degree of impact was perceived by stakeholders regarding The Program in terms of:
    a. Overall impact on teachers?
    b. Overall impact on students?
    c. Overall impact of materials?
    d. Overall impact of Program personnel?
    e. Overall impact of The Program on STEM education?
2. What perceptions do Program personnel have regarding the overall impact of The Program on STEM education?
3. What perceptions do teachers have regarding the overall impact of the Program on STEM education?

Methodology

This research is a mixed-methods summative impact study (Patton, 2008). The Program director requested a summative program evaluation reviewing (a) contact statistics for The Program, (b) overall perceptions of The Program among teachers and Program personnel, and (c) The Program's overall impact on STEM education. (personal communication, January 10, 2012). A mixed-methods approach is appropriate for this research.

Mixed-methods research uses both qualitative and quantitative research and is of particular value in education related research (Mertens, 2005). Morse (2002) says that by using both quantitative and qualitative methods, a researcher is able to obtain a more complete picture of the phenomena being studied. Creswell (2009) notes that mixed-methods research can balance biases found in other research methods. Mixed-methods allows for triangulation of data providing a solid foundation to the research. Mixed-methods research can be sequential, concurrent, or transformative (Creswell). Sequential mixed-methods research occurs when a researcher uses one research method to follow-up on a different research method. For example, a researcher might conduct a quantitative survey then use those results to conduct a qualitative interview. Concurrent mixed-methods research occurs when a researcher collects both quantitative and qualitative research at the same time. The data is then merged to create a complete picture of the research problem. Transformative mixed-methods research occurs when a researcher uses a mixed-methods approach to encourage social change and is based on an overarching theoretical framework (Mertens). Quantitative and qualitative data will be collected simultaneously for this research, creating a concurrent mixed-methods study.

Four issues must be considered in the design of a mixed-methods research (Creswell, 2009). Timing is the first issue. This study will be concurrent in nature; it will collect both quantitative and qualitative data at the same time. Creswell writes that concurrent data collection is desirable when the researcher does not have time to revisit the field. Since The Program is ending, time is of the essence. Data will need to be collected before funding has been exhausted.

The second issue is weighting. Weighting is the decision to give preference to one type of data over another (Creswell, 2009). Weighting is determined by interests of the researcher, the audience for the study, and what the researcher wants to emphasize. A utilization-focused evaluation must take into account the desires of the primary user (Patton, 2008). The Program director expressed concern with the lack of collectable quantitative data generated by employees. The director noted the existence of too many variables to truly quantify program impact in terms of student achievement and teacher professional development (personal communication, January 10, 2012). He also noted similar concerns expressed by previous funding sources. One source was the U.S. Department of Education. The U.S. Department of Education desires quantifiable results for their grant funded programs. The director was able to establish the difficulty of producing such evidence and received permission to use distribution statistics as proof of performance. This research will therefore contain a larger part of qualitative research than quantitative research. The study will triangulate both types of data to provide validity.

Mixing is the third issue in a mixed-methods design. Data mixing can occur during collection, analysis, or interpretation, or as Creswell (2009) points out, during all three stages. Mixing shows how the qualitative data and the quantitative data are connected. One goal of mixing data is to provide support information, as in the case of this study. Creswell refers to this process as embedding data. Data will be mixed throughout the research process to help provide an overall Program understanding.

The final point of consideration in choosing a mixed-methods design deciding between theoretical or transformative perspectives. Mixed-methods designs use a theoretical framework to design the research (Creswell, 2009). Since this research is a UFE studying a community of practice, it clearly uses theory to drive research.

According to Rossi, Lipsey, and Freeman (2004) research questions in a UFE should be designed to "focus the evaluation on the areas of program performance at issue for key decision makers and stakeholders" (p. 69). Each research question should gather data about a specific question generated by the primary intended user. Patton's (2008) five criteria for UFE questions include (a) the question is empirical therefore you can collect data from it, (b) there is more than one possible answer to the question, (c) the primary intended user wants the question answered, (d) the primary intended user personally wants to use the data generated by the question, and (e) the primary intended user can specify what he or she will do with the data generated by the question.

Creswell (2009) writes about the emerging field of mixed-methods research questions. According to Creswell, mixed-methods research follows one of three basic designs. The first option is to write separate quantitative and qualitative research questions. The second option is to write separate quantitative and qualitative research questions centered on a mixed-methods question. The mixed-methods question can be constructed at the beginning of the research or can emerge as themes are clarified. This option shows the importance of each type of research as well as the importance of mixing the two types of data. Option three is to construct a mixed-methods question that incorporates procedures and content without the addition of separate quantitative and qualitative questions. Creswell prefers the second option.

The director agreed a summative program evaluation would be beneficial to program partners and stakeholders (personal communication, January 10, 2012). Currently, The Program does not have a summative evaluation tool. A mixed-methods approach generated quantitative and qualitative research questions that guided this study. Following Creswell's (2009) approach, research questions were written for both quantitative and qualitative phase.

Mertens (2005) described four designs for mixed-methods research: (a) pragmatic parallel, (b) pragmatic sequential, (c) transformative parallel, and (d) transformative sequential. As previously discussed, summary program evaluations are not transformative in nature, eliminating options three and four. Data will be collected in a parallel fashion, making this study a pragmatic parallel design.

The Program has demographic archival quantitative data such as the number of students impacted, the number of teachers impacted, the number of teacher workshops conducted. (Appendix B). Further quantitative data can be collected to evaluate the satisfaction of Program users and Program employees regarding overall Program impact. However, purely quantitative data will not provide rich, in-depth personal information about The Program's result. A qualitative approach is needed for such an investigation. Mixed-methods is the research paradigm best allowing complete program analysis.

UFE utilizes a backward design approach (Rossi, Lipsey, & Freeman, 2004). Backward design helps determine who will use the evaluation as opposed to who is interested in the evaluation. Backward design helps establish priorities and timelines for research. Once evaluation usage was determined by the director, the development of specific instrumentation led to desired data.

Data analysis will occur on many levels. Annual reports provided by the director will yield insight into The Program's history. A quantitative questionnaire will be developed from the UFE goals presented by the director. The questionnaire will be distributed to educators who have utilized The Program at least once. Next, interview questions for Program personnel will be created, seeking answers to the director's questions. A set of focus group questions will be constructed for educators who are very familiar with The Program. Program personnel will recommend schools and groups of educators who are familiar with The Program. These interviews will be in the form of focus groups at the participating schools and at Program workshops. Open and axial coding will be used to analyze interview data. Findings will be reported in Chapter 4, with discussion following in Chapter 5.

Significance of the Study

This study is designed to provide a summative program evaluation for a STEM science enrichment program in one Midwestern state. Patton (2008) details several intended uses for UFE. These include overall summative judgment, formative improvement and learning, accountability, monitoring, development, and knowledge generation. This study serves as The Program's summative evaluation during its final six months of service. Initially, Patton's overall summative judgment might be considered as the intended use for this study. However, summative judgments are intended for funders and others who make major decisions about The Program's future. Knowledge generation usage is intended for program designers, and information discovered during this type of UFE can inform general practice. Knowledge generated from this study can be used by other existing and future enrichment programs to guide program development.

Definition of Terms

The following are key terms utilized within the confines of this study. These terms are relevant to mixed-methods research and program evaluation.

Axial Coding – regrouping openly coded data in such as way as to discover relationships between information collected and the phenomena being studied (Creswell, 2007).

Communities of Practice – a social cognitive learning theory originated by Jean Lave and Etinne Wenger in 1991 (Wenger, 2006). Communities of Practice are groups of people who work together to improve what they do. To be a Community of Practice, the group must contain three components.

1) *The Domain* – a shared identity brought about by a particular interest. In the case of this study, educators interested in improving science achievement are the domain.

2) *The Community* – members interact and share information, building relationships that enable members to learn from each other.

3) *The Practice* – members work within the community as practitioners. They share resources to improve the group as a whole.

Impact – having a strong, immediate effect, either positive or negative.

Open Coding – in qualitative data analysis, segmenting data into categories of information to discover major themes of the study (Creswell 2007).

Primary Intended User – in program evaluation, the person or persons who will be utilizing the evaluation findings (Patton, 2008). For purposes of the study, the director of the STEM enrichment program is the primary intended user.

Program Personnel – Employees of The Program serving as education specialists.

STEM – acronym for Science, Technology, Engineering, and Mathematics. This study is a program evaluation of a STEM enrichment program.

The Program – pseudonym for the STEM enrichment program being evaluated in this study. The Program utilizes highly trained educators who are available to provide services to every school district, private school, or public group within its Midwestern state. Services include but are not limited to student and teacher workshops on STEM curricula, in-class presentations and modeling of STEM lesson plans, providing STEM resources for educators and the general public, and serving as STEM consultants throughout their state.

The Program Director – person overseeing the STEM enrichment program. The director is responsible for funding, communication with key influential Program associates, personnel, and Program objectives.

Utilization-Focused Evaluation (UFE) – evaluation that is done for and with the primary intended user(s) (Patton, 2008). Traditional program evaluation is conducted without thought as to data utilization upon completion of the study. UFE begins with a known use for the resulting data.

Limitations and Delimitations

The nature of UFE contains two specific limitations. The first is the fact that evaluations are value-laden by nature (Patton, 2008). This limitation is minimized by the fact that primary intended users are determined before the evaluation occurs. The user determines program values he or she wants investigated instead of the evaluator making those decisions. The second limitation to UFE is a high turnover rate for intended users. As this is a summative study, there will be no intended user turnover.

The following were identified as limitations for this study.

1. The timeframe for the study was limited because The Program had only six months of remaining funding when the study began. In order to utilize program personnel, the research had to be completed before The Program disbanded.

2. This study was limited in that survey and interview questions were based on participant perceptions and therefore were subjective in nature.

3. This study was limited because it is subject to interpretation and analysis by the researcher who is employed by The Program.

4. This study was limited through lay-offs and budget cuts The Program encountered during its final year of operation, limiting the pool of potential respondents.

The delimitation identified for this study is the fact that only one STEM enrichment program was studied and it is unknown if findings can be generalized to other programs.

Summary

A STEM enrichment program in a Midwestern state seeks a summative utilization-focused program evaluation as program funding comes to an end. Elements of the program have existed since 1999. A mixed-method approach will allow the researcher to gather the types of data requested by the primary intended user. The program to be studied currently has no cumulative data regarding its overall impact on key stakeholders. The purpose of this study is to create a utilization-focused summative program evaluation designed to answer the primary intended user’s questions.

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

This mixed-methods summative utilization-focused program evaluation examines one science, technology, engineering and mathematics (STEM) enrichment program in a Midwestern state. The Program's funding ends with the current school year. The Program's director seeks a summative report examining overall program impact and utilization. Previous program evaluations have been limited to quantitative statistical data on program usage. The director seeks a deeper summative analysis from Program personnel and Program users. This study will help inform other STEM enrichment programs as to the value and impact of their programs.

The previous chapter outlined this study's conceptual framework including pragmatism as the research paradigm, Communities of Practice (CoPs) as the theoretical framework, and Utilization-Focused Evaluation (UFE) as a conceptual lens. The study's problem, purpose, research questions, and methodologies were also explained. This chapter reviews relevant literature for the study. Areas examined include utilization-focused evaluation, communities of practice, and the science education in the United States.

Utilization-Focused Evaluation

Rossi, Lipsey, and Freeman (2004) state three major recognized forms of evaluation. Independent evaluation leaves the evaluator to plan and conduct the project without input from stakeholders. Empowerment evaluation produces useful information and findings while promoting program enrichment, self-development, and political influence. Program beneficiaries gain from this type of evaluation. The third described evaluation form is participatory or collaborative evaluation. Participatory evaluation uses an evaluator who collaborates with concerned stakeholders. The evaluator may be someone with close ties to the organization requesting the evaluation or may be an outsider hired to complete the task. UFE is one type of participatory evaluation (Rossi, Lipsey, & Freeman).

Five principles guide UFE evaluators as well as traditional evaluators. First, systematic inquiry dictates that evaluators conduct orderly organized research using data as evidence. Second, the competency guideline requires evaluators to fulfill their obligations proficiently and professionally. Third, evaluators must show integrity and honesty by completing an unbiased evaluation. Fourth, respondents, program participants, clients and other stakeholders must be treated with respect throughout the process. Finally, the general public's welfare must be protected by the evaluator (American Evaluation Association, 1995). UFE evaluators serve many roles. The evaluator can be called upon to be a methodological research designer, judge or negotiator (Vassar, Wheeler, Davison, & Franklin, 2010). Patton (2008) refers to evaluators as being active-reactive-adaptive. Combining the two roles creates an evaluator who is active as a research designer, reactive as a judge, and adaptive as a negotiator.

UFE provides active stakeholder involvement (Vassar et al., 2010). Active participation increases stakeholder interest resulting in increased investment. Franke, Christie, and Parra (2003) discuss the repercussions of losing key stakeholders. During their UFE of a government program, key personnel requesting the evaluation left the department. The researchers were able to overcome the deficit by converting unintended users into primary intended users through the creation of buy-in. Misuse can be a byproduct of change in intended users. The researchers had to ensure new users were as committed to the evaluation as the initial primary users had been.

Patton (2008) lists fourteen fundamental premises of UFE. These guidelines act as a comprehensive overview (Figure 2).

- Commitment to intended use by intended users should be the driving force in an evaluation.
- Strategizing about use is ongoing and continuous from the very beginning of the evaluation.
- Personal interests and commitments of those involved in the evaluation contribute significantly to use.
- Careful and thoughtful stakeholder analysis should inform identification of primary intended users.
- Evaluation should be focused in some way; focusing on intended use by intended users is the most useful way.
- Focusing on intended use requires making deliberate and thoughtful choices.
- Useful evaluations must be designed and adapted situationally.
- Intended users' commitment to use can be nurtured and enhanced by actively involving them in making significant decisions about the evaluation.
- High quality participation is the goal, not high quantity participation.
- High quality involvement of intended users will result in high quality, useful evaluations.
- Evaluators have a rightful stake in an evaluation in that their credibility and integrity are always at risk.
- Evaluators committed to enhancing use have a responsibility to train users in evaluation processes and the uses of information.
- Use is different from reporting and dissemination.
- Serious attention to use involves financial and time costs that are far from trivial.

Figure 2. Fundamental premises of utilization-focused evaluation from Patton, 2008 as found in Stufflebeam, Madaus, and Kellaghan, 2000 – as modified by researcher.

Stufflebeam, Madaus, and Kellaghan (2000) categorize UFE as a social agenda-directed/advocacy approach to evaluation. Such approaches are directed at making a difference in society, ensuring all segments have equal access to educational and social opportunities and services. Social advocacy evaluations intend to give power to the disenfranchised (Stufflebeam). Stufflebeam considers UFE social agenda-directed evaluation because “it requires democratic participation of a representative group of stakeholders, whom it empowers to determine the evaluation questions and information needs” (pg. 77). The author goes on to note that UFE does not truly meet the definition of social agenda directed evaluation because it does not advocate social agendas or better serve the disenfranchised.

UFE incorporates the knowledge of the evaluator and the desires of the primary intended users. The evaluator works with intended users to determine how data will be used. The evaluator then designs research useful in the gathering of needed data. Participatory forms of evaluation generated information more likely to be used than traditional program evaluations conducted by outsiders (Patton, 2008). Utilization creates a pragmatic world-view through which to conduct evaluations.

Communities of Practice

Communities of Practice are found throughout society. Education, organizations, government, associations, the web, and social sectors are utilizing CoPs to manage knowledge (Wenger, 2006). While each CoP is unique, common characteristics exist (Figure 3).

- Mutual relationships are continuous but may or may not be harmonious or collegial.
- Information flow and dissemination is rapid and seamless.
- Limited ceremonial speech; language is informal.
- Innovation is desirable.
- Conversations begin where they last left off.
- Minimal need for background information; common understanding of problems
- Group agreement as to membership.
- Tacit acknowledgement of the competencies, strengths, and weaknesses of others.
- Common tools, methodologies, techniques, and artifacts.
- Group language uses jargon, acronyms, and unique terminology.
- A shared world-view concerning specific items.

Figure 3. Common characteristics of communities of practice outlined by Kerno and Moss, 2010, pg. 81 and Cox, 2005, pg. 531 – as modified by researcher.

Communities of Practice theory originated in 1991 when Lave and Wenger applied the term to mentor/apprentice relationships. Other common names for CoPs include learning networks, thematic groups, and tech clubs (Wenger, 2006). Brown and Duguid immediately followed with their own CoP study (Cox, 2005). Cox differentiates between the two works. According to Cox, Lave and Wenger's CoPs model focused on knowledge reproduction; an experienced person passes knowledge to someone new. Learning was very traditional in the sense of master teaching student. On the other hand, Brown and Duguid's model focused on solving problems using new approaches (Cox). Wenger has since continued the work. A 1998 solo work and a 2002 work with coauthors McDermott and Snyder complete the four works considered seminal to CoPs theory (Cox). Cox is critical of Wenger's work for two reasons. First is lack of definition of terms and second is the use of the ambiguous term community. Roberts (2006) expresses a similar concern. The term community is difficult to define from a sociological perspective (Cox, 2005). Community is generally considered a positive place where many similar people exist. Communities are considered static. Second, according to Cox, Wenger did not clearly define community of practice until his second work, and changed the definition in his collaborative book. Wenger's latest definition aligns CoPs as a managerial tool instead of the office tool previously defined.

Roberts (2006) explains CoPs as flexible and changing. Additionally, CoPs cannot be formed (Lave & Wenger, 1991). CoPs are created naturally through a mutual sharing of interest, commitment, and communication. Negotiation, learning, meaning, and identity occur within CoPs. Members form a cohesive group through three dimensions of relationships (Wenger, 1998). First, mutual engagement occurs through member interaction. This can be complementary where community members have different skills and different jobs they contribute to the whole or it can be overlapping where community members possess similar skills with similar jobs who contribute to improving the community as a whole. Second, joint enterprise creates a sense of understanding. Artifacts, stories, tools, and rules are by-products of joint enterprise. Community members create such resources as a way of coping with community demands. Joint enterprise leads to creation of a shared repertoire of resources. The shared repertoire is reflective of community members' mutual engagement (Figure 4). Wenger and Snyder (2000) list three modes of belonging including engagement, imagination, and alignment. Eckert (2006) credits CoPs as connecting the individual person, the group, and society.

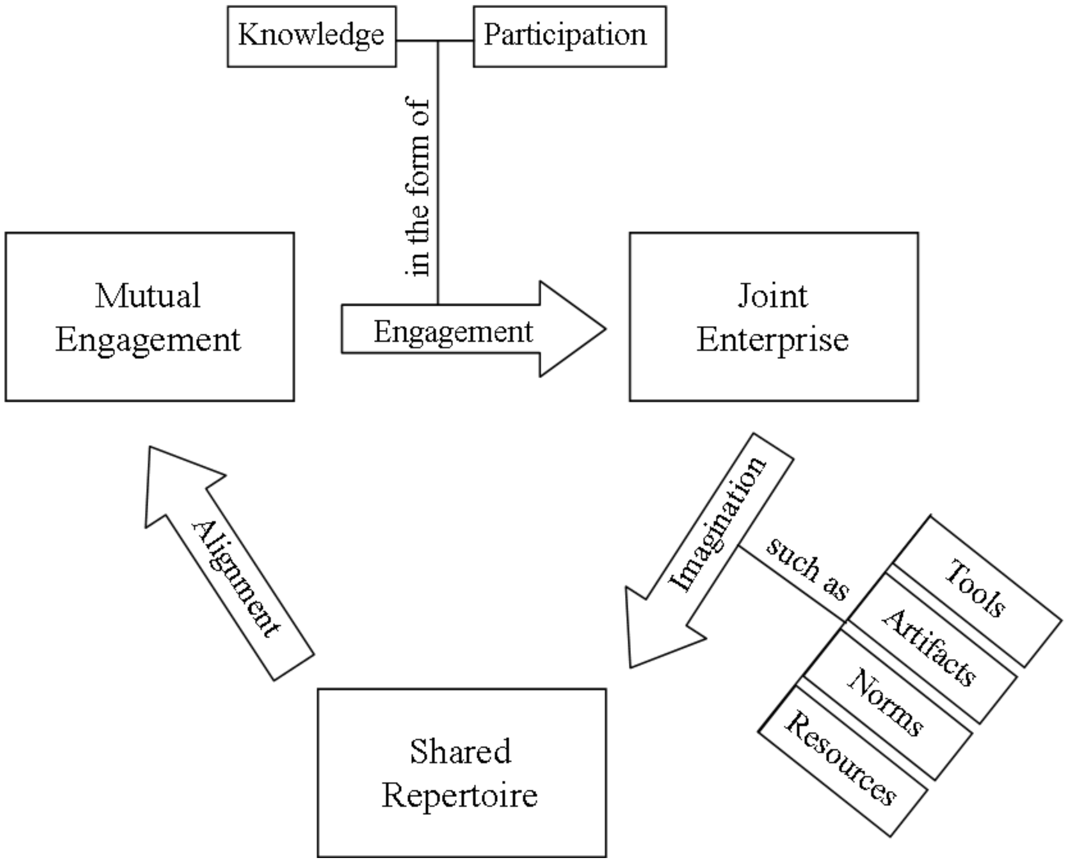

Figure 4. Three dimensions and modes of communities of practice.

Kerno and Mace (2010) outline three challenges and limitations to CoPs. First, time demands constrain CoPs from engaging participants in prolonged, sustained discourse. Wenger (2006) allows flexibility in terms of time constraints writing that some CoPs meet frequently while others only occasionally. He provides the example of the Impressionist painters who met in cafes to discuss their art, but practiced their craft as individuals in their own studios. The second challenge occurs when CoPs members adhere to a rigid hierarchy of power and communication, inhibiting the horizontal flow of information. Kerno and Mace place this limit on organizationally created CoPs. CoPs form naturally and without thought to intentionality (Lave & Wenger, 1991). Hierarchy is not an issue with such groups who give power to those deemed worthy; to those who provide natural leadership. The third challenge is socio-cultural issues. Kerno and Mace refer to the individualism traditionally found in Western cultures verses concern for the group found in Eastern cultures. The authors write that individualism “represents a trend serving to erode the conditions that might enable and strengthen CoPs in organizations” (pg. 87). Roberts (2006) refers to this challenge as power. Members who possess more expertise, who participate fully, naturally yield more power than newcomers. Wenger (1991) addresses the issue of power in two ways. First, members increase in status as they gain knowledge. A fourth grade teacher with 20 years of experience yields more power as an educator CoPs than a first year teacher. However, as years progress, the latter has increased in knowledge, garnering more respect and power within the CoPs. This does not mean the first year teachers are non-contributing members. They may be more knowledgeable of new trends in education and technological advances, thusly contributing to the CoPs. The power issue is further addressed by Wenger’s reminder that CoPs form naturally and unintentionally. Members give power to whom they deem worthy.

Coinciding with power, Roberts (2006) lists trust as a challenge to CoPs. Members may be reluctant to share knowledge due to lack of trust. Individuals who trust each other engage in joint enterprise based on respect and mutual understanding. Competition discourages information sharing and therefore the effectiveness of CoPs (Roberts). A dual concern expressed by Roberts is the differentiation between fast and slow communities. Slow communities are stable, allowing growth and development of trust, ameliorating power issues. Fast communities are more characteristic of today’s rapidly evolving business structures. Businesses often grow quickly and fail equally as fast. Rapid pace prohibits the development of mutual trust and understanding (Roberts). Wenger (2006) places no time constraints on CoPs. They develop and dissolve as needed. Businesses proceeding at such rapid paces may not meet the criteria for CoPs. They may not have time to develop a shared repertoire and resources. Such businesses might be better conceived under a different theory.

Robert's (2006) next concern with CoPs lies in the fact that individuals possess specific preferences and predispositions which may or may not be relinquished upon group membership. Her concern is that certain predispositions may allow incremental knowledge development but resist radical innovation. However, the very nature of CoPs requires members to grow in nature. As co-creators of a joint resource repertoire, members learn from each other through mutual engagement (Wenger, 1998).

Lave and Wenger (1991) did not place size or geographical restraints on CoPs. Their first identified CoPs included Yucatec Mayan midwives in Mexico, Via and Gola tailors in Liberia, U.S. Navy quartermasters, butchers in U.S. supermarkets, and non-drinking alcoholics. CoPs membership varies greatly and globally within these five examples. Roberts (2006) writes, "[t]here is a need to differentiate communities of practice in terms of size and spatial reach as it is not possible to expand all communities beyond certain limits" (pg. 631). Wenger (1998) incorporates the idea of constellations to address the issue. "Some configurations are too far removed from the scope of engagement of participants, too broad, too diverse, or too diffuse to be usefully treated as a single communit[y] of practice" (pgs. 126-127). In scientific communities, constellations are groups of stellar objects viewed as a group even though they may be far apart in size, distance, or composition. In the same sense, very large CoPs can be subdivided into more manageable CoPs. A person may not be able to discern the entire community due to its extremely large size. Instead, focusing on a particular CoPs cluster can provide insight into the group's workings.

Communities of Practice are groups of people who share a concern or passion for something they do and learn how to do it better as they regularly interact (Wenger, 2006). CoPs cannot be formed, but rather are natural extensions of mutual engagement, joint enterprise, and shared repertoire. Knowledge is shared among members. Members may know each other and have direct contact, or anonymity may exist. Some CoPs are small and function for many years while others are global and short lived. Very large networks of CoPs are referred to as constellations. CoPs theory is becoming more prevalent in the business world, but is also used in education and government (Cox, 2005; Wenger; Roberts, 2006; Kerno & Mace, 2010).

Science Education

The debate about how best to teach science is not new. Since the foundations of the United States (U.S.), educators have held differing opinions. This section provides a brief history of science education in the U.S., information regarding the currently favored constructivist paradigm, a look at scientific inquiry, and finally examination of current science teaching strategies and methodologies, including The Program.

Science Education in the U.S.

American education can be broken into two parts including the Colonial Period from 1607-1787 and the National Period from 1787-present (Cordasco, 1976). Each period can be further subdivided in reference to major philosophical shift in education.

Science as a school subject was introduced during the National Period. Herbert Spencer and Henry Huxley both advocated for the inclusion of science in standard curricula as early as 1861. In 1893 the historic Committee of Ten outlined a scope and sequence for primary grades through high school (National Educational Association, 1894). The Committee of Ten consisted of ten prominent men from colleges and high schools. Their goal was to establish a scope and sequence that would make college entrance requirements uniform. Their report included time for physics, chemistry, and astronomy classes, as well as natural history classes which later became biology. The Committee's concept of geography included science concepts such as astronomy, meteorology, zoology, and botany.

The report encouraged science education as early as first grade. Physics, chemistry, and astronomy were to be taught five periods per week first through eighth grade by conducting experiments, leaving a twelve week elective astronomy course, chemistry, and physics for high school. Biology was to be taught in grades one through eight twice per week for not less than thirty minutes per session. Instruction was to be devoted to learning about plants and animals and was to correlate with language, drawing, literature, and geography. Biology instruction was followed by one year of botany or zoology and one-half year of anatomy, physiology, and hygiene in high school. Time for geography, the study of Earth, its environments, and inhabitants was to be equal to number work for grades one through seven. Meteorology was to be taken one-half year in high school (Vazquez, 2006). Additionally, the report called for a laboratory component covering at least 60% of allocated time. Vazquez (2006) reports less than 15% of high school curricular time is devoted to science education. The Committee's recommendations total 25% of high school course work. The Committee urged stressing acquisition of knowledge through careful observation of nature including field work.

STEM Education

The acronym STEM has come to represent an educational reform movement aimed at increasing student achievement in mathematics and science (Hanover, 2011). Former U.S. Representative Vernon Ehlers writes, “When I came to Congress in 1993, the phrase ‘STEM education’ did not exist” (Ehlers, 2010). Ehlers who has a Ph.D. in nuclear physics was instrumental in initiating the current reform movement as he served on the Science Committee, the Education and Workforce Committee, the National Science Foundation Act reauthorization legislation, and the Mathematics and Science Partnerships program (Ehlers). The National Science Foundation (NSF) began calls for educational reform with the acronym SMET in the early 1990’s, but Dr. Judith Ramaley rearranged the letters during her tenure as NSF assistant director of the education and human resources directorate from 2001-2004 (Chute, 2012; Sanders, 2009).

Sanders (2009) refers to the sudden interest in STEM education as STEMmania. According to Sanders, the publication of *The World is Flat* (Friedman, 2005), a book outlining how China and India could surpass America as global leaders, caused funding and interest to be redirected to STEM.

Dr. Steven Breckler, Executive Director for Science for the American Psychological Association helps define STEM by incorporating not only what STEM is, but also what it is not (2007). Breckler lists mathematics, physics, biology, engineering, computer science, geosciences, behavioral science, and social science as part of STEM. Subjects not included are areas such as art, literature, music, humanities, and business administration. Breckler writes that while behavioral and social sciences are included in some NSF documents, these two subject areas are not fully included in STEM funding sources.

The Hanover Research Group's 2011 publication entitled *K-12 STEM Education* Overview the four major STEM education goals as determined by the President's Council of Advisors on Science and Technology (PCAST). These include ensuring a STEM-capable citizenry, building a STEM proficient workforce, cultivating future STEM experts, and closing the STEM achievement and participation gaps. Behavioral and social sciences are not included in their table of relevant STEM subjects.

Constructivism

Constructivism has a rich history in the science classroom. Roots of constructivism date to the 18th century work of Jacques Rousseau, with American constructivism centered on the works of John Dewey (Matthews, 2003). Jean Piaget and Lev Vigotsky contributed to the modern understanding of constructivism (Matthews). The recommendations of the Committee of Ten are constructivist in nature through the encouragement of observation, eliciting prior knowledge, and application of acquired knowledge (Baviskar, Hartle & Whitney, 2009).

Abundant literature exists on constructivism (e.g. Colburn, 2000; Valanides, 2002; Straits & Wilke, 2007). A problem arises in defining constructivism. Colburn notes two distinct meanings of constructivism currently used in education. The first is constructivism as a philosophy which deals with the nature of reality. The second is constructivism as a learning theory representing a variety of teaching strategies. Baviskar, Hartle, and Whitney (2009) agree, and add two different categories of constructivism:

personal and social. Personal constructivism exists when individuals learn using constructivist theory. Personal constructivism does not state learning only occurs in groups or that all individuals in a group learn. Social constructivism states that groups of people construct knowledge through interaction. Valanides (2002) categorizes constructivism as cognitive or social. For Valanides, "the cognitive constructivist perspective emphasizes the internal processes of knowledge construction, whereas the socio-cultural perspective focuses on children's cognitive development as it occurs through social interaction" (pg. 51). These discrepancies could cause confusion for the science teacher. While there are many labels attached to constructivism, one commonality exists. Constructivism includes the idea of building new knowledge through thinking and exploration (Unal & Akpinar, 2006; Colburn, 2000; Straits & Wilke, 2007). Other names for constructivist learning include learner-centered, child-centered, discovery learning, and progressive learning (Matthews, 2003). The next sections show how scientific inquiry and current science best practices are constructivist in nature.

Scientific Inquiry

Scientific inquiry methods meet multiple definitions of constructivism. The National Research Council (NRC) (2000) delineated five essential features at the core of inquiry-based learning: (a) the learner engages in scientifically oriented questions, (b) the learner gives priority to evidence in responding to questions, (c) the learner formulates explanations from evidence, (d) the learner connects explanations to scientific knowledge, and (e) the learner communicates and justifies explanations. These five features are used in NRC's national science teaching standards. "Students actively develop their understanding of science by combining scientific knowledge with reasoning and thinking skills" (NRC, 1996, p. 2). Figure 5 demonstrates how essential features of scientific inquiry as outlined by the NRC are related to basic components of constructivism as outlined by Baviskar, Hartle, and Whitney (2009).

Scientific Inquiry Features	Constructivist Component
The learner engages in scientifically oriented questions.	Eliciting prior knowledge Creating cognitive dissonance
The learner gives priority to evidence in responding to questions.	Creating cognitive dissonance
The learner formulates explanations from evidence.	Resolving cognitive dissonance
The learner connects explanations to scientific knowledge.	Reflection on learning (to self) Application of knowledge with feedback
The learner communicates and justifies explanations.	Reflection on learning (to others) Application of knowledge with feedback

Figure 5. Comparison of scientific inquiry and constructivism.

Scientific inquiry is not a solitary set of teaching methods (Hume, 2009; Colburn, 2000). Instead, it employs a variety of strategies used to teach scientific inquiry in a constructivist manner such as research, cooperative learning, discrepant events, predicting, and lab work (Colburn, 2000).

The current philosophy in science education advocates a hands-on/minds-on approach taught through various forms of inquiry (Dean & Kuhn, 2006; Michalsky, Mevarech, & Haibi, 2009). Hands-on science has been advocated in schools since the 1970s. The National Academy of Sciences (NAS) reports four strands that describe students who are proficient in science (Duschl, Schweingruber, & Shouse, 2007). These four strands represent constructivism and scientific inquiry. According to the NAS students should be able to (a) know, use, and interpret scientific explanations of the natural world (b) generate and evaluate scientific evidence and explanations, (c) understand the nature and development of scientific knowledge, and (d) participate productively in scientific practices and discourses. Translating the four strands into everyday classroom activities is a challenge for educators.

Science Instructional Strategies and Methodologies

Many independent studies exist promoting a particular best practice to improve science education. Young and Lee (2005) promote kit-based instruction in conjunction with intensive professional development. Others see strong literacy lessons used in conjunction with hands-on activities as providing the minds-on learning the National Standards desire (Linek et al., 2009; Michalsky et al.). Modeling is used in some science classrooms (Archer, Arca, & Sanmarti, 2007). Context-based classrooms use application as a starting point for science lessons, as opposed to traditional classrooms that use application at the end of the lesson (Bennett, Lebben, & Hogarth, 2006). In addition to multiple methods of teaching science, there are multiple delivery systems being used in delivery models (Levy, Pasquale & Marco, 2008; Linek et al., 2009).

Gess-Newsome (1999) includes five delivery models. First is classroom generalist with one self-contained teacher covering most if not all subjects. Second is classroom science specialist who still teaches a self-contained classroom but also provides leadership to other teachers in terms of teaching science. Third are science support teams. This scenario entails an additional staff member who joins a self-contained classroom during science instruction, thus providing the classroom two education professionals. Fourth is departmentalization within grade levels where students switch teachers to provide specialized content. Finally are science specialists. Here, the teacher is solely responsible for science instruction and acts as a science expert. Each method has advantages and disadvantages (Figure 6).

Delivery Model	Advantages	Disadvantages
Classroom Generalist	Teacher knows students well – knows student interests. Allows for a flexible curriculum and thematic lessons.	Teacher may not have a strong science background. Teacher may feel time pressures towards other subjects, neglecting science instructional time.
Classroom Science Specialist	Increases teacher content and curricular knowledge. Science instructional time becomes dedicated.	Time is needed for communication and collaboration between teacher and specialist.
Science Support Team	Teachers share expertise. Dedicated science time. Increases teacher knowledge and confidence in science instruction.	Increased personnel costs. Time is needed for communication and collaboration.
Departmentalization within Grade Level	Guaranteed science time. Allows science resources to be centralized. Fewer lesson plans needed for the teacher.	Decreased knowledge of students. Minimal use of thematic units.
Science Specialists	Guaranteed science time. Highly qualified science teachers. Centralization of science supplies.	Limited knowledge of students. Decreased use of integrated units. Increased personnel costs.

Figure 6. Advantages and disadvantages of science delivery models.

The Program

The Program consists of two components. First is an educator resource center. The Program's educator resource center is housed at a regional university within its state. The educator resource center is one of approximately 70 centers throughout the U.S. and its territories (personal communication from Program coordinator, May, 2012). Centers are funded by a federal agency specializing in STEM education and activities. Centers are responsible for providing educators, students, and the general public with educational and promotional materials including posters, lithographs, CD's, DVD's, and student activities (personal communication from Program director, January 14, 2012). Materials are provided free of charge.

The second component of The Program is the Education Specialist Network. "The Network is comprised of full-time, trained . . . educators whose purpose is to supplement and enhance K-12 science, math, and technology education in the state" (personal communication from Program director, May 2012). Appendix A provides a list of services provided by the Network.

The Program received initial funding in 1999 with the opening of the center. The Network received funding beginning the 2004 school year. Both have been in continuous operation until the time of this research. According to the director, funding cuts have forced the closure of the Network with the end of the current school year, with the center to close prior to the start of the next school year (personal communication, January 14, 2012).

Summary

A review of literature reveals a connection between utilization-focused evaluations, communities of practice theory, and science education. All three are pragmatic in nature. They seek a real-world application to educational theory.

UFEs are user driven. Primary intended users help sculpt research questions. Results are meant to be used in predetermined ways. The evaluator acts as a judge, negotiator, and research designer as the process unfolds.

CoPs exist because of user participation. CoPs members share a domain, community, and a practice. This creates a shared repertoire of resources used by members to increase knowledge both of the individual and the community. CoPs occur naturally. They cannot be formed by management. Science educators who intentionally share resources to gain knowledge about their profession constitute a CoPs.

Science educators are trained to use a variety of techniques which include scientific inquiry and hands-on methods. Scientific inquiry may use hands-on methods, or may be more research based. Both approaches are pragmatic in nature. Reform standards emphasize real-world applications for acquired science knowledge (NRC, 2000).

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

Introduction

A science, technology, engineering, and mathematics (STEM) enrichment program in a Midwestern state seeks a summative program evaluation. The Program is finishing its final six months of funding. After thirteen years of serving teachers, students, pre-service teachers, and the general public, The Program will end at the close of this school year. Utilization-focused evaluation (UFE) employs a backward design. The evaluator and primary user first determine goals for the evaluation prior to research. Once established the evaluator fashions instruments best suited to collect necessary data. This research uses a mixed-methods approach to ensure a full, rich evaluation (Mertens, 2005). This chapter will review the research paradigm, conceptual framework, lens for the study, the study problem and purpose, and research questions. Additionally, each of the two research methodologies will be discussed: part one is instrumentation, collection, and analysis of quantitative data and part two is the instrumentation, collection, and analysis of qualitative data. Parts will be conducted concurrently (Creswell, 2009).

Research Paradigm, Conceptual Framework, and Lens

Pragmatism is well suited as a research paradigm for this study. Pragmatism focuses on the practical nature of research looking for real-world applications (Mertens, 2005). Communities of Practice (CoPs) and UFE center around real-world application. CoPs are naturally pragmatic and provide a supportive framework for this research. CoPs are groups of people who share a passion or common interest and interact as practitioners. CoPs vary greatly in size, geographical region, membership, norms, and resources. The Program functions as a CoP. Its personnel share a common interest in STEM education, sharing and creating new resources that benefit The Program's mission. UFE more narrowly focuses the research to study specific aspects of The Program determined by the director. UFE is also naturally pragmatic in that gathered data serves a predetermined application.

Problem and Purpose

The purpose of this study is to determine the impact and utilization of The Program on STEM teachers and students, the impact and utilization of The Program's materials and personnel on STEM educators, and the overall impact of The Program on STEM education. Impact and utilization will be investigated by conducting a Utilization-Focused Evaluation of The Program for the director. Standard program evaluation will not allow the director to have input as to study focus or uses upon completion. UFE allows the director to examine specific Program areas and include multiple viewpoints from various stakeholders. The director will then be free to share findings with Program personnel, people who have been instrumental in supporting The Program, past funders, and potential future funders.

Research Questions

The director of a science, technology, engineering, and mathematics program, referred to as The Program desires a summative program evaluation. The Program's funding ends with the current school year and the director feels an evaluation would be beneficial to Program partners and stakeholders (personal communication, January 10, 2012). Currently, The Program does not have a summative evaluation tool. The purpose of this research is to conduct a utilization-focused program evaluation summarizing the effectiveness of The Program. The following questions guided this mixed-methods research:

1. What degree of impact was perceived by stakeholders regarding The Program in terms of:
    a. Overall impact on teachers?
    b. Overall impact on students?
    c. Overall impact of materials?
    d. Overall impact of Program personnel?
    e. Overall impact of The Program on STEM education?
2. What perceptions do Program personnel have regarding the overall impact of The Program on STEM education?
3. What perceptions do teachers have regarding the overall impact of the Program on STEM education?

Research Methods

A case study involves multiple data sources to research a single issue, program, or case (Creswell, 2007). Case studies are typically qualitative. This mixed-methods research while primarily qualitative also contains a quantitative element. The inclusion of quantitative data for the purposes of program evaluation does not eliminate this research as a case study. Creswell (2009) states that case studies explore a program, are bounded in time and activity, and collect a variety of data over a period of time. A summative UFE of The Program meets Creswell's criteria.

Creswell (2009) writes that mixed-methods research uses both pre-determined and emerging methods, contains both open and closed questions, collects multiple forms of data, uses statistical and text analysis, and interprets information across databases. Data collected for this study include demographic archival data and surveys to collect quantitative data, and interviews and focus groups to collect qualitative data. Each type of data will be analyzed individually, but mixed-methods research allows data to be combined for analysis (Creswell). Creation of a matrix during concurrent mixed-methods research presents an analysis of both quantitative and qualitative data (Appendix J).

Quantitative Phase

One method used for descriptive research is surveying (Mertens, 2005). Survey data generalizes from a sample to a population and allows quick turn-around (Creswell, 2009). Surveys can be used in program evaluation when information needs to come directly from people (Fink, 2009).

The Program currently utilizes a standard teacher feedback form to gather data (Appendix C). The feedback form provides information about the specific presentation or workshop at which the form is distributed. It does not provide summative program data. The Program director as primary intended user seeks data not provided on the current feedback form. An overall program evaluation form was needed to gather desired data.

A non-experimental survey design was used to create the evaluation. Data was cross-sectional to force a rapid turn-around. Rapid turn-around was desirable for this study since The Program is closing. The questionnaire was self-administered and available in both electronic and paper formats. Having two formats provided access to more potential respondents. Educators who have utilized The Program on at least one occasion were asked to complete the questionnaire. It is unknown precisely how many educators have utilized the services of The Program during its history. The Program which started with one education specialist grew to include six education specialists at its peak, but two factors have influenced the potential sample population for this study. First, lay-offs have reduced personnel to four education specialists at the time of this research. This results in fewer teacher contacts for The Program as a whole. Second, the four remaining personnel have worked on a restrictive budget since the 2010-2011 school year, limited in terms of mileage and supplies. This has resulted in an additional deduction in the number of educators contacted by The Program. A random sample was not possible for this study as participants needed to meet the specific criteria of having utilized The Program. Creswell (2009) refers to the type of sample used for this study as cluster sampling. Cluster sampling occurs when the researcher identifies a group and samples from within that group. Participants were recruited from a state-wide science educator conference and dissemination from Program personnel.

Validity

Survey items were designed to gather data requested by The Program director acting as the primary intended user of the evaluation. The director and six other Program personnel were used to establish content and face validity for the survey by acting as an expert panel (Mertens, 2005). Panel members examined the survey's layout, response items, and response choices. Changes were made, and the survey was re-sent to panel members. It was determined that survey questions provide data sought by the intended user; thus creating a valid survey.

Pilot Testing

Since all surveys must be pilot tested (Fink, 2009), a school which frequently utilized The Program's resources was asked to participate. A paper copy of the survey was distributed to fifteen educators who are very familiar with The Program. Each was asked to evaluate the survey for design, item content, and response content. The researcher conducted a focus group with the respondents to examine the survey's ease of use, wording of questions, time needed for completion, overall survey appearance, and ease of ability to understand directions. The researcher combined recommended changes from the expert panel and teacher focus group to make desired changes. The final survey was distributed (Appendix F).

Data Analysis

Descriptive statistics will be used to analyze survey data. Responses will be grouped into two categories: strongly agree and agree, and strongly disagree and disagree. Responses will be counted and reported as percentages.

Qualitative Phase

The summative UFE for The Program contains substantial qualitative data. "Qualitative methods are used in research that is designed to provide an in-depth description of a specific program, practice, or setting" (Mertens, 2005, pg. 229). Patton (2008) provides three reasons to gather qualitative data. First, if an educational program is based on humanistic values, qualitative data allows personal contact. Second, qualitative methods are acceptable when no useful, practical, valid, or reliable quantitative measure can be found. Third, qualitative data can be used to add depth to quantitative measures. This study qualified for all three reasons.

The qualitative phase began with The Program's director seeking a summative program evaluation. A letter from the director indicated his desire for the evaluation as well as preliminary questions for which he would like an answer (Appendix E). The next step was to determine specifically which of the director's questions could be answered within a UFE. Five groups of stakeholders were needed to gather all requested data: Program personnel, teachers who have utilized The Program, students who have received Program presentations, key influential people in politics and funding, and pre-service educators. Program personnel determined that due to the high turnover rates in the past two years of key influential people who provided political and funding assistance, this group would have to be excluded. Second, pre-service teachers would prove to be a difficult and resource consuming group. Workshops and presentations are delivered to pre-service educators who move into classroom settings, scattered among different school districts. They are often anonymous to Program personnel with little, if any contact information; therefore pre-service teachers were also eliminated from the study. Students were eliminated as a desired data group to avoid parental notification and school liability concerns.

The two remaining groups, teachers and Program personnel were able to provide answers to eleven of the thirteen user-created questions. Methods for gaining information for each question were established (Appendix E). The next step was to create an interview and focus group schedule and establish protocols for each group (Appendixes G and H). Program personnel interviews were conducted face-to-face and audio recorded. Transcripts were made from each interview to provide written text for analysis.

Pseudonyms were assigned to each participant to provide anonymity. Analysis was in the form of open and axial coding to see if emergent themes exist (Mertens, 2005).

Program personnel were asked to provide the names of educators at schools who frequently utilized The Program as a resource. The educators were contacted in an attempt to arrange an on-site focus group. Focus group questions were constructed in preparation for the first meeting. Focus groups promote self-disclosure (Krueger & Casey, 2000). Many reasons exist for conducting focus groups including evaluation research (Krueger & Casey). Focus groups should be used when the researcher desires a range of ideas or feelings, to bring insight into complicated topics, the researcher wants ideas to emerge from the group, or the researcher needs to better understand quantitative date (Krueger & Casey). This study uses each of these reasons. The number of focus groups needed varies with the research. Once data saturation has occurred and no further themes emerge, the researcher can stop conducting focus groups. Seven schools agreed to host focus groups which were audio recorded. Transcripts of the recordings were made. Data was open-coded looking for general themes. Next, data was axial coded, forming relationships among data points (Mertens, 2005). Written comments from the quantitative survey were transcribed and coded in the same way.

Once all data had been gathered and analyzed separately, a matrix was constructed combining quantitative and qualitative data (Figure 7 and Appendix J). Creswell (2009) lists this as one data validation process used in mixed-methods research. Validation will allow a summative program evaluation to be generated.

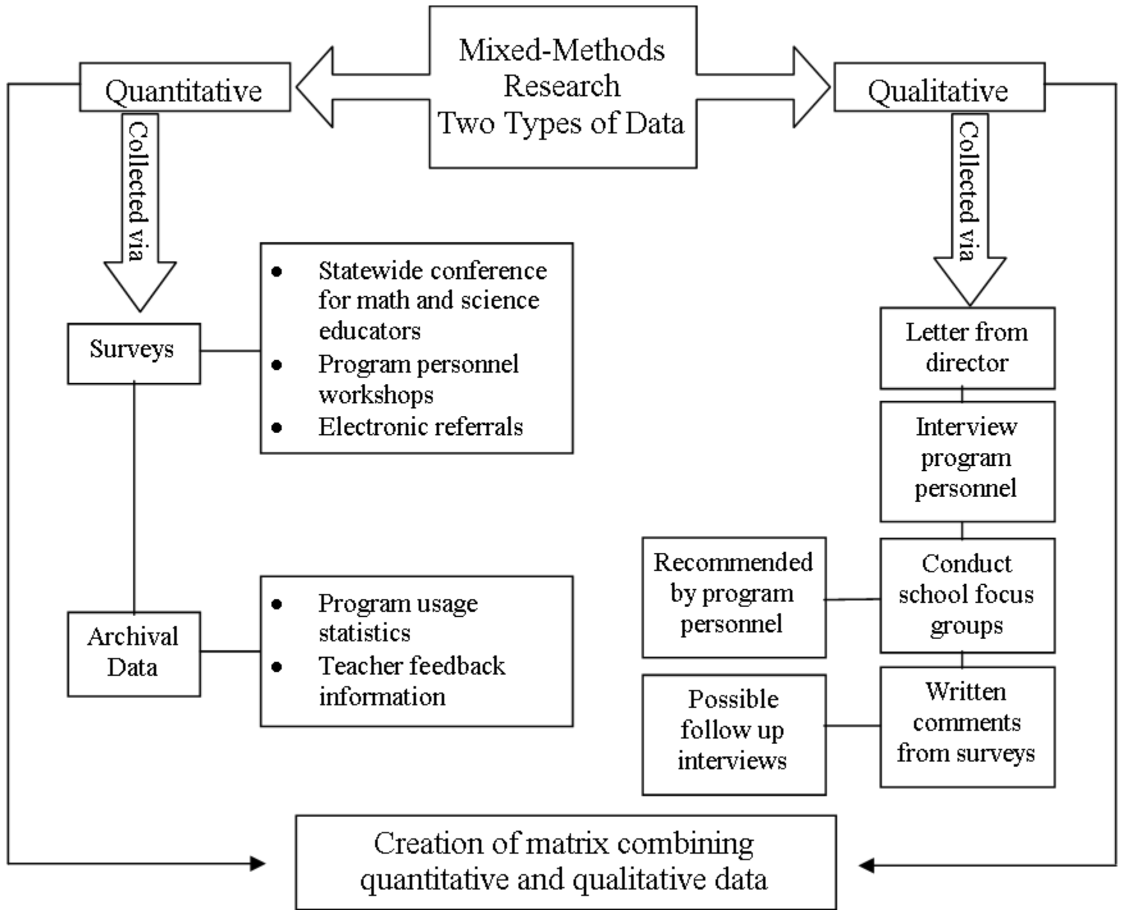

Figure 7. Research collection strategy.

Data security

Security measures designed to protect research participants were established prior to conducting research. The quantitative survey contained no identifiers linking participants to responses. Survey data is stored in a locked cabinet within a locked office accessible only to the researcher. Audiotapes of focus groups and Program personnel were erased upon completion of transcription. No identifiers were used during the transcription process. Pseudonyms were used for individuals and schools. Transcripts are stored in a locked cabinet within a locked office accessible only to the researcher. Data stored on the researcher's computer is secured via password. The name of The Program, its state and location, and primary funding agencies have been avoided to protect study participants.

Summary

As funding comes to an end, The Program needed a summative program evaluation. UFE was determined to be the best method for producing user desired research. A mixed-methods design allowed all necessary data to be gathered and triangulated. Data was collected concurrently through a quantitative survey, demographic archival data, Program personnel interviews, focus groups of Program users, and written comments on the quantitative survey. A matrix triangulating the data was constructed as a method of validating the research (Appendix J). Chapter 4 presents research findings while Chapter 5 discusses those findings.

CHAPTER FOUR

FINDINGS

Introduction

A science, technology, engineering, and mathematics (STEM) enrichment program in a Midwestern state requested a summative program evaluation. The Program lost its funding and is closing at the end of the current school year. Previously generated program data has been limited to statistical evidence including number of students encountered, number of teachers at workshops, number of publications distributed, etc. (Appendixes A and B). Anecdotal evidence has not been systematically collected and exists only in forms such as the occasional comment on a teacher feedback form, email sent from a workshop participant, or event media coverage (Appendix C). The Program coordinator responsible for compiling teacher feedback statistics reported less than 5% of the feedback forms received contained useful written comments (personal communication, January 27, 2012). The Program lacks a summative evaluation reflective of its widespread usage, multiple stakeholders, and commitment to STEM education. Without such an evaluation, The Program's impact on STEM education will remain unknown. It will also remain unknown if The Program's overall model can be considered a successful format for future STEM enrichment programs.

The purpose of this study was to determine the impact of The Program on teachers and students, the impact and utilization of The Program's materials, the impact of Program personnel, and the overall impact of The Program on STEM education. Impact and utilization was investigated by conducting a Utilization-Focused Evaluation

(UFE) of The Program for the director. Standard program evaluation would not allow the director to have input as to study focus or uses upon completion. However, UFE allows the director to examine specific Program areas and include multiple viewpoints from various stakeholders. The director will then be free to share findings with Program personnel, people who have been instrumental in supporting The Program, and past funders. Findings will allow stakeholders to better understand The Program's statewide impact on STEM education, potentially modeling similar programs in the future.

This mixed-methods case study was designed to provide the director of The Program a summative evaluation. Mixed-methods research allows a blending of data to create a more complete picture of the phenomena studied (Mertens, 2005). The director of The Program recognized the challenges of quantifying the Program impact (personal communication, January 17, 2012). The director felt qualitative data gathered from key stakeholders could provide a different type of data useful to better understand The Program's impact. Quantitative data was also gathered as a means of verifying results.

This chapter presents research findings for two types of quantitative data which include a teacher survey and Program demographic archival data, and three forms of qualitative data including written comments from teacher surveys, teacher focus groups, and Program personnel interviews.

Quantitative Data

Quantitative data came from two sources. First, The Program possessed demographic archival data such as the number of students and teachers reached, the number of presentations by Program personnel, and the number of materials distributed (Appendixes A and B). Second, teachers who had utilized The Program's services on at least one occasion were asked to complete a quantitative survey regarding the overall impact of The Program on students and teachers, the overall impact of materials and Program personnel, and the overall impact of The Program in general. The survey also contained information about frequency of usage of various Program services such as having Program personnel in the classroom, professional development workshops, and school visits (Appendix F).

Surveys

Surveys were distributed by Program personnel at educator workshops, conferences, school visits, and via email. The survey was returned by all 109 educators from across The Program's home state who participated in Program workshops and presentations during the data collection period. Five general areas of information regarding The Program were gathered: overall impact on teachers, overall impact on students, overall impact of materials, overall impact of Program personnel, and overall impact of The Program on STEM education. Data collected from the quantitative survey attempted to answer research question 1:

1. What degree of impact was perceived by stakeholders regarding The Program in terms of:

    a. Overall impact on teachers?

    b. Overall impact on students?

    c. Overall impact of materials?

    d. Overall impact of Program personnel?

    e. Overall impact of The Program on STEM education?

The survey contained twenty questions regarding The Program's impact and five questions regarding frequency of usage. Each impact questions had four choices: Strongly agree, agree, disagree, and strongly disagree.

Overall Impact on Teachers

The quantitative survey contained five stems regarding The Program's impact on teachers. This section was designed to answer the following questions from The Program's director who is the primary intended user: (a) How do teachers perceive the impact of The Program on their own teaching effectiveness, (b) do they think professional development provided is beneficial to teachers, and (c) how much do teachers employ teaching techniques and approaches taught and modeled by Program personnel, especially in professional development deliveries (Appendix E)? Table 1 lists the results from the overall impact on teachers section of the quantitative survey.

Table 1

The Program's Overall Impact on Teachers

	Agree or Strongly Agree	Disagree or Strongly Disagree
The Program has positively impacted my STEM teaching	99	1
The Program has made me a better teacher	96	4[a]
The Program has increased my knowledge of STEM teaching activities	100	0
The Program has provided beneficial professional development	97	3[a]
The Program has increased my motivation regarding STEM topics	99	1

Note. Judgments were made on a four-choice scale. Numbers represent percentages for each response group.

[a] Written comments from surveys indicate respondents would have checked “not applicable” instead of disagree if choice had been provided.

Overall Impact on Students

The quantitative survey contained fours stems regarding The Program’s impact on students. This section was designed to answer the following questions from The Program’s director who is the primary intended user: (a) How has The Program impacted student learning, and (b) how has The Program impacted student interest in STEM topics or their attitudes about STEM topics (Appendix E)? Table 2 lists the results from the overall impact on students section of the quantitative survey.

Table 2

The Program’s Overall Impact on Students

	Agree or Strongly Agree	Disagree or Strongly Disagree
The Program has positively impacted students	100	0
The Program has increased student STEM learning	100	0
The Program has increased student interest in STEM topics	100	0
The Program has increased overall student attitudes towards science and other STEM topics	100	0

Note. Judgments were made on a four-choice scale. Numbers represent percentages for each response group.

Overall Impact of Materials

The quantitative survey contained four stems regarding The Program's impact of materials. This section was designed to answer the following questions from The Program's director who is the primary intended user: (a) How much do teachers use the educational materials supplied to them by The Program personnel, (b) does impact outweigh expenses, and (c) what do teachers think of the materials provided by The Program (Appendix E)? Table 3 lists the results from the overall impact of materials section of the quantitative survey.

Table 3

The Program's Overall Impact of Materials

	Agree or Strongly Agree	Disagree or Strongly Disagree
The Program provides useful educational materials	100	0
The Program provides high quality educational materials	99	1
The Program has improved my science, math, or technology curriculum	99	1
The Program uses materials that enhance STEM education	99	1

Note. Judgments were made on a four-choice scale. Numbers represent percentages for each response group.

Overall Impact of Program Personnel

The quantitative survey contained five stems regarding The Program's impact of materials. This section was designed to answer the following questions from The Program's director who is the primary intended user: How were Program personnel perceived by students and teachers (Appendix E)? Table 4 lists the results from the overall impact of Program personnel section of the quantitative survey.

Table 4

The Program's Overall Impact of Program Personnel

	Agree or Strongly Agree	Disagree or Strongly Disagree
The Program personnel provide professional programs	100	0
The Program personnel are knowledgeable regarding STEM topics	100	0
The Program personnel are helpful to me as a teacher	100	0
The Program personnel are helpful to students	100	0
The Program personnel are quality educators	100	0

Note. Judgments were made on a four-choice scale. Numbers represent percentages for each response group.

Overall Impact of The Program

The quantitative survey contained four stems regarding The Program's impact of The Program. This section was designed to answer the following question from The Program's director who is the primary intended user: What are the overall opinions of The Program's merit, worth, and significance (Appendix E)? Table 5 lists the results from the overall impact of The Program section of the quantitative survey.

Table 5

The Program's Overall Impact of The Program

	Agree or Strongly Agree	Disagree or Strongly Disagree
The Program helps schools	100	0
The Program helps teachers	100	0
The Program helps students	100	0
The Program is a worthwhile program	100	0

Note. Judgments were made on a four-choice scale. Numbers represent percentages for each response group.

Demographic Archival Data

The Program kept statistics regarding number and type of programming conducted by Program personnel. These statistics include categories such as number of presentation, number of conferences, number of students reached, and number of teachers reached (Appendixes A and B). Examination of this data answers the primary intended user's question, "What is The Program's total impact on teachers, students, and the general public in terms of contact statistics" (Appendix E)?

Data showed steady increase in contact statistics from the 199-2000 school year through the 2009-2010 school year. During these years, The Program went from one education specialist who was also the educator resource center director to six education specialists, including the educator resource center director. While not every category grew every year, there was a general upward trend in number of contacts overall. Increases were most noticeable during the 2004-2005 school year when three additional education specialists were added to The Program. After the 2009-2010 school year, contact statistics drop dramatically. For example, the number of teachers contacted by The Program saw a decrease of 66% during the 2010-2011 school year while the number of students contacted experienced a decrease of 33%. Contact on the general public decreased 26 %. This was the first year of Program funding reduction. The 2011-2012 school year continued to see overall downward usage statistics. There were only four operating education specialists during this time. Figure 8 shows contact statistics for teachers, students, and general public over the 13 years data was gathered by The Program.

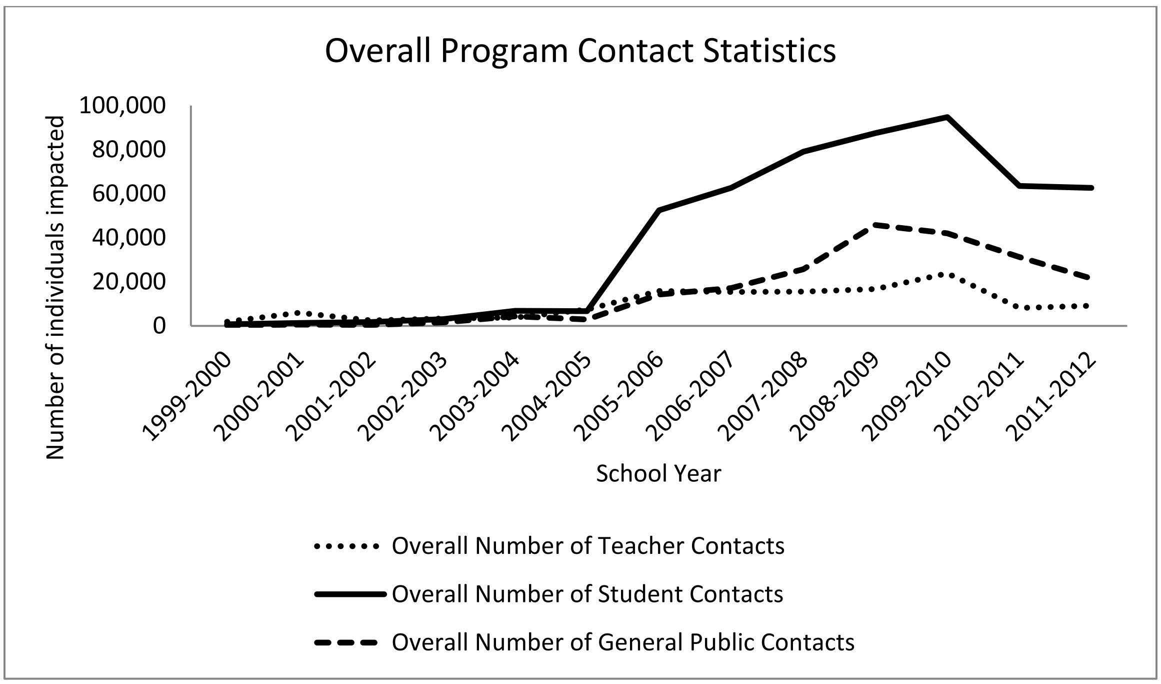

Figure 8. Contact statistics for The Program.

Qualitative Data

Qualitative data included content analysis of three data sources. First, written comments from the quantitative survey given to teachers who utilized services of The Program on at least one occasion were open coded to discover themes. Second, seven teacher focus groups were conducted at schools recommended by Program personnel.

Schools who had utilized The Program's services on multiple occasions were asked to participate. The focus groups were audio recorded, transcribed, and open coded to determine emergent themes (Appendix H). Third, face-to-face interviews with Program personnel were audio recorded, transcribed, and open coded to determine emergent themes (Appendix G).

Written Comments from Teacher Surveys

Written comments from teacher surveys were gathered for analysis. Comments for each survey section were open coded to discover themes embedded in the comments. Mertens (2005) writes that open coding closely examines data to look for similarities and differences. Similarities can then be organized into themes (Creswell, 2009). The number of occurrences for each theme was recorded.

Open coding for each section followed a standard procedure.

1. All written comments from teacher surveys were transcribed into Microsoft Word documents created for each survey section: impact on teachers, impact on students, impact of materials, impact of personnel, and overall impact.
2. Each section received a close first reading where the researcher noted possible themes.
3. Each section received a second close reading when reoccurring words and phrases were highlighted using different colors.
4. Highlighted words and phrases were counted and those that emerged as trends were recorded as an individual table for each survey section.
5. Documents were analyzed for words and phrases and number of occurrences was entered into code book.

Teacher Focus Groups

Focus groups were conducted with seven groups of educators from across The Program's state. Focus groups were recruited two ways. First, a page attached to the end of the quantitative teacher survey asked participants to consider hosting a focus group (Appendix F). Second, Program personnel were asked to recommend schools with which they had multiple contacts and interaction with more than 3 teachers. A focus group was held at every school that offered to participate through the teacher survey except for one: a mutual time could not be arranged between teachers and the researcher to hold a focus group. Additionally, every school recommended by Program personnel agreed to participate. Each focus group was audio recorded then transcribed verbatim. Participants received informed consent letters prior to participation in addition to oral consent information prior to starting the recorder (Appendix I). Focus group questions were written prior to the event and were designed to answer The Program director's questions (Appendixes E and H). Teacher responses are identified by the letter assigned to the focus group in which they participated followed by a randomly assigned number for their group. For example, A2 indicates speaker 2 from focus group A.

Program Personnel Interviews

One-on-one interviews were conducted with Program personnel. Three current employees and one past employee agreed to participate. Two interviews were conducted face-to-face and two interviews were conducted via telephone. All interviews were audio recorded then transcribed verbatim. All participants received letters of informed consent prior to the interview in addition to oral consent information prior to starting the recorder (Appendix I). Interview questions were written prior to the event and were designed to answer The Program director's questions (Appendixes E and G). Since all Program education specialists were asked for an interview, no pilot group was available. However, the Program director examined the interview protocol (Appendix G) and agreed the established questions could potentially elicit desired data. Employees are identified by a randomly assigned number 1-7. Not all employees participated in an interview.

The Coding Process

After focus group and interview transcription was completed, the documents were analyzed to determine if emergent themes could be discovered. Open coding for each section followed a standard procedure.

1. Transcripts from teacher focus groups and Program personnel were created in Microsoft Word. A new document was created for each participating school or employee.
2. Each document received a close first reading where the researcher noted possible themes.
3. Each document received a second close reading examining for codes already in the code book.
4. If a theme was already in the code book, the number of occurrences in the focus group transcripts and Program personnel transcripts was documented. If a new theme emerged, it was added to the code book and occurrences were documented.
5. The written survey comments were reexamined for the new codes found in the transcripts and occurrences were documented in the code book.

Overall impact on teachers. Five themes emerged from the three qualitative sources regarding The Program's overall impact on teachers. Figure 9 depicts the themes, examples of code words, and number of occurrences. Data collected was an attempt to answer multiple questions from the director: (a) How do teachers perceive the impact of The Program on their own teaching effectiveness, (b) do they think the professional development provided by the program is beneficial to teachers, and (c) how much do teachers employ teaching techniques and approaches taught and modeled by Program personnel, especially in PD deliveries?

	Examples of code words	Number of written comments from survey given to teachers	Number of comments from teacher focus groups	Number of comments from Program personnel interviews
The Program taught teachers new/ different information or teaching strategies	• taught me things I didn't know • gave me some good ideas • I have gotten new teaching strategies • new ideas and interests	15	31	13
The Program taught teachers how to increase hands-on or inquiry methods	• I was doing too much directed inquiry • hands-on activities that engaged students • enable me to use hands-on activities • it motivates me to bring more hands-on lessons to the students	10	4	2
The Program was beneficial or helpful to teachers	• strengthened my knowledge • improved how I teach • gave me more confidence	21	22	11
The Program increased teacher excitement about STEM	• made me reflect on my own instruction of science and math • gave me more confidence and a deeper love for astronomy • has shown me science is not threatening	4	4	3
The Program allowed teachers to use resources immediately and/or saved them time	• make and take was invaluable • materials and interaction to use almost immediately • could take back to class and start using them	1	6	3

Figure 9. Emergent themes, examples of code words, and number of occurrences for written comments from teacher surveys regarding overall impact on teachers.

Program personnel offered interesting insights regarding The Program's overall impact on teachers. Employee 2 commented:

> [The Program] allowed me to truly reach teachers that were terrified of science, did not want to teach science, and used The Program's resources to get them excited about teaching science. Now they come and ask me for more and more information and resources because they've caught the bug.

Employee 7 remarked, "STEM teachers I guess are the heartbeat of what we do. Those that are willing and hoping for enhancement of understanding – I think we have helped them see different ways of doing what they do." This employee offered a summary of how The Program has helped teachers by saying, “It’s been an outstanding example of direct help for the teachers to get them using hands on science.” Employee 3 noted:

> A lot of the teachers teach all of the subjects and I don’t think they think of themselves as STEM teachers . . . But I think it [The Program] makes them aware that they can actually teach all those things. It gives them a resource to draw from.

Focus-group teachers also commented on The Program’s overall impact on teachers. A kindergarten teacher from focus group C1 said, “You came to help me when I was struggling with one of my standards in kindergarten. It was great.” A second teacher remarked on The Program’s impact on her teaching during focus group D2:

> I am not such a science person. I was never interested in the solar system or space as a kid. It just wasn’t me. And so for my own knowledge I now think, ‘Oh, I should look into the number of moons or see if they found more constellations.’ It didn’t interest me so I never – and then she [Program employee] came in and was talking about it and I was thinking I need to know this stuff. It educated me . . .”

A second grade teacher in focus group G2 said:

> The curriculum has stayed basically the same but you [Program employee] always came in with different activities so as a teacher I was able to do some of your past activities with my students that you had used prior so it was really nice to develop some of those lessons and add them to my repertoire.

Overall impact on students. Five themes emerged from the three qualitative sources regarding The Program’s overall impact on teachers. Figure 10 depicts the themes, examples of code words, and number of occurrences. Data collected was an attempt to answer two questions from the director: (a) How as The Program impacted student learning, and (b) how has The Program impacted student interest in STEM topics or their attitudes about STEM topics?

	Examples of code words	Number of written comments from survey given to teachers	Number of comments from teacher focus groups	Number of comments from Program personnel interviews
The Program engaged/interested/ and/or excited students about STEM subjects	• they are enjoying learning about science • excited about these lessons • has increased the interest of students for science	8	27	12
The Program led students to explore other activities/ subjects	• they begin wonder more about stuff and tie things together • remember lessons and build on the foundations • they transfer knowledge learned to other lessons	2	12	7
The Program increased student knowledge	• interesting activities the students enjoy and learn from • students learned and retained the information • use knowledge gained throughout year	11	21	3
The Program personnel and activities were enjoyed by students	• students love it when employee comes • wish employee would come more often • engaged and excited • look forward to it	25	9	3
The Program offered resources or information to students that would have otherwise been unavailable	• provided items my rural students may have never been able to see • brings topics we do not have time to teach • valuable experiences they would not have otherwise	5	12	1

Figure 10. Emergent themes, examples of code words, and number of occurrences for written comments from teacher surveys regarding overall impact on students.

Many comments were made in both the teacher focus groups and employee interviews about The Program's overall impact on students. Among comments that explained the impact on students include one from Program Employee 5 regarding her second visit to a school:

> I remember a librarian at a middle school where I went in December and her attitude was so positive about it. One of the things she said was, ‘this is a big day – kids in the whole school are talking about your coming again.’ I know we improved kids’ attitudes about science.

Employee 2 said:

> How many times have I . . .had three or four parents come up to me and say, ‘You’re The Program lady. My kids saw you at ---and they can’t stop talking about it.’ They [students] are excited about things their parents never thought they’d be excited about.

Employee 4 commented about a similar event:

> Those students are coming back to me and visiting me, contacting me, because of the interest from my visiting their classroom . . .I see this especially during the summers when I do summer schools – oh I remember seeing you at some museum or I remember seeing you at something – and now I did my science project on a rocket or whatever. They [students] are so encouraged by what we bring into the schools, they visit, they want to know, so I think we’ve enhances and excited them.

Teachers also mentioned The Program’s overall impact on students. A fifth grade teacher from focus group F1 said, “It makes them excited to learn. Everyone is engaged – there’s not one student that’s not. They’re quite, they’re respectful, they’re listening, they want to know, they have questions. It’s peaked their interests so they want to learn more.”

Another teacher who missed a presentation by Program personnel recounted this experience during focus group D2:

> I was on maternity leave when [the employee] brought in the moon rock but I feel like I was there that day because my kids have shared it. 'You weren't here, you weren't here, but you should have seen it !' Or, 'Did you know it was worth and she let us look at it,' and I feel like I was there. I feel like I didn't miss that day because I've had 23 reenactments of it over and over . . .

Overall impact of materials. Five themes emerged from the three qualitative sources regarding The Program's overall impact of materials. Figure 11 depicts the themes, examples of code words, and number of occurrences. Data collected was an attempt to answer the following questions from the director: (a) How much do teachers use the educational materials supplied to them by The Program personnel? (b) Does the impact outweigh the expense? (c) What do teachers think of materials provided by The Program?

The primary intended user, The Program's director, asked specifically about material usage. To answer his question about how much teachers use materials provided by Program personnel, two questions were asked on the teacher survey. The first question was, "How often do you use Program education materials to prepare for a lesson or unit?" Second, "How often do you use Program education materials with your students?" Table 6 shows the results from the teacher survey regarding material usage.

Table 6

Usage of Program educational materials by teachers

	More than 2 times per month	1-2 times per month	1-2 times per quarter	1-2 times per school year	Not applicable / have not used
How often do you use Program education materials to prepare for a lesson or unit?	7	31	25	22	15
How often do you use Program education materials with your students?	10	32	19	25	13

Note: Judgments were made on a five-choice scale. Numbers represent percentages for each response group.

Figure 11 shows coding results from the overall impact of materials found in teacher focus groups and Program personnel interviews.

	Examples of code words	Number of written comments from survey given to teachers	Number of comments from teacher focus groups	Number of comments from Program personnel interviews
Teachers have shared materials provided by The Program with other educators	• posters, pictures are used by all teachers • teachers I have shared them with have been very pleased • I have shared with 5 other teachers	3	1	0
The Program provides quality materials	• relevant ideas and materials • great educational program and materials • materials for all curriculum areas	12	2	2
Materials provided by The Program have increased student interests or learning	• helped information stick for my students • helped create an environment that was motivating • it really made us think • useful to enhance instruction	9	5	0
Materials provided by The Program could be used immediately in the classroom	• take back to class and use right away • left workshop ready to teach	1	2	2
Materials provided by The Program were useful to teachers	• helped create a hands-on learning environment • good materials wish I'd seen more • teachers stand in line to get the materials • great materials	5	15	7

Figure 11. Emergent themes, examples of code words, and number of occurrences for written comments from teacher surveys regarding overall impact of materials.

Comments about the overall impact of The Program's materials include a comment from Employee 7 who was told by a science teacher, 'with what you do I can kick it up a notch because you're helping, you're supplying materials.'"

A middle school science teacher said during focus group E4, "I appreciated the materials but I also appreciated it was like she was training us – it was like free on-site training and I thought that was very valuable." A second teacher in the same focus group added, “We can pass along the notebook but there’s something different about having someone be there and guide you through the notebook then there is just passing it along and you having to interpret it all for yourself.”

Overall impact of Program personnel. Two themes emerged from the three qualitative sources regarding The Program’s overall impact of materials. Figure 12 depicts the themes, examples of code words, and number of occurrences. Data collected was an attempt to answer the following question from the director: How were Program personnel perceived by students and teachers?

	Examples of code words	Number of written comments from survey given to teachers	Number of comments from teacher focus groups	Number of comments from Program personnel interviews
Program personnel were helpful to students and teachers	• able to explain topics and engage students with great success • helpful and informative • does a great job with students	17	7	15
The Program personnel were professional, well-trained, and educated	• dynamic presentation skills reinforced by vast knowledge • staff was very knowledgeable • good solid lesson – well received • courteous, on-time, well prepared	24	2	1

Figure 12. Emergent themes, examples of code words, and number of occurrences for written comments from teacher surveys regarding overall impact of Program personnel.

Teachers from focus groups and Program personnel made additional comments regarding the overall impact of Program personnel. A teacher from focus croup C1, a school which had utilized The Program in years past, but did not have the opportunity during the current year said:

> We missed you coming this year. I always thought it was good for the kids to hear and learn from somebody else and we could refer back to it and say remember when she discussed so and so and we missed that.

Another teacher from focus group A4 referred to a professional development workshop she had attended when she said, “We didn’t have one teacher come out of that workshop that wasn’t crystal clear on what they could do.” A middle school science teacher in focus group E3 spoke of her employee contact:

> The Program person that was for our district, you could call her 24 hours a day and she would be more than happy to come in and help us with any problem we had or answer a question in the middle of a meeting that we were having. We always felt like we could call her anytime and she would be more than happy to provide research for us or she would go back to do the research if we had specific questions. She did that for us on more than one occasion.

Finally, a second grade teacher from Focus Group G4 quipped:

> All the lessons just being hands-on – it’s things you can buy at the store but let’s say that’s neat, but when I go to a store I’m not going to look at that and say, ‘Hey, I can use that in a science lesson’ because my brain doesn’t work that way. I’m not that creative so I’m going to steal what I got from your lessons.

Overall impact of The Program. Three themes emerged from the three qualitative sources regarding The Program’s overall impact of materials. Figure 13 depicts the themes, examples of code words, and number of occurrences. Data collected was an attempt to answer two questions from the director: (a) How can The Program be improved and made even more effective, (b) what is The Program’s culture, including structure, format, personnel, etc., and (c) what are the overall opinions of The Program's merit, worth, and significance?

	Examples of code words	Number of written comments from survey given to teachers	Number of comments from teacher focus groups	Number of comments from Program personnel interviews
The Program was enjoyed/appreciated – favorable comment	• The Program is a great program • wonderful • extremely worthwhile program	13	6	0
The Program should continue –it will be missed	• hope it will continue • we will miss this resource • cannot be replaced • nothing else like it out there	2	8	4
The Program enhanced curriculum or standards	• great curriculum enhancement • supports our curriculum • helps meet state and core standards	5	2	0

Figure 13. Emergent themes, examples of code words, and number of occurrences for written comments from teacher surveys regarding overall impact of The Program.

Many comments made during teacher focus groups and personnel interviews underscore the overall impact of The program. Program Employee 2 said:

> It'll be interesting to see 3-5 years from now if there's an increase from the schools we've worked heavily with in terms of students pursuing [STEM] degrees because it feels like there really should be from the verbal communication we have with the students and teachers.

The same employee continued:

> I can tell you from districts' data crunching, the districts I have worked most closely in have seen over the last eight years a significant increase in their student scores in science, and not just science because we were doing integrated work

> with some of them and looking at particularly how they could integrate language arts and science, and the math and science, their scores went up . . . and they attribute it to our Program.

Program Employee 3 said:

> We're one of those few programs I think that comes to an end without it being a negative reason, like because we weren't effective. I think we could keep going for years because that's how much impact we have.

Employee 5 said:

> There was a big article in the newspaper here recently about a school who got a grant and basically what they had done is taken an activity and presentations I had done with them and had put together a grant . . . so I think these are all ripple effects that started because of our Program.

Employee 5 also said, "I think this Program is one of those secret stars that didn't get a lot of recognition but has a lot of impact."

Additional Data Collection

Since a UFE is primary intended user directed, it was necessary for the researcher to gather data to answer predetermined questions (Appendix E). Data from Program personnel interviews was gathered to answer the following questions posed by The Program's director who is the primary intended user: (a) How can The Program be improved and made even more effective, (b) was The Program administered effectively and fairly, and (c) to what extent have Program goals and intended outcomes been attained? The following data was collected to answer these questions.

How can The Program be improved and made even more effective? Employee 7 commented The Program could be improved through a larger commitment by its state; a partnership with a voice in how STEM processes could be utilized and how The Program's free resources could have made education in the state stronger. Employee 2 said she would have liked more training during her first year so she could have made an impact more quickly. Employee 5 would have liked more conference calls to share ideas, but noted that would have required time away from schools. Three of the four employees interviewed would have liked more education specialists on staff. Employees 2 and 3 mentioned that more education specialists would have decreased travel time and would have allowed more time in schools.

Was The Program administered effectively and fairly? Employee 7 commented:

> All materials were fairly given. Effectively, oh, yes. I've always said that as long as we floated our boat, [the director] let us float our boat - as long as we're on task and doing our job and doing it well.

Employee 3 commented regarding the Program's administration:

> I think it's been done incredibly well. That fact that we only see each other with everyone sitting at the same table once a year but we all still work together – it's done so well it's almost like we see everyone, bosses included, once a week. I have always felt even though hundreds of miles separate all of us, all I would have to do is pick up a phone and say I need this or I need you or I need advice and it would be there.

Employee 2 equated The Program's administration with its impact:

> That should go without saying by the fact that – look at the impact we've had through our teachers and students and school districts. So has it been administered effectively? Yes, we've reached our goals. And maintained our staff. The administration of it must have gone smoothly. They're wonderful. They're supportive. They've been there to provide guidance. They're our biggest cheerleaders. They're great.

Employee 5 said, "I thought they were very willing to give us anything we needed and were very supportive."

To what extent have Program goals and intended outcomes been attained? All four interviewed employees agreed Program goals had been met. Employees 2 and 3 mentioned specific goals, "We've helped teachers, we've made teachers more aware of materials that are out there, and we've excited teachers and students about STEM education and pursuing careers in those areas."

Summary

The findings presented in Chapter 4 were the result of a mixed-methods case study of a STEM enrichment program. The Program's funding source ended resulting in closure at the end of the current school year. The director requested a UFE as a summation of The Program's overall impact. Data was gathered for five areas of impact: teachers, students, materials, personnel, and overall impact. Quantitative data was collected via surveys from teachers who had used The Program's services and demographic archival statistics previously gathered by Program's personnel. Qualitative data was collected through written comments on the teacher surveys, teacher focus groups, and Program personnel interviews. The findings from this chapter along with their implications are discussed in chapter five.

CHAPTER FIVE

DISCUSSION AND IMPLICATIONS

Introduction

This study was conducted based on the problem that The Program did not have a summative program evaluation. The director did not have data to share with Program personnel, past funding sources, educational partners, and potential future funders regarding the overall impact of The Program. Five areas of impact were outlined by the director: overall impact on teachers, overall impact on students, overall impact of materials, overall impact of Program personnel, and overall Program impact on STEM education. After discussion with The Program's director, it was determined that a Utilization-Focused Evaluation (UFE) would be the desired method for obtaining needed research information.

A mixed-methods case study design was implemented. Two quantitative methods were used. First, a survey was distributed to teachers who had utilized Program services on at least one occasion. Second, demographic archival statistics previously collected by The Program were reviewed.

Three qualitative data sources were used. First, written comments from the quantitative teacher survey were collected. Second, focus groups were conducted with seven groups of educators who had used The Program's services on multiple occasions. Third, Program personnel were interviewed. Focus groups and interviews were audio recorded and transcribed verbatim. Both were open coded to discover emergent themes regarding The Program's overall impact.

Quantitative and qualitative data were combined to examine overall Program impact for the desired areas. Data was reported in the previous chapter. This chapter discusses the findings from chapter four as well as conclusions regarding The Program's overall impact based on the reported data, and implications for future STEM education programs.

Discussion of the Findings

This case study attempted to answer three research questions. Research questions were derived from an initial conversation with The Program's director, who was to be the primary intended user of the UFE. To answer these questions, the director's questions were divided into five sections: overall impact on teachers, overall impact on students, overall impact of materials, overall impact of Program personnel, and overall impact of The Program. RQ1 asked what degree of impact was perceived by stakeholders for each the five categories. RQ2 asked the perceptions of Program personnel regarding The Program's overall impact, while RQ3 asked the perceptions of teachers regarding The Program's overall impact. A discussion of the findings for each section of information desired by the director follows based upon information reported in chapter four.

Overall Impact on Teachers

The director and primary intended user for this UFE posed three questions regarding The Program's overall impact on teachers. First, he wanted to know how teachers perceive the impact of The Program on their own teaching effectiveness. Second, he asked if teachers thought the professional development provided by The Program was beneficial. Third, he asked how much do teachers employ teaching techniques and approaches taught and modeled by Program personnel, especially during

PD deliveries. Data to answer these questions were collected in the teacher survey, the teacher focus-groups, and the Program personnel interviews (Table 1 and Figure 8).

Both groups of participating teachers, those who completed surveys and those who participated in focus groups, indicated The Program positively impacted their own teaching effectiveness. Between 96% and 100% of the 109 respondents marked the agree or strongly agree column. This is supported by the emergent themes from collected qualitative data (Figure 9). A total of 43 comments from teachers were categorized under the theme, "The Program was beneficial or helpful to teachers."

Chapter two of this research discussed science education. Hands-on and inquiry methods are recommended best practices for science teachers (NRC, 2000). An effective science teacher would utilize these types of activities in his or her classroom. Further, the constructivist paradigm discussed in chapter two states new knowledge is created through thinking and exploration (Unal & Akpinar, 2006; Colburn, 2000; Straits & Wilke, 2007). Therefore, the impact of The Program on teaching effectiveness can be investigated through this lens. Collected data indicates The Program positively impacted teacher effectiveness through increasing the number of STEM teaching activities, hands-on and inquiry methods, and teaching new information or strategies.

The teacher survey discovered 100% of the 109 teachers surveyed agreed or strongly agreed with the statement, "The Program has increased my knowledge of STEM teaching activities." Qualitative data included 46 teacher comments from the theme, "The Program taught teachers new/different information or teaching strategies," and 14 comments from the theme, "The Program taught teachers how to increase hands-on or inquiry methods."

The director's second question regarding the overall impact on teachers was addressed in the teacher survey through the prompt, "The Program has provided beneficial professional development." Of the 109 respondents, 97% responded agree or strongly agree. However, professional development did not emerge as a theme in written comments from the teacher surveys, teacher focus-group transcripts, or Program personnel interviews. One response regarding The Program and professional development occurred during teacher focus group A4:

> Well it's been a few years since [name of Program personnel] can to our school and did a PD for our teachers but they really enjoyed it because it was a topic that they probably would not have ventured into in her depths and it was so ominous for them until she brought it down on a level they could do.

A teacher added a written comment on the teacher survey, "This program and [name of Program personnel] in particular provide a wonderful opportunity to expand professionally,"

However, while the terms PD and professional development were not specifically mentioned, data suggesting teachers grew professionally as a result of The Program were numerous. Three stems on the teacher survey suggest teachers received professional development through The Program. "The Program has positively impacted my STEM teaching" received 99% agree or strongly agree responses. "The Program has made me a better teacher" received 96% agree or strongly agree responses. "The Program has increased my motivation regarding STEM topics" received 99% agree or strongly agree responses. Further, eight comments from teachers were included in the theme, "The Program increased teacher excitement about STEM." A teacher who is becoming a better teacher, has increased motivation and excitement, and is receiving a positive impact on STEM teaching is growing as a professional (Supovitz & Turner, 2000).

The director's third question regarding the overall Program impact on teachers was not directly addressed though specific questions. Some teachers commented they regularly use Program techniques and approaches modeled by program personnel. "Several elementary teachers have used and continue to use lessons and resources introduced to us during workshops and school visits" was a comment written on one teacher survey. During two teacher focus-groups comments were made that indicated the teachers reused material modeled by Program personnel every year.

One additional theme emerged that was not addressed in questions posed by the director. During qualitative data analysis, "The Program allowed teachers to use resources immediately and/or saved them time" appeared in seven teacher comments: once in comments on the teacher survey and six times in teacher focus-groups. Teachers appear to appreciate this aspect of The Program.

Based on collected data, The Program's overall impact on teachers appears to be positive. Teachers reported positive responses on surveys and during teacher focus-groups. The director's questions regarding overall impact of The Program and teacher's perceptions of The Program have been answered through collected data.

Overall Impact on Students

The Program director posed two questions regarding The Program's overall impact on students. First, he wanted to know how The Program impacted student learning. Second, he wanted to know how The Program impacted student interest in STEM topics or their attitudes about STEM topics. Data were collected through teacher surveys, teacher focus-groups, and Program personnel interviews. It was decided early in the study to avoid the use of students. This was to ensure student privacy and avoid liability issues. Teachers and Program personnel, as experts in the education of students, are qualified to provide opinions on the overall impact on students. Their perceptions were used to gather data.

A total of 109 respondents to four questions regarding The Program's overall impact on students summarize teachers' perceptions of student impact. A 100% response rate for all four questions indicates positive impact. Teachers surveyed unanimously agreed The Program positively impacted students, increased student learning, increased student interest in STEM topics, and increased overall student attitudes towards science and other STEM topics.

Teacher focus-groups and Program personnel interviews yielded five emergent themes that help answer the director's questions. "The Program increased student knowledge" received 35 comments from teachers and personnel. An additional 18 comments were made that "The Program offered resources or information to students that would have otherwise been unavailable." Providing previously unavailable resources would positively impact student learning, assuming the materials were high quality and correlated to curriculum. This issue is investigated further in the overall impact of materials section found later in this chapter.

The second director's question was answered through the emergent theme "The Program engaged/interested and/or excited students about STEM subjects." A total of 47 comments positively supported this question.

Thirty seven comments were discovered with the theme “The Program personnel and activities were enjoyed by students.” As an educator, it is tempting to connect student enjoyment of lessons and activities to an increase in interest, which in turn leads to an increase in knowledge. Data from this research seems to support this hypothesis in that teachers and Program personnel overwhelmingly indicate The Program increased student knowledge, interests, and attitudes while students enjoyed various aspects of The Program. Further investigation using students as respondents would be necessary to gain a clearer picture of The Program’s overall impact on students.

An additional emergent theme for which the director did not originally seek information was, “The Program led students to explore other activities/interests.” A total of 21 comments were recorded. Some anecdotal evidence indicated further interest in STEM topics or projects. Other data reflected an expansion of student interest branching out from original STEM topics presented by The Program personnel. Multiple teachers and Program personnel recounted student increase with regards to literature after presentations. Sometimes, it was an increase in non-fiction usage of books from the classroom library. Once, a class raised money and donated a set of STEM career books to their school library after a Program career presentation. Other information showed an increase in books about mythology after a presentation about stars.

Overall, data suggest a positive impact on students from The Program. Impact was positive in terms of student learning and student attitudes and interests towards STEM topics. It is also possible that The Program increased student interests in subjects outside of STEM, such as literature. Further research collecting data from students would be needed to confirm these finding.

Overall Impact of Materials

The Program director posed one question with three parts regarding impact of materials: (a) How much do teachers use the educational materials supplied to them by The Program personnel, (b) does impact outweigh expenses, and (c) what do teachers think of materials provided by The Program? Data were collected via teacher surveys, teacher focus-groups, and Program personnel interviews.

Four stems on the teacher survey asked questions regarding The Program's materials. Between 99% - 100% of teachers survey agreed or strongly agreed Program materials were useful, high quality, improved science, math, or technology curriculum, and enhanced STEM education. Teacher focus-groups and Program personnel interviews support these findings. A total of 27 comments emerged under the theme, "Materials provided by The Program were useful to teachers," with an additional 16 comments under, "The Program provides quality materials." "Materials provided by The Program have increased student interests or learning" received 14 comments. Data indicates teachers feel Program materials are quality and useful, which would indicate a positive impact on education. Two additional themes emerged from teacher and personnel data. Four comments were made that teachers who received materials from The Program shared them with other teachers, thus increasing usage. Also, five comments were made about Program materials being immediately usable in the classroom. A similar theme emerged on the overall impact on teachers section with ten comments made.

In terms of material usage, 38% of surveyed teachers reported they use Program educational materials to prepare for a lesson or unit one or more times per month, compared with 25% who use materials one to two times per quarter, and 22% who use materials one to two times per school year. Not applicable/have not used was indicated by 15% of respondents (Table 6).

Additionally, 42% of surveyed teachers responded they use Program materials with their students one or more time per month. Another 19% reported material usage one to two times per quarter, and another 25% reported material usage one to two times per school year. Not applicable/have not used was indicated by 13% of respondents (Table 6).

Overall, Program materials seemed to make a positive impact on STEM education. On average, 40% of surveyed teachers use Program materials at least once per month in either lesson preparation or directly with their students, and an average of 45% use materials at least once or twice per school year. The director indicated a 25% material usage rate by teachers would justify expenses (personal communication, July 5, 2012). Material usage seems to be significantly higher than the director’s goal for teachers who responded. Further research into frequency of material usage by other teachers would create a clearer picture of overall impact of materials.

Overall Impact of Program Personnel

The Program director had one question relating to Program personnel: How were Program personnel perceived by students and teachers? Five stems from the quantitative survey gathered data to answer this question.

Teachers were asked if Program personnel provided professional programs, were knowledgeable about STEM topics, were helpful to teachers and students, and were quality educators. A 100% agree or strongly agree response rate indicates teachers’ perceptions. Survey data is supported by comments from teachers and Program personnel. “Program personnel were helpful to students and teachers” was a common theme with 24 comments from teachers. “The Program personnel were professional, well-trained, and educated” also emerged as a theme with 26 teacher responses.

Overall, Program personnel seemed to make a positive impact on both students and teachers. While no students were asked their opinions, teachers reported their overall impression regarding Program impact on students. Teachers reported a positive impact on both student STEM attitudes and interest when students had contact with Program materials and personnel.

Overall Impact of The Program

Since The director six questions regarding the overall impact of The Program, it appears this is the area about which he is most interested. The wide range of questions posed for this section yielded various forms of data.

The director was interested in The Program’s total impact on teachers, students, and the general public in terms of number of contacts made by Program personnel. Statistics were gathered from Program demographic archival data. Figure 8 represents collected data. The Program showed modest growth between 1999 and 2004. During this time The Program functioned with one education specialist for the first five years, then gained two specialists during the 2005-2006 school year. During this first year for the education specialist network, the number of teachers, students, and general public impacted grew, but as one Program personnel noted, growth was limited because they did not feel prepared to hit the ground running; understanding how to best utilize The Program’s resources took time. However, when two additional education specialists joined the network in 2005, impact statistics increased substantially as evidenced by

113% growth in teacher contacts, 690% growth in student contacts, and 393% growth in general public contacts. One Program personnel remarked that the three new employees were fortunate in that veteran employees provided guidance previously unavailable. This allowed new Program personnel to conduct more contacts their first year than previous personnel made when they were first hired.

It was also found in Program statistics for general public contacts that the 2005-2006 school year was the first year a mobile Program exhibit was available. The mobile exhibit made 5,600 general public contacts its first year. If you remove mobile exhibit statistics from the total general public contacts it still leaves a 199% increase attributed strictly to Program personnel.

Contact statistics continued to increase for both teachers and students until the 2009-2010 school year. General public contact statistics began to decline in 2008-2009. Budget cuts initiated during the 2008-2009 school year refocused Program efforts on teachers and students. This, coupled with the fact The Program did not have a mobile exhibit that year could account for the 8% decline in general population contacts. The following years, further budget cuts including the loss of two education specialists resulted in decreased teacher and student contacts.

The director posed one question regarding overall Program impact which required input from teachers: What are the overall opinions of The Program's merit, worth, and significance? Four stems on the teacher survey resulted in 100% agree or strongly agree responses. All teachers surveyed agreed The Program helped schools, helped teachers, helped students, and The Program was a worthwhile program. This was supported by comments found in three emergent themes. First, "The Program was enjoyed/appreciated or another favorable comment” emerged with 19 comments. Second, “The Program should continue – it will be missed” emerged with 14 comments. Finally, “The Program enhances curriculum or standards” emerged with 7 comments.

The director sought answers from Program personnel regarding three questions. First, how can The Program be improved and made even more effective? Second, what are the opinions of Program personnel with regard to The Program and its effectiveness? Third, was The Program administered effectively and fairly?

Program personnel expressed on overall feeling of affection and appreciation for The Program, and the impact it has made on STEM education. They expressed few ways of improving The Program. Program personnel felt The Program could be made more effective by increasing the number of education specialists throughout the state. This would decrease travel time and increase time with students and teachers. Personnel also expressed they would have liked to have contributed a bigger voice in STEM education at the state level. Restoration of funding was also desired by Program personnel to keep The Program going past the end of the current school year.

Program personnel thought The Program was highly effective commenting most about being helpful to students and teachers, providing useful materials to teachers, engaging or interesting students in STEM topics and activities, and providing new information and teaching strategies to teachers.

Program personnel thought The Program was administered effectively and fairly. They commented on fair distribution of materials and funds. One Program employee noted The Program had to be administered effectively or it would not have seen continued growth and success. A comment was also made about the fact that Program personnel saw their supervisors once or twice per year, yet The Program ran smoothly and saw continued growth. She credited effective administration as a contributing factor.

Limitations and Delimitations

Four limitations affected this study. This section will address each limitation.

1. The timeframe for the study was limited because The Program had only six months of remaining funding when the study began. In order to utilize program personnel, the research had to be completed before The Program disbanded.

2. This study was limited in that survey and interview questions were based on participant perceptions and therefore were subjective in nature.

3. This study was limited because it is subject to interpretation and analysis by the researcher who is employed by The Program.

4. This study was limited through lay-offs and budget cuts The Program encountered during its final year of operation, limiting the pool of potential respondents.

The first limitation addresses the limited timeframe for this study. The study was conducted during the final six months of operation for The Program. Grant-sourced funding was depleted for the education specialist network at the end of the school year, with the educator resource center to close two months later. Budget cuts had already reduced Program personnel by two education specialists. Neither of the two personnel reduced the previous year responded to requests for an interview. Time constraints prevented teacher focus groups from occurring at regional teacher conferences. One conference in particular would have allowed teachers from small schools to participate. Often, only one teacher from a school utilized The Program’s services. Those teachers could have constituted a focus group in a conference setting. Their data contribution may have provided insight not gained through other focus groups.

A second issue involving the time frame related to potential sentimentality with closure of The Program. Respondents may have rated Program impact highly as a sign of fidelity to Program services and personnel. Several teachers commented on the lack of funding and services for science education, even with federal level promotion of STEM education. Potentially, teachers could have given The Program high ratings as a statement expressing this concern. Particularly high rating for Program personnel on the teacher surveys could have been a response of gratitude for services rendered.

The second limitation addresses the trustworthiness of responses. All responses were provided by teachers and Program personnel. Only teachers who had utilized The Program's services on at least one occasion could answer questions about The Program's impact. This limiting factor coupled with the subjective nature of choosing the most appropriate response from a four-choice scale potentially leads to biased data. Teachers who frequently used The Program may have been more likely to return the survey than teachers who seldom used The Program. The fact that a teacher repeatedly used services is an indicator he or she thinks it is a worthwhile and helpful experience.

The teacher survey could have included the question, "What could be done to improve The Program," or "what were some of The Program's weaknesses?" This would have generated valuable data on how to change The Program's model for future STEM enrichment programs.

For Program personnel, interviews were a way of reflecting on their careers, as their positions were being eliminated. They may have provided different responses if they had been continuing with the same position. In particular, they may have provided more information for the director's question, "How can The Program be improved and made even more effective?"

The third limitation was the fact that the researcher was also an education specialist for The Program. This potentially skewed data interpretation and analysis towards a favorable outcome regarding The Program. To reduce potential bias, the researcher asked three fellow educators not associated with The Program to review findings, indicating areas of potential bias. Data from potentially biased areas were reexamined and changed as needed.

The fourth limitation was the fact that budget cuts had reduced the number of teachers and schools available for research. Teachers no longer in regular contact with Program personnel may not have received surveys. Teachers who have not had contact with The Program for more than one year may not have felt qualified to answer questions regarding The Program's impact. Schools that had frequented Program services in previous years, but had not received services for the current year may not have been asked to participate in a focus group. Program personnel may have only recommended teachers and schools they thought would respond favorably regarding Program impact. Further research involving schools which had previously used The Program's services but had chosen to discontinue use would provide valuable insight.

The delimitation identified for this study is the fact that only one STEM enrichment program was studied and it is unknown if findings can be generalized to other programs. The uniqueness of The Program may not allow comparisons to be drawn. It is not known if the overall Program model could be used with a different funding agency.

Perhaps it was the name and reputation of The Program's federal funding source that so positively impacted data.

Implications for STEM Education

This case study reveals several implications for STEM education. These include the need for STEM enrichment programs to support teachers, students, and schools, modeling future STEM enrichment programs after The Program, and utilizing Communities of Practice (CoPs) as a means to enhance STEM education.

First, this study revealed the need for STEM enrichment programs to support teachers, students, and schools. Study participants revealed their appreciation of such a program through a near 100% agrees or strongly agrees response rate in every category on the teacher survey. Teacher focus groups further showed support as teachers mentioned how they needed help with STEM standards and curriculum. One Program employee noted that often, elementary school teachers did not recognize themselves as STEM teachers, because they teach all subject areas. Elementary teachers need to be encouraged to rethink their roles within STEM education.

Second, this study showed The Program could be an effective model for future STEM enrichment programs. This was shown through demographic archival Program data. As long as The Program was fully funded, usage showed an upward trend in all categories. The number of contacts with teachers, students, and the general public consistently increased over the years. It was only after budget cuts that contacts began to decrease. As one Program employee noted, the fact that The Program saw continual growth meant it had a positive impact; teachers and schools would not have asked for return visits otherwise.

Finally, this study shows CoPs are a means to enhance STEM education. A CoP is a group of people, “who share a concern or a passion for something they do and learn how to do it better as they interact regularly” (Wenger, 2006, pg. 1). CoPs cannot be artificially created. They are naturally formed through a mutual engagement, joint enterprise, and shared repertoire. The Program functioned as a CoP. Program personnel worked with each other, sharing ideas and information, providing back-up support for presentations and workshops, all while growing individually as professionals. This was evidenced in Program personnel interviews. Employees commented about the sharing of resources, the feeling of closeness without direct communication, the feeling that support was a phone call or email away, and how their personal knowledge increased from being a part of The Program.

The CoP grew as Program personnel trained teachers how to use Program resources. Teachers from across the state joined The Program CoP, but also formed their own CoPs within their own school buildings and school districts, creating a STEM constellation. Program personnel learned from classroom teachers, classroom teachers learned from Program personnel, and students learned from both. Students who have gained a deep appreciation of STEM topics and are considering STEM careers because of The Program would constitute their own CoP.

Conclusions

Several conclusions can be drawn from this study. First, The Program was beneficial to teachers and students. Teachers reiterated their appreciation for The Program repeatedly in written survey comments and focus groups. The Program was able to support STEM education by being there to support teachers and students.

Second, Program materials were not only beneficial, but were used with much more frequency than previously realized. Initially, The Program director expressed concern if cost of materials was warranted when compared to actual usage. Teachers expressed a usage rate that indicated the expense was more than justifiable.

Third, Program personnel were regarded as high-quality STEM professionals. Program personnel provided a service far beyond STEM education. They provided encouragement to teachers and pathways of exploration for students. They kept STEM education a relevant topic in today's mathematics and communication arts-centered curricula.

Finally, The Program worked because its three-prong approach to education provided full-service STEM enrichment. Many educational programs focus on one aspect: students, teachers and professional development, or resources. The Program intertwined all three layers to create a model worth repeating. Without a doubt, The Program made a positive contribution to STEM education.

Summary

A STEM enrichment program in one Midwestern state lost its funding and is scheduled to close at the end of the current school year. The Program had been in service for 13 years and was composed of two parts. The first part is the educator resource center. The educator resource center supplied STEM educational materials free of charge to teachers, students, and the general public. The second part of The Program is a network of education specialists. The specialists are located throughout the state and provide in-school, regional, and state wide presentations and professional development. Services are preschool through adult and cover a wide range of topics. All specialist services are free of charge.

The Program director requested a summative evaluation. He specifically requested information regarding The Program's overall impact on teachers and students, The Program's overall impact of materials and personnel, and a general summary of Program impact on STEM education. All five areas were studied in this mixed-methods case study.

Data were collected four ways. One way was via a quantitative survey distributed to teachers who had utilized The Program's services on at least one occasion. A total of 109 teacher surveys were collected. Written comments from the surveys were also collected. Second, teacher focus groups were conducted with seven groups of teachers who had utilized Program services regularly. This group of teachers was able to provide insight into The Program's impact for each category surveyed. Third, Program personnel were interviewed to gain their perceptions of Program impact. Four of the six possible Program personnel agreed to interviews. Finally, Program demographic archival data was examined to reveal impact statistics based on number of contact made with teachers, students, and the general public.

Data were examined seeking answers to the director's questions. Overall, a positive impact was found in every area. Both groups of teachers, those surveyed and those participating in focus groups, overwhelmingly showed support for The Program and its services. Data may be biased by the fact that budget cuts had reduced the number of teachers and schools available for research. Further research would be needed to determine if such bias exists.

The Program emerged as a CoP. Program personnel were clearly unified in their commitment to STEM education. They share resources, not only with each other but with other STEM educators. This led to additional CoP naturally forming in school districts throughout the state.

With the closing of The Program, further research will be difficult. A study of students regarding their perceptions of The Program would be beneficial, as would studies of pre-service educators who attended Program workshops, and key influential people such as Program funders and political leaders. However, it is questionable if such data will be available as time goes on and people become more removed from the effects of The Program.

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Appendix A

List of STEM Enrichment Program Services

Service	Total number of services provided since program inception
Presentations and workshops delivered by program personnel (primarily in K-12 setting)	10,356
Presentations and workshops conducted at professional education conferences and workshops	468
Display booths held at professional education conferences	121
Distribution of educational products directly related to program funding sources	807,988
Visits to non-schools sites for presentations and workshops	734
Phone, email, and postal contacts made by program personnel to program users	656,076
Contacts made via program website	107,847
Contacts made through on-site office visits	12,346
Presentations delivered via mobile display unit	3,066

Note. Totals reflect time period from December 1, 1999 the first day open for the educator resource center through May 31, 2012, the final day for the education specialist network.

Appendix B

Program Contact Statistics

Impact Group	Total number impacted since program inception
Teachers	129,457
Students	522,510
General Public	207,383
Pre-Service Educators	7,060

Note. Totals reflect time period from December 1, 1999 the first day open for the educator resource center through May 31, 2012, the final day for the education specialist network.

Appendix C

Program Teacher Feedback Form

XXXXXXXXXXXXXXX PROGRAM
TEACHER FEEDBACK FORM

Title of Presentation:		Date
	Presenter:	
School or Institution		
City	State	Zip

Type of School *Circle all that apply*

Public Parochial Private Rural Urban Suburban Charter Other

Your email address:

Your email address will be used only to automatically generate an email invitation to complete an anonymous 120 day follow up survey. No permanent record of contact information for participants in this activity/event is retained by xxxxxx

I do not wish to provide this information. Please X here. O

List all grades you teach *(Example: K-4)*	
List all subjects you teach *(Example: Science, music)*	

To what extent do you agree with the following statements?

Rating: 5 Strongly Agree; 4 Agree; 3 Neutral; 2 Disagree; 1 Strongly Disagree

(1) _____ **This xxxx experience has inspired me to bring XXXX content into my classroom.**

(2) _____ **I can immediately apply what I learned from this XXXX experience to my teaching**

about science, technology, engineering or mathematics (STEM).

(3) _____ **I will be more effective in teaching STEM concepts introduced in this XXXX experience.**

(4) _____ **Based on my XXXX experience, I will make changes to my teaching activities.**
Which activities do you plan to change or add to your teaching practices? Check all that apply

(a) _____ **Use printed materials presented at my XXXX experience.**

(b) _____ **Use subject matter covered at my XXXX experience.**___ Use technology resources introduced at my XXXX experience

(c) _____ **Use web resources presented at my XXXX experience.**

(d) _____ **Use teaching techniques presented at my XXXX experience.**

(e) _____ **Other. Please specify:**

(5) _____ **The XXXX materials used in this experience align well with what I teach.**

(6) _____ **These resources will be effective in increasing my students' interest in STEM topics.**

(7) _____ **This XXXX experience provided ideas for encouraging student exploration, discussion and participation.**
(8) _____ **This was a valuable experience.**
(9) _____ **Participation in this experience was a good investment of time.**
(10) _____ **This experience was well organized.**
(11) ______ **The objectives of this experience were clear.**

Continue the same rating scale for the following 3 items, adding "0" (Not Applicable) if appropriate.

(12) _____ **I received activities, ideas, or resources that could be used to involve families in their children's STEM education.**

(13) _____ **I plan to use the family ideas suggested.**

(14) _____ **I think the resources suggested will be effective with families.**

(15) **Please rate the leaders of this workshop** ***(circle):*** **Excellent Good Average Poor Very Poor**

(16) **Please rate this workshop** ***(circle):*** **Excellent Good Average Poor Very Poor**

(17) **Recommendation you would give regarding the Xxxx XXXX Education Program and its provision of experiences such as this to Xxxx teachers, students, and general public** ***(circle):***

Excellent Good Average Poor Very Poor

Use the reverse side for comments you have regarding this event and/or the Xxxx XXXX Educati Program. Such comments are strongly encouraged.

Appendix D

Letter from Program Director Requesting UFE

[redacted] [redacted] **PROGRAM**

[redacted]

[redacted] **Director**

January 23, 2012

Sally Carter
[redacted]

Dear Sally,

I was excited to learn that you are at least considering an assessment study of the [redacted] Program as the topic for your doctoral dissertation. Such a study would be extremely valuable, not only to me as program director, but also to [redacted] (as our primary program partner), to [redacted] and to all those, statewide, interested in STEM education (especially at the K-12 level). Based on my lengthy experience in educational research and program assessment, I fully realize that there will be some limitations on the "kinds of things" you can evaluate due to the structure and format of the program. However, there is still a great deal that can be learned and, as I said previously, such a summative study would be very beneficial to science education in [redacted]. I therefore urge you to give this possible topic serious consideration. If you end up selecting a different topic, I will understand and still give you my 100% support.

For what it is worth at this stage should you actually decide to do a study of the [redacted] Program, following are some questions or elements that I would be interested in and/or that I think should be included in your study. Again, I realize that the nature of the program and its delivery methods may not allow an evaluation of every item. However, I have still included those for "completeness" sake and because you may have ideas or techniques for assessment that I am not aware of. Admittedly, some of the following may be overlapping to one degree or another.

1. To what extent have program goals and intended outcomes been attained? (You already know what these goals and outcomes are as well as I do.)

2. How can the program be improved and made even more effective?

3. What is the program's culture, including structure, format, personnel, etc.?

4. How is the program perceived by key knowledgeable and influential individuals (including, of course, K-12 and other educators)?

5. What are the overall opinions of the program's merit, worth, and significance?

6. What is the programs total impact on teachers, students, and the general public of [redacted] in terms of a variety of factors, e.g., numbers of presentations and workshops delivered, numbers of [redacted] materials distributed, number of students directly impacted, number teachers directly impacted, number of public directly impacted, etc., etc.

7. How has the program impacted student learning? (This is one of those items that may prove impossible to assess quantitatively. However, indirect assessment would be useful through teacher opinions based on direct observations of their own students.)

8. How has the program impacted student interest in STEM topics or their attitudes about STEM topics? (Again, teacher observations of their own students may be the only or best avenue to get at this kind of assessment. I have found over the years that teachers are pretty darn good, objective judges of both learning and attitudes of their students.)

9. How do teachers perceive the impact of the program on their own teaching effectiveness? Similarly, do they think the professional development provided by the program is beneficial to teachers?

10. How much do teachers use the [redacted] educational materials supplied to them by program personnel? Enough to outweigh the expense of the materials?

11. How much do teachers employ teaching techniques and approaches taught and modeled by program personnel, especially in PD deliveries.

12. What kind of impact has the program had on pre-service teachers?

13. What are the opinions of program personnel, themselves, with regard to the program and its effectiveness?

14. Was the program administered effectively and fairly?

Okay . . . that's enough. Although I know not all of the above can be answered in one study, it still feels good to get the questions off my chest. Don't hesitate to give me a yell if I can be of any help to you in whatever study you decide on!!

Best Wishes,

[redacted]

Appendix E

Primary Intended User Questions and Research Components

Questions for UFE from primary intended user	Impact category	Identified stakeholders	Research methodology	Justification to include/ exclude
How can The Program be improved and made even more effective?	Overall program impact	Employees	Interview	Include: Collectable data Locatable sources
How is The Program perceived by key knowledgeable and influential individuals?	Overall program impact	Teachers Political leaders	Focus Group	Exclude: High turnover Minimal sources
What are the overall opinions of The Program's merit, worth, and significance?	Overall program impact	Teachers Employees	Interviews Focus Groups Surveys	Include: Collectable data Locatable sources
What is The Program's total impact on teachers, students, and the general public in terms of contact statistics?	Overall program impact	Employees	Demographic Archival Data	Include: Collectable data
How has The Program impacted student learning?	Overall impact on students	Students Teachers Employees	Focus Group Interviews Surveys	Include: Teachers only Collectable data Locatable sources
How has The Program impacted student interest in STEM topics or their attitudes about STEM topics?	Overall impact on students	Students Teachers	Survey Focus Group Interviews	Include: Teachers only Collectable data Locatable sources
How do teachers perceive the impact of	Overall impact on	Teachers	Survey Focus Group	Include: Collectable data

The Program on their own teaching effectiveness? Do they think the professional development provided by The Program is beneficial to teachers?	teachers			Locatable sources
How much do teachers use the educational materials supplied to them by Program personnel? Does impact outweigh expenses? What do teachers think of materials provided by The Program?	Overall impact of materials	Teachers	Survey Focus Group	Include: Collectable data Locatable sources
How much do teachers employ teaching techniques and approaches taught and modeled by Program personnel, especially in PD deliveries?	Overall impact on teachers	Teachers	Survey Focus Group	Include: Collectable data Locatable sources
What kind of impact has The Program had on pre-service teachers?	Overall impact of personnel	Pre-service Teachers	Survey Focus Group	Exclude: Limited sources Impractical for scope of study
What are the opinions of Program personnel with regard to The Program and its effectiveness?	Overall program impact	Employees	Interviews	Include: Collectable data Locatable sources
Was The Program administered effectively and fairly?	Overall program impact	Employees	Interviews	Include: Collectable data Locatable sources
How were Program personnel perceived by teachers and students?	Overall impact of personnel	Students Teachers	Focus Groups	Include: Collectable data Teachers only

Appendix F

Quantitative Survey

Please respond to the following items regarding The Program. Space is provided if you wish to write additional comments. Please mark one choice for each item. ***This survey is for research purposes.***

Overall Impact on Teachers	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
The Program • has positively impacted my STEM teaching.				
The Program • has made me a better teacher.				
The Program • has increased my knowledge of STEM teaching activities.				
The Program • has provided beneficial profession development.				
Written Comments regarding **Overall Impact on Teachers**:				

Overall Impact on Students	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
The Program • has positively impacted students.				
The Program • has increased student STEM learning.				
The Program • has increased student interest in STEM topics.				
The Program • has increased student				

attitudes towards science and other STEM topics.				
Written Comments regarding **Overall Impact on Students:**				
Overall Impact of Materials	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
The Program • provides useful educational materials.				
The Program • has improved my science, math, or technology curriculum.				
The Program • uses materials that enhance STEM education.				
Written Comments regarding **Overall Impact of Materials:**				
Overall Impact of Program Personnel	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
The Program Personnel • provide professional programs.				
The Program Personnel • are knowledgeable regarding STEM topics.				
The Program Personnel • are helpful to me as a teacher.				
The Program				

Personnel • are helpful to students.				
The Program Personnel • are quality educators.				

Written Comments regarding **Overall Impact of Program Personnel:**

Overall Program Impact	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
The Program • helps schools.				
The Program • helps teachers.				
The Program • helps students.				
The Program • is a worthwhile program.				

Written Comments regarding **Overall Program Impact:**

Overall Program Utilization	**More than 2 times per month**	**1-2 times per month**	**1-2 times per quarter**	**1-2 times per school year**	**Not applicable Have not used**
• How often do you use personnel in your classroom?					
How often do you use					

• personnel in your school?					
How often do you use • educational materials to prepare for a lesson or unit?					
How often do you • use education materials with your students?					
How often do you • attend Program workshops or presentations outside of your school?					
Written Comments regarding **Overall Program Utilization:**					

Focus Groups Needed

If your school frequently utilizes the services of The . . . Program, we need your help. We need several schools to host focus groups. Each focus group would last approximately 30 minutes and should include three or more people who frequently use the . . . Program and materials. Questions asked during the focus group are designed to gather anecdotal evidence about the . . . Program, its personnel, and its impact on students and teachers. *Information gathered during the focus groups will be anonymous*. If you would like to be contacted, please fill out the information below.

Name:

____

School:

____

Email:

____

Thank you for your cooperation!

Appendix G

Program Personnel Interview Protocol

Thank you for volunteering to participate in this study. I am here today to get a better understanding of employee's perceptions of the . . . Program. I am going to ask you questions about the Program's impact on students and teachers. This interview is for research purposes in my work as a graduate student at the University of Xxxx.

I want to restate that participation in this focus group is completely voluntary. Should you feel uncomfortable at any point with the content of the discussion or other participants, feel free to leave the room or ask that the conversation be re-directed. The conversation will be recorded for transcription purposes. The recordings will be destroyed once transcription is complete. The written transcription will not contain identifying features such as your names or the name of your school. Thank you again for your participation.

1. Tell me about The . . .Program.

2. What are your opinions about The Program's overall merit and worth?

3. How is The Program perceived by key influential people – teachers, superintendants, political leaders, etc.?

4. Do you think The Program's goals have been attained?

5. How can The Program be improved and made even more effective?

6. How has The Program impacted student learning?

7. How has The Program impacted pre-service learning?

8. How has The Program impacted STEM teachers?

9. How has The Program impacted student interest in STEM attitudes and topics?

10. What are your opinions of The Program and its effectiveness?

11. Has The Program been administered effectively and fairly?

12. What else would you like to discuss about The Program and its impact?

Appendix H

Teacher Focus-Group Protocol

Thank you for volunteering to participate in this study. I am here today to get a better understanding of educators' perceptions of The . . . Program. I am going to ask you questions about the Program's impact on students and teachers. The focus group is for research purposes and my work as a graduate student at the University of Xxxx.

I want to restate that participation in this focus group is completely voluntary. Should you feel uncomfortable at any point with the content of the discussion or other participants, feel free to leave the room or ask that the conversation be re-directed. The conversation will be recorded for transcription purposes. The recordings will be destroyed once transcription is complete. The written transcription will not contain identifying features such as your names or the name of your school. Thank you again for your participation.

1. Tell me what you know about The . . . Program.

2. What are your opinions about The Program's overall merit and worth?

3. How has The Program impacted student learning?

4. How has The Program impacted you as STEM teachers?

5. How has The Program impacted student interest in STEM attitudes and topics?

6. What are your opinions of The Program and its effectiveness?

7. How often do you use the educational materials supplied by The Program?

8. How do you use the educational materials supplied by The Program?

9. What else would you like to discuss about The Program and its impact?

Appendix I

Letter of Informed Consent

XXXXXXXXX Evaluation
Sally Carter
University of Xxxx - Columbia
xxx-xxx-xxxx
xxxx@mail.xxxx.edu

You are invited to take part in a research study regarding the xxxxxxxxx Program. The study is a summative program evaluation.

What the study is about: This study is designed to gain a better understanding of educator's perceptions of the xxxxxxxxx Program including but not limited to student impact, educator impact, Program benefits, and overall opinions of the Program.

What you will be asked to do: As a participant, you will be asked to participate in either a one-hour long focus group with other educators who have utilized resources provided by the xxxxxxxxxx Program or a one-hour interview if you are employed by the xxxxxxxxxx Program.

Risks and Benefits: It is not anticipated that you will personally experience either risks or benefits from this research. Through your participation in this study, professionals in education will better understand the policies and practices that drive reading STEM enrichment programs.

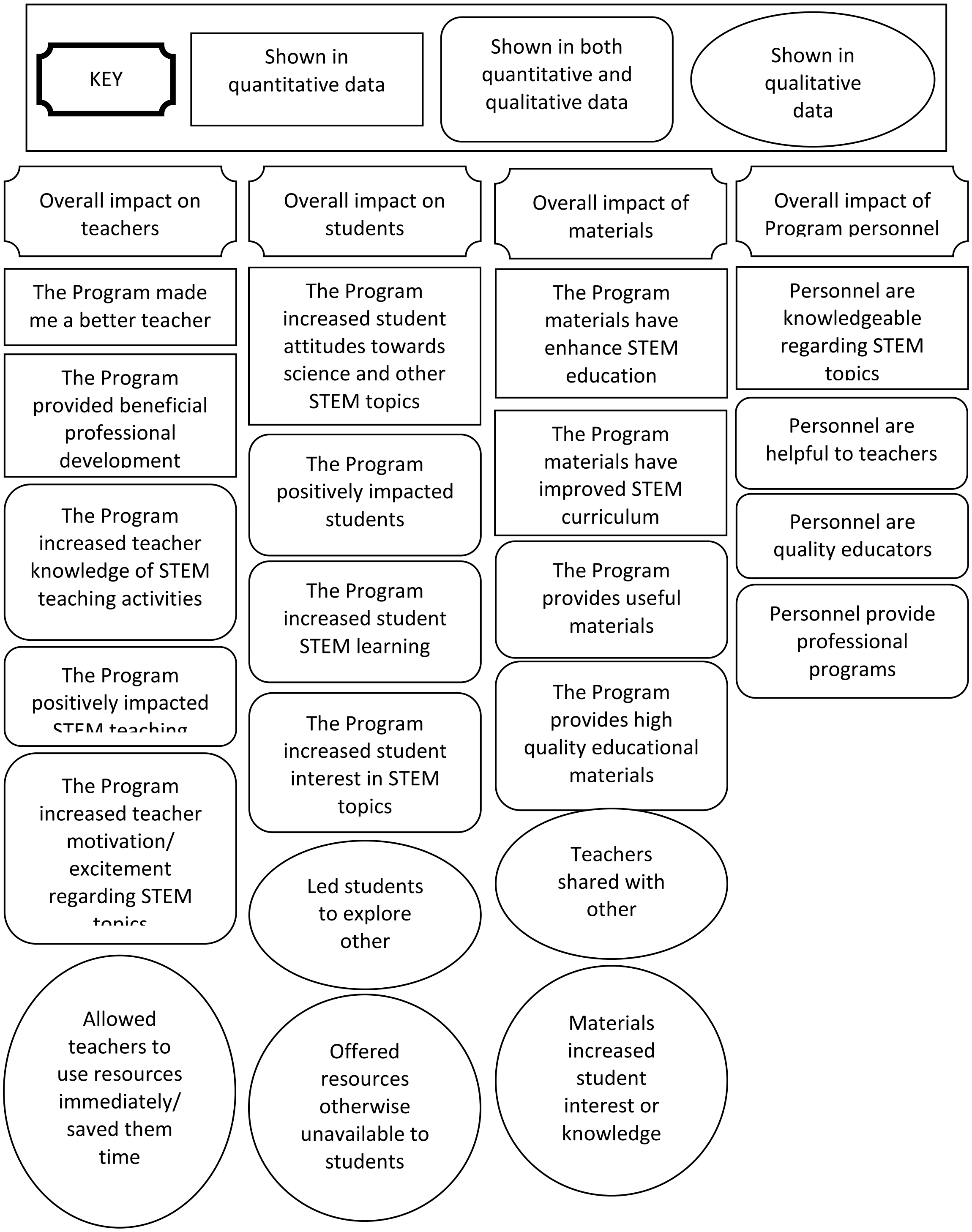
Taking part is voluntary: Taking part in this study is completely voluntary. If you choose to be in the study you can withdraw at any time without consequences of any kind. You may choose to leave for a particular question, or simply not contribute to the discussion for a particular question. Participating in this study does not mean that you are giving up any of your legal rights.

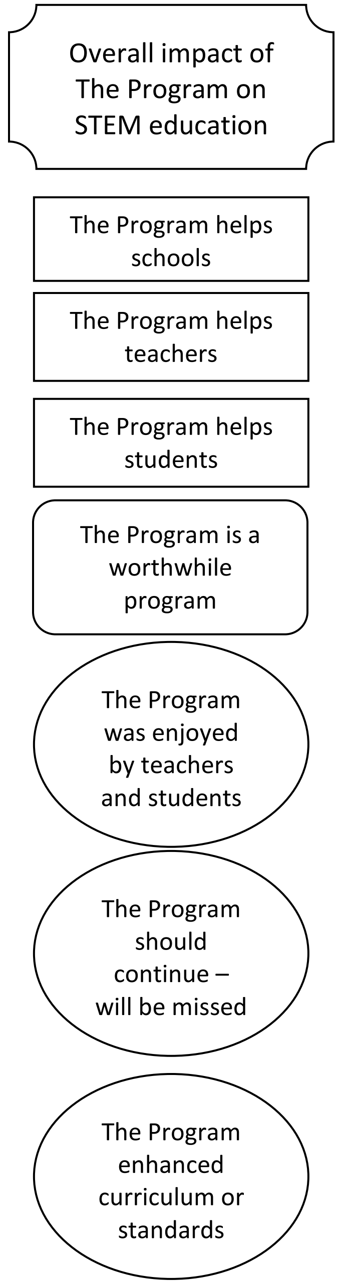
Your answers will be confidential: The records of this study will be kept private. Data will be kept on tape recorders and then destroyed once the discussions have been fully transcribed. Transcriptions of the discussion will be kept on a personal computer to which only the researcher has access. Any report of this research that is made available to the public will not include your name or any other individual information by which you could be identified.

If you have questions or want a copy or summary of the study results: Contact the researcher at the email address or phone number above. You will be given a copy of this form to keep for your records. If you have any questions about whether you have been treated in an illegal or unethical way, contact the research advisor Dr. Phillip Messner at pemday@nwxxxx.edu or the Institutional Review Board at the University of Xxxx at 485 McReynolds Hall, Columbia, MO at 573-882-9585 project #1201380.

Appendix J

Data Mixing Matrix




Overall impact of The Program on STEM education
The Program helps schools
The Program helps teachers
The Program helps students
The Program is a worthwhile program
The Program was enjoyed by teachers and students
The Program should continue – will be missed
The Program enhanced curriculum or standards

VITA

Sally Carter earned a B.A. in Speech Communication from Truman State University, a B.A. in Elementary Education from Buena Vista University, a M. Ed. in Elementary Education from the University of Missouri –St. Louis, and an Ed. D. in Educational Leadership and Policy Analysis from the University of Missouri – Columbia. She has had a variety of teaching assignments ranging from preschool autistic children to high school science and government. In 2004, she was a state finalist for the Presidential Award for Excellence in Mathematics and Science Teaching. During this time she was a fifth grade science teacher at Schuyler County R-I Schools.

Recently, Sally served as an education specialist for the STEM enrichment program in this case study. During those seven years, she had incredible experiences that taught her about the endless possibilities that await us, if only we take a chance and show a little courage. Sally is looking forward to the next wonderful possibility God has awaiting her.

Sally's wonderful husband Dave and two children, Kevin and Jenifer provide an incredible support system for all of her endeavors – even if they aren't all successful.