

USING SYSTEM THINKING PROTOCOLS TO IMPROVE STUDENT  
ANALYTICAL THINKING AND FOSTER ENGAGEMENT IN RURAL  
COMMONS

Kristin Guin-Grosse

A capstone submitted in partial fulfillment of the requirements for the  
degree of Master of Arts in Education: Natural Science and Environmental  
Education.

Hamline University

Saint Paul, Minnesota

August 2019

Primary Advisor: Melissa Erickson  
Content Reviewer: Rebecca Batchelder  
Peer Reviewer: Jesse Rock  
Peer Reviewer: Megan Wagner

With sincere gratitude to my family, friends, and colleagues who have supported my interests and efforts during this capstone research. Additional acknowledgement is due to the dedicated and enthusiastic staff at Hamline University. Through the vision of remarkable educators I have grown as a scholar and as a human being.

*We humans are smart enough to have created complex systems and amazing productivity; surely we are also smart enough to make sure that everyone shares our bounty, and surely we are smart enough to sustainably steward the natural world upon which we all depend.*

- Donella Meadows

## TABLE OF CONTENTS

CHAPTER ONE: Introduction.....	6
Personal Reflection.....	6
Community Engagement Teaching.....	7
Social-Emotional Learning.....	8
Why Systems Thinking?.....	9
Preserving the Rural Commons.....	12
Summary.....	13
CHAPTER TWO: Literature Review.....	16
Engagement Education in the Rural Commons.....	17
Service Learning and Civics in the Commons.....	19
Project-Based Learning.....	20
Social-Emotional Learning.....	20
Why Does Rural Matter?.....	22
Linking Place-Based Learning to the Commons.....	25
Place-Based Stewardship Education.....	27
Learning with Systems Thinking.....	29
Summary.....	33
CHAPTER THREE: Methods.....	35
Introduction.....	35

School and Community Demographics.....	36
Project Overview: Systems Thinking Toolkit.....	39
Project Overview: Engagement Education.....	40
Curriculum Framework.....	41
Cultural Studies.....	42
Nature Studies.....	43
Real-world Problem Solving.....	44
Entrepreneurial Opportunities.....	45
Induction into the Community.....	46
Assessment and Reflection.....	46
Summary.....	47
CHAPTER FOUR: Conclusion.....	49
Introduction.....	49
Essential Learnings.....	50
Reflection on the Literature.....	51
Implications.....	52
Limitations.....	53
Future Research.....	53
Communicating the Results.....	55
Benefit of Research to Education Profession.....	56
Summary.....	57
REFERENCES.....	59

BIBLIOGRAPHY.....67

## CHAPTER ONE

### Introduction

#### Personal Reflection

“Do we have to?” That is the first phrase I typically hear from my seventh grade students as I propose a service learning project. My school fosters service learning on campus as a tool for enhancing students’ sense of community and commitment to their learning environment. Some of the projects we engage in are chosen by teachers or other staff members. Sometimes we offer to serve the local nature center - where we do not have a choice and will likely be asked to pull buckthorn. A dreaded project for all involved. On occasion, students are asked to provide suggestions for an upcoming service opportunity. In all cases, enthusiasm for service is low. Service learning is a valuable tool for developing students’ sense of self-efficacy. One way to accomplish increased student engagement in service is to ground the service in meaningful community engagement projects (McBride & Chung, 2015). In an effort to enhance service learning for middle grade students, I focused my research on answering the question, *how can systems thinking be applied through community engagement pedagogy to improve student*

*higher-order thinking and foster student self-efficacy in their contribution to rural commons?*

**Community engagement teaching.** It can be challenging to reach out to community leaders and develop high quality service experiences for students. Through local service students can enhance civic engagement, gain a sense of agency in the community, and develop access to their local assets (Smith, 2009). Assets are valued members of a community who invest in young people in an effort to foster healthy youth development. Community engagement teaching - which blends the well researched pedagogies of environmentally focused place-based learning, project-based learning, and civic and community service - holds a promise for developing active, curious, engaged citizens. Teaching a blend of the best practices of these pedagogies is a vehicle to raise a community of people who are aware of, connected to, and care for their surroundings (Casapulla & Hess, 2016; Bandy, n.d.; North American Association of Environmental Education, n.d.).

Community engagement teaching does not rely upon one specific pedagogy. Educators can use best instructional practices to build high-quality lessons. Bandy (n.d.) suggests the following four aspects: academic content linked to the project; community partnerships; student reflection; and constructive student feedback. My objective as an educator is to help all learners grow as productive human citizens. The promise of well-designed community engagement projects offers a compelling path for shaping student learning (Casapulla & Hess,



2016; Promise of Place, n.d).

In my work as a middle school teacher, at an Environmental Education-focused STEM school, I focused on guiding students to experience meaningful learning through community engagement projects that fostered learning connections and cooperative exchanges with community assets in their rural commons. In tandem, I explored an instructional approach grounded in helping students balance their social emotional needs and develop analysis skills through systems thinking strategies.

**Social-emotional learning.** As a middle school teacher, a key ancillary concern I have for my students is their social and emotional well-being as it bears on their success at school and in their future. Some obstacles, that also served as a growth objective for planning where systems thinking drove lesson development, was a concern for my students' lack of skills in self-regulation, goal setting, and empathy. These concerns contributed to a desire to use service learning pedagogy to increase our immediate sense of community at our school and to extend that awareness to our broader, local community. Service is an integral part of the student experience at our school. Unfortunately, I frequently found middle school students reluctant, disengaged, and frustrated with the expectation of service to our school community. In assessing the potential for service to our local historical society, I saw a path to increase student engagement, teach the tenants of service learning - deeply and purposefully - through credible effort, contribution to their community resources, and initiation of a model for student-led projects.

Research has found substantial evidence for improved social-emotional outcomes for students in a community-based, asset-rich learning environment (Carr & Kefalas, 2009; Casapulla & Hess, 2016; Smith & Williams, 1999; Theobald, 1997). Explicit instruction in social-emotional learning can enhance the academic learning experience (Chung & McBride, 2015). In their research on Engagement Education, Chung and McBride (2015) note that social-emotional learning skills are most effective when incorporated into the school day. Students learn to recognize and manage emotions, make thoughtful decisions, problem-solve conflict, develop healthy relationships, and avoid negative behaviors (Chung & McBride, 2015, p.194). What requires further research are the methods that most effectively achieve the goals of social-emotional learning. Adolescent self-efficacy is enhanced by contribution to the family and the community connected to the youth (Chung & McBride, 2015). Several authors note that student self-reflection is a valuable quality in SEL instruction is (Chung & McBride, 2015; Bandy, n.d.). Further promise exists in the increased likelihood of continued, lifelong civic engagement (Chung & McBride, 2015; Theobald, 2006). As an educator, I view my role as an intermediary and as a community participant. My objective is to guide students to develop the skills they need to take action that reflects their personal values. In addition, I model, through my actions, the contributions that I value in my community.

**Why systems thinking?** A theme that has emerged repeatedly in my research - as an integral outcome of many sub-disciplines in environmental

education - is systems thinking. This key understanding, that systems are everywhere and comprise interconnected elements, offers students insight to grasp the meaning of large scale systems such as our national food or energy systems. They can also perceive the interconnections in their own lives. Using the tools of systems thinking pattern recognition was integral to my question: *how can systems thinking be applied through community engagement pedagogy to improve student higher-order thinking and foster student self-efficacy in their contribution to rural commons?*

As my philosophy of environmental education has expanded, I have been able to recognize systems thinking as a critical tool for student understanding. In addition, students grounded in systems thinking will have the broad-based tools of knowledge, inquiry, and reflection to better sustain community action (NAAEE, n.d.; Ecoliteracy, n.d.). Systems thinking is an analytical modeling practice that looks at the complexity of natural and human-made systems and examines patterns of behavior in order to solve problems (Senge, 2000). All systems - the flow of traffic in a city during rush hour and the flow of blood through the circulatory system - require an understanding of patterns of behavior. Using models to examine predictable patterns of behavior in systems is systems thinking. We live in a complex world with complex problems. Systems thinking is a crucial tool for analyzing the patterns in the systems that govern all life (Meadows, 2008; Senge, 1999).

Since the larger goal of working with and teaching students is to enrich their understanding of the world around them, I saw the holistic perspective of systems thinking, and an introduction to its applications, as an ideal organizing principle for the complex task of developing a year-long project-based curriculum. My research targeted systems thinking tools for adolescent learning.

Initially, the focus for teaching systems thinking leaned toward high school and college students learning. The Next Generation Science Standards (NGSS) include standards for teaching systems thinking to middle school students (NGSS, n.d.). Research has identified entry points for adolescent thinking and learning that can be developed through systems thinking strategies (Clark et al., 2017; Roychoudhury et al., 2017). I began seeking tools to teach my students the critical, complex analysis skills found in systems thinking. Systems thinking strategies are ideal problem solving tools for the protracted environmental issues we face. I believe that developing student efficacy in problem-solving through system thinking is well suited, not only to our STEM school community, but to all school communities.

An environmentally-focused STEM school is an ideal incubator for this project. Although I am a content teacher of humanities standards in English language arts and social studies, my work with students at this vibrant school requires integration with STEM and environmental education standards. My colleague and I integrate instruction to include critical learning of environmental stewardship and conservation. We construct opportunities for students to engage

in service learning on campus and at our local nature center. We comb through the content standards and the environmental education standards designated by our charter authorizer - an Audubon center. Drawing inspiration from Peter Senge and his seminal work for building learning organizations, I found an irresistible resource for systems thinking to guide our vision for student learning. That vision includes a desire to cultivate civic-minded service and deep thinking individuals.

**Preserving the rural commons.** I believe that the most effective, enduring experiences for students, experiences that help them to retain a connection to their community, must include sensitivity to preserving the rural commons. Early in my studies in the NSEE - MA program at Hamline University, I came to appreciate that environmental education is not solely a journey away from a built environment to a rural location. As I began to interpret environmental education with a more broad vision, I saw the importance of preservation and stewardship of the human social environment. In addition to our natural environments, the settings where human beings live, work, and recreate, both rural and urban, require community preservation initiatives (NAAEE, n.d.). Through this lens, I saw the rural commons, where I live and teach, as a ripe environment for a stance of stewardship and preservation. I asked myself, how can meaning and purpose exist in local community education experiences? How can I keep my student-community rooted and invested in their community? My focus was consistently drawn to guiding my students toward engagement with local assets in the commons.

There was a stark difference between the well-funded museum experiences my students and I enjoyed in a large metropolitan area north of our town. While it is difficult to replace a first-hand opportunity to debate a current issue at the capitol building in the city; there were learning experiences, showcased at the urban museums, that coincided with industrial shifts common to much of the state. The families of my students had invested in our forays to the city. As a school, we continue to invest heavily in the transportation costs of engaging in learning opportunities that are far from our local community. If we hope to see our local, rural community survive and thrive, despite suburban sprawl, we need to invest in the enduring vitality of our environs (Cass, 2009). I became convinced that I could do more to help my students weave a coherent narrative of how the industrial shifts of 19th-century told a story worth noting in their local community. I focused on providing students with engaging inquiry and interaction with rural assets. Students could interact with the themes and concepts in the vibrant history that existed in our rural commons. In tandem with their content learning, students would develop the tools of analysis through systems thinking.

### **Summary**

Students must develop critical thinking and problem-solving skills to serve their pursuit of lifelong civic learning and active engagement (Meadows, 2008; Senge, 2000; Theobald, 2006). In order to gain the skills and confidence necessary to make changes in their own lives, in the lives of others, and in the

lives of the people in their community, students need repeated opportunities to explore their questions and seek solutions (Casapulla & Hess, 2016). As their facilitator, I encourage students to develop a connection to their places of learning and living and use that connection to lead lives that contribute to a healthy, sustainable lifestyle. They will understand that sustainability is supported by environmental integrity, social equity, and shared prosperity as they cultivate those traits in service to their surroundings (Carr & Kefalas, 2009; Smith, 2005; Theobald, 2005).

As an environmental educator, I see an opportunity to open a door to learners to achieve critical thinking skills, to experience vibrant inquiry-based learning, and to enjoy a lifelong sense of purpose as a civic-minded member of their community. Working with participants in a learner-centered experience allows me to function as a facilitator in student learning. In this capacity, I can model my expectations and guide students to discovery. Through this approach, students have space to take risks and ask questions as they seek answers to improving their quality of life. Students who bond with nature can understand our interconnectedness as beings interacting with large, complex systems (NAAEE, n.d.). Students can develop a systemic language for articulating their learning. Understanding how to view the patterns and solve the problems within complex systems requires the critical analysis skills found in systems thinking (Clark et al., 2017; Meadows, 2008).

The following chapters seek to answer the question, *how can systems thinking be applied through community engagement pedagogy to improve student higher-order thinking and foster student self-efficacy in their contribution to rural commons?* Chapter two will review the literature pertaining to community engaged teaching. The literature review will explore the pedagogies inclusive in community-engaged learning. In addition, the strong connection of environmental education concepts to place-based pedagogy will be explored. Additional instructional methodologies that enhance or are enhanced by place-based learning in the rural commons will follow. The correlation of service learning, social-emotional growth, and civic engagement with community assets will be discussed and the research reviewed. Finally, the literature review will examine the research in systems thinking that explores the introduction of systems thinking skills to K-12 students.

In chapter 3, I will describe the methods used to develop a tool kit for community engagement and project-focused lessons enhanced by systems thinking tools. The project will address my effort to apply systems thinking protocols to a place-based project model for adolescent humanities curriculum in the rural commons. In addition, Chapter three will address my decision to add teacher implementation materials in a systems thinking tool kit. The fourth, and final, chapter will present my conclusions and recommendations for further research of community engagement teaching and systems thinking instruction.



## **CHAPTER TWO**

### **Literature Review**

#### **Introduction**

Developing and implementing engaging humanities instruction at a STEM school with an environmental education focus poses unique challenges to integrating disciplines. In keeping with a STEM focus, methods are community-focused and inquiry, place, and project-based. As referred to above, these approaches can be found in engagement education (Casapulla & Hess, 2015; Bandy, n.d.). Student learning is structured to provide opportunities for hands-on experience. According to Newell (2003), effective teaching and learning are best accomplished with integrated content and close collaboration with grade-level colleagues. Current pedagogical best-practices demand techniques that bring student learning into alignment with 21st-century trends (Quigley, 2010). Considered among the best-practices, project-based learning places students at the center of learning as students embark on explorations with a driving question to steer their inquiry (Kingston, 2018; Krauss, 2013). Today's students need to learn to work collaboratively and to engage in complex problem-solving with their

peers (Krauss, 2013; Quigley, 2010). All of these expectations are relevant to dynamic student learning and challenge any classroom teacher daily. There are many questions percolating in the minds of educators worldwide regarding how to accomplish the expectations of 21st-century education.

In an effort to remain rooted in the intersection of rural education and community this study endeavors to answer the question: *how can systems thinking be applied through community engagement pedagogy to improve student higher-order thinking and foster student self-efficacy in their contribution to rural commons?* Chapter Two will look at how the literature defines community engagement pedagogy. Civic engagement, service learning, and place-based learning blend well together in instructional planning (Promise of Place, n.d). This compatibility will be examined through the literature. Particular attention will be given to the implementation of service learning in the rural commons. Project-based learning is frequently a tool for teaching inquiry in community engagement education and will receive attention as it pertains to the work of this capstone. An ancillary focus of this author's instructional practices for middle school students includes attention to social-emotional learning. The unique needs of adolescent learners merits an examination of social-emotional learning in the context of engagement education. Finally, the literature review will explore the implementation of systems thinking in interdisciplinary middle school curriculum development.

### **Engagement Education in the Rural Commons**

Engagement education, defined by Casapulla and Hess (2016), “is place-focused and the local community is the context for learning” (p. 46). The methodology and theoretical underpinnings of place-based education can be found in the educational theories of John Dewey. Dewey asserted that learning should be grounded in lived experience rather than a preparation for living (Dewey, 1907). Dewey’s University of Chicago Lab School, of the late 19th and early 20th centuries, suggested methods that were the precursor to the place-based education movement - the Lab School sought to substantiate grounding curriculum in the regions and surrounding communities and, as Dewey urged, in the lives of the local inhabitants (Dewey, 1907).

According to *The Promise of Place* (n.d.), place-based education (PBE) offers learning opportunities that focus on local participation in school or community service projects. In addition, there is a natural intersection of place-based learning and service learning contributing to community engagement (Promise of Place, n.d.). Place-focused theorists of the past quarter-century wrote convincingly of a necessary return to the rich resources available in the local community for student learning of science, mathematics, civics, conservation, and sustainability (Hagstrom, 1993; Orion, 1998; Smith, 2002; Smith & Williams, 1999; Sobel, 2004). Smith (2002) sought to define place-based education as the practice of grounding student “learning in local phenomena” and connecting the learning to the “students’ lived experience” (p. 586). Smith lamented that most

students today are asked to internalize and master knowledge created by others (2002, p. 586).

**Service learning and civics in the commons.** Service learning instruction can dovetail with engagement education when the service is connected to developing student understanding of civic engagement and local assets in the rural commons (Carr & Kefalas, 2009; Casapulla & Hess, 2016; Chung & McBride, 2015). “Service learning is a teaching and learning strategy integrating meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility and strengthen communities (Ryan, 2012)”. What discriminates service learning from community service is the additional focus on student learning and reflection (Casapulla & Hess, 2016). As noted above, service learning fits naturally with an instructional focus on engagement education (Casapulla & Hess, 2016; Promise of Place, n.d.; Smith, 2002).

Participation in service learning, that is rooted in place, strengthens three developmental competencies: agency, social relatedness, and moral-political awareness (Casapulla & Hess, 2016, p. 46). In the research by Casapulla and Hess (2016), students were part of a place-focused community project to restore a town artifact. They were organized into work groups and focused on different aspects of the project through a democratic process involving student choice. Key components of the project included place-based education focused on a project-based endeavor that incorporated a driving question building student

agency through choice, democratic learning, and community involvement. The authors defined a model of engagement education encompassing: place-based education, project-based learning, asset-based community development, and democratic orientation that accomplished the central objective of situating the learning in the local community with community mentors. Students enjoyed increased self-awareness, self-confidence, and responsibility (Casapulla & Hess, 2016). Place-based education grounds the instructional strategies of project-based learning and service learning to the rich resources in the rural commons.

**Project-based learning.** Project-based learning (PBL) is often referred to in tandem with 21st-century learning methodologies. PBL is a pedagogy that integrates with the broader concept of systems thinking. At the heart of PBL is a questioning pedagogy. The teacher and students develop an inquiry process for a question or set of questions that students seek to answer. In a 2005 PBL intervention study, a student-centered activity for social studies learning put equal emphasis on knowledge and skills took into account the students' personal experiences and allowed for interaction with the surrounding environment. The students in the project-based class showed greater academic gains in social studies than their peers in a traditional instructional model. Students also gained competency in higher-order thinking and research skills. Students reported positive perceptions of project-based learning, the content, and in their own engagement in the project (Gultekin, 2005).

**Social-emotional learning.** According to Chung and McBride (2015),

explicit instruction in social-emotional learning can enhance the academic learning experience. Research examining social-emotional learning has established that the skills should be incorporated throughout the school day and preferably in the daily experience of the student (Chung & McBride, 2015; Zins, 2004). Students learn to recognize and manage emotions, make thoughtful decisions, problem-solve conflict, develop healthy relationships, and avoid negative behaviors (Zins, 2004). What requires further research are the methods that most effectively achieve the goals of social-emotional learning practices. Adolescent self-efficacy is enhanced by contribution to the family and the community connected to the youth. Further promise exists in the increased likelihood of continued, lifelong civic engagement (Chung and McBride, 2015).

There is a growing body of research exploring social-emotional learning (SEL) in adolescents developed in tandem with service learning (Chung & McBride, 2015; Elias, Zins, & Weissberg, 1997). This age group grapples with complex problems that can disrupt a productive learning environment. Students struggle with a declining interest in school, low levels of motivation, and poor self-esteem. Increasingly, schools districts are adding social-emotional learning modules to teach adolescents the strategies of self-control, developing relationships, and communicating one's needs. Students who struggle with social-emotional learning are at risk of poor school performance, dropping out, teen pregnancy, increased drug use, anxiety, and depression (Zins, 2004). Students who receive specific instruction and strategies for SEL demonstrate increased

advantages in student learning and success in school (Elias, Zins, & Weissberg, 1997). These skills can be transferred to adult experiences as the student matures.

More than 20 years of research exploring social-emotional learning in adolescents offers insight into SEL needs for school-age children (Chung & McBride, 2015; Elias, Zins, & Weissberg, 1997). Often SEL programs focus on one aspect of student need - teen pregnancy, drug use prevention, academic performance (Chung & McBride, 2015). Over the past decade, SEL instruction has been implemented as a broad-based plan through the school day (Chung & McBride, 2015). Schaps (2004) identifies research supporting SEL as an essential school community priority that can enhance educational practice. Incorporating SEL programming into community engaged teaching is a logical fit for student academic and emotional success (Chung & McBride, 2015).

**Why does rural matter?** The established history and justification for place-based instructional practices suggests a legitimate approach to best practices for rural school children (Casapulla & Hess, 2016; Sobel, 2004). Place-based education provides a grounded venue for student learning and a “lab” to learn the practices of community contribution (Casapulla & Hess, 2016; Smith, 2002, p. 586). Students who mature with a sense of efficacy and purpose in their communities are more likely to discern a reason for remaining and contributing to those communities (Carr & Kefalas, 2009; Theobald, 2005). Smith (2002) suggested five themes to organize place-based projects: cultural studies, nature studies, real-world problem solving, entrepreneurial opportunities, and induction

into community processes (p. 587). He further asserted that teachers must create the curriculum for their classrooms and embed it in the unique characteristics of their surroundings (Smith, 2002).

According to the eighth biennial report by the Rural School and Community Trust, *Why Rural Matters: Understanding the Changing Landscape* (Showalter, Klein, Johnson, & Hartman, 2017), more than one in four of America's public schools are rural, and nearly one in six of the nation's students are in rural areas (pg. 1). To further elucidate the scale of the population served by rural schools the study notes more than 8.9 million students attend rural schools - more than the enrollments of New York City, Los Angeles, Chicago, and incredibly, the next 75 largest school districts combined (pg. 1) . According to the WRM study (2017), only 17 percent of state education funding is allocated to rural districts. There is increased pressure on policymakers to confront and ameliorate the problems in rural education at all levels of government (pg. 7). These significant numbers indicate a sector of the nation that demands attention (pg. 8).

The needs in rural public education merit an exploration of the best practices and outcomes for youth in rural communities (Showalter, Klein, Johnson, & Hartman, 2017). Patrick Carr & Kefalas (2009) closely examined rural life in America and suggested "retooling small towns for a global economy". The author's recommendations included a major federal initiative along the lines of the century-old, yet still viable, Homestead Act (Carr & Kefalas, 2009).



Recognizing the pressing need to revitalize rural communities should be a national focus - local schools in small communities are positioned to drive this type of global focus and change (Carr & Kefalas, 2009).

Economic factors that pull individuals outside of their rural community are well documented (Carr & Kefalas, 2009). Research supports cultivating the assets of local roots to reinforce students' sense of self-efficacy and value in their communities (Casapulla & Hess, 2016). In his 1997 book, *Teaching the Commons: Place, Pride and the Renewal of Community*, Theobald, an authority on education and the rural commons, asserted that we run the risk of youth who have no sense of place. Youth have lost their allegiance and shared obligation to their community (Theobald, 1997). At the close of the 20th century, community and place-focused education emerged as a focal point for students' potential to re-engage with learning through community or place-based education (Smith, 2002; Smith and Williams, 1999). Educators explored projects that offered student agency and stimulated a sense of democratic, community-focused self-efficacy (Smith, 2002).

Theobald (2006) looked at the triad of Montesquieu-Jefferson-Tocqueville and their writings. The authors touted American citizenry and encouraged investment in local government and society. According to Theobald (2006), schools risk failing to cultivate reasoned judgment in students as we prepare them for the economic concern of an occupation. Theobald (2006) contends that our focus on education as an economic solution rather than reasoning as a solution

threatens to lead us astray. Youth who can navigate complex dynamics in social, political, and scientific systems can employ reasoned judgment to a local, rural commons with a global understanding (Carr & Kefalas, 2009; Hernandez-Ramos & De La Paz, 2009; Theobald, 1997). With a rich, cultivated understanding of their political role as citizens of a rural commons youth will be prepared to move into a reflective role as engaged citizens in adulthood. (Theobald, 2006)

**Linking place-based learning to the commons.** The economic focus of public school education continues in a nationwide emphasis on 21st-century skills for career and college readiness. Theobald is not the only modern educational theoretician to lament the loss of community in education. A movement devoted to a new, progressive interpretation of place-based education has grown for two decades (Smith & Williams, 1999; Sobel, 2004). Sobel (2004) asserted that place-based learning offers a more expansive and inclusive approach to instruction. In creating place-based schools, Sobel pointed to two principles: maximize student ownership through partnerships with community members and engage students in real-world projects in the local environment and community (Sobel, 2004, p. 73). As Smith (2002) suggested, this becomes the mandate for the instructor - to seek and incorporate complex inquiry-based thinking with community engagement projects that rely on local assets, challenge students to build local connections, and require complex, integrative thinking and problem-solving (p. 593). Equally important to communities, is a collective focus on environmental quality and sustainability (NAAEE, n.d.). Placed-based

education can position student learning in a setting that deeply engages students' sense of belonging and investment in their community through learning opportunities that explore local sustainability issues (Gallay, Marckini-Polk, Schroeder, & Flanagan, 2016; Smith, 2002). Students are more inclined to apply skills that they have actually used rather than told how to use (NAAEE, n.d.).

Place-based education, well suited to the interests of the rural commons, looks at both the natural and built environments Sobel (2004) stated,

The history, folk culture, social problems, economics, and aesthetics of the community and its environment are all on the agenda. In fact, one of the core objectives is to look at how landscape, community infrastructure, watersheds, and cultural traditions all interact to shape each other. (p. 73)

The argument that classrooms are often void of the elements that allow students to experience what is in their community amplifies as students progress through middle and high school (Smith, 2002). Today, place-focused education aims to draw students into learning through a connection with their local environment, community assets, and municipal resources (Promise of Place, n.d.). The potential for long-term gains for students and communities is supported in research examining place-based education in a variety of settings (Casapulla & Hess, 2016; Gallay et al., 2016; Smith, 2002). A critical aspect of place-based education is preparing students who are actively engaged in their learning, who

reflect on their learning, and who grow to apply these skills to their experience as citizens in their local communities (NAAEE, n.d; Smith, 2002; Sobel, 2004).

Rural schools often struggle with the burden of enrichment education that is out of reach for the school community due to travel costs and time investment (Casapulla & Hess, 2016). One response to this concern is to create rich learning experiences for students that are accessible locally. These learning opportunities become increasingly relevant to student learning and civic development when the students are engaged in the problem solving necessary to create the project (Casapulla & Hess, 2016; Krauss, 2013).

**Place-based stewardship education.** Place-based stewardship education (PBSE) offers an additional dimension to place-based methodology. PBSE contributes to a specific community project that targets investment in environmental stewardship in the commons (Gallay et al., 2016). Rural community living possesses challenges: small size, limited budgets, and remote location cause logistical difficulties for rural community stewardship objectives (Gallay et al., 2016). In *PBSE: Nurturing Aspirations to Protect the Rural Commons* (2016), the authors sought to develop rural students' connection to their community, their future aspirations, and their sense of stewardship toward the environmental commons (Gallay et al., 2016). The "commons" in this exploration were the environmental resources and the public spaces integral to life in the area. The authors established that "the ethic of caring for those things we hold in common emanates from the experience of being a citizen of a local place"

(Gallay et al., 2016, p. 156). Cultivating stewardship of the environment offers students a natural connection to investing in the shared, local community (Gallay et al., 2016; Smith 2002). Small school size and a strong sense of community can be distinct advantages to rural schools that are quick to respond to the needs of the commons. Communities need to invest in educating a younger generation to be engaged citizens (Promise of Place, n.d.; Smith, 2002). Engaged youth who understand how to contribute are more inclined to step into service in the rural commons (Carr & Kefalas, 2009; Theobald, 2006). Community-based organizations (CBO) that work with youth to solve local problems contribute to developing a sense of agency and purpose in local youth (Casapulla & Hess, 2016; Gallay, 2016). Stewardship and community service learning offer the potential for increasing student agency and rootedness in their rural communities. Casapulla and Hess (2016) contributed significantly to the research on student engagement in rural commons. The authors noted the challenges faced by rural communities as youth traditionally left for economic opportunity elsewhere and civic engagement declined for the remaining rural youth. Outcomes such as those observed by Casapulla and Hess are supported in the research (Carr & Kefalas & Kefalas, 2009; Smith, 2002; Theobald, 1997). Through the cultivation of local community-based assets working with schools to engage students in real-world projects, local communities can support youth to better understand their place and how to develop critical skills as engaged citizens (Promise of Place, n.d.; Smith, 2002).

**Learning with systems thinking.** The complexity of designing instructional materials that address the demands of community engagement through project learning in a rural commons, while simultaneously meeting state standards, engaging students, and involving community assets begged for a systems perspective to integrate student learning. Understanding how complex systems interact is central to systems thinking (Assaraf & Orion, 2010; Roychoudhury et al., 2017; Sterman, 2003). At its most basic, systems thinking involves an understanding of the elements that interact dynamically within a complex system (Clark et al., 2017). Systems thinking allows practitioners to recognize patterns in how we view and interpret the world around us from a holistic perspective. Looking at the whole and the parts to find the relationships, patterns of behavior, and meaning (Senge, 1990). Forrester, a professor at the MIT Sloan School of Business Management, was the founder of system dynamics (Forrester, 1994). Forrester (1994) developed computer modeling simulations to illustrate internal forces and decision making within a complex corporate system. Forrester's models became the groundwork for system dynamics (Senge, 1990).

Research on systems thinking and system dynamics spans more than 50 years (Forrester, 1994). For the purposes of this capstone, a review of the more current research provides a useful foundation to answer the question: *how can systems thinking be applied through community engagement pedagogy to improve student higher-order thinking and foster student self-efficacy in their contribution to rural commons?* An examination of recent trends in research into systems

thinking instruction for K-12 students will illustrate how the models of systems thinking aid in understanding complex scientific, social, and political problems. (Meadows, 2008; Senge, 1990; Sweeney, 2001). In his seminal book, *The Fifth Discipline: How to Build a Learning Organization*, Senge (1990) identified five essential disciplines for leading organizations into the next century: systems thinking, personal mastery, mental models, building a shared vision, and team learning. The author asserted that systems thinking is the essential, unifying discipline that binds the additional four into a foundation for organizational growth (Senge, 1990).

Often touted as a tool for scientific reasoning and improved organizational management, Peter Senge propelled the practice of systems thinking into late-20th-century institutions and organizations (Senge, 1990). The author contended that long-term goals were not realized because problem solvers lacked systems thinking strategies and thus fell victim to short-term solutions (Senge, 2000). Forrester (2016) asserted that students should learn the tools of systems thinking in elementary school. Students who can examine behaviors and analyze trends can break the destructive cycle of seeking short-term solutions for long-term problems (Senge, 2000, p. 232).

Karamann (2013) explored the intersection of system thinking development in preservice teachers performing community service. He observed that the nature of community service offered a unique experiential opportunity to challenge the system thinking capabilities of students. Karamann (2013) argued

that community service projects provided a rich venue for transdisciplinary exploration of the social, environmental, and analytical thinking that systems thinking demands (Karamann, 2013).

More recently, leading proponents of systems thinking have advocated for developing tools and models that teach systems thinking to K-12 students (Assaraf, 2005; Benson & Marlin, 2017; Clark et al., 2017; Meadows, 2008; Senge, 2006; Sweeny, 2011). As a result, research on cultivating systems thinking in students has grown. Researchers have argued that findings support the benefit of early introduction to the models and patterns of systems thinking (Assaraf & Orion, 2010; Benson & Marlin, 2017; Clark et al., 2017). Clark (2017) conducted research on the implementation of Environmental Dashboard (ED) with 4th and 5th grade students. Environmental Dashboard, developed at Oberlin University, is an interactive tool that relies on systems thinking models to foster local awareness of environmental impacts of human behavior (Building Dashboards, n.d.). Clark (2017) explored the implementation of ED with elementary students and determined that students gained increased facility in systems thinking through experience with ED (Clark et al., 2017). Students who possess fluid confidence in recognizing patterns of behavior will establish a greater capacity for understanding complex life systems (Assaraf & Orion, 2010; Meadows, 2008; Roychoudhury et al., 2017; Senge, 2000; Sweeney, 2001). Systems thinking is now included as a cross-cutting concept in the Next Generation Science Standards (NGSS, n.d.). Integrating systems thinking across the disciplines is becoming an



imperative. Teaching students to test assumptions, to understand and make predictions, and to find points of leverage for meaningful change are expectations for 21st-century learners (Clark et al., 2017; Forrester, 2016; Senge, 2000).

Sternman (2003) identified specific skills required for successful systems thinking in college students. The necessary skills include the ability to read change-over-time graphs, understand feedback loops and causality, and perceive dynamic complexity (Senge, 2000; Sternman, 2003). Systems thinkers examine stocks and flows, interpret the growth and decline of interrelated parts, recognize delays and potential outcomes, identify non-linear relationships, and use prediction to interpret an outcome (Sternman, 2003). Current research indicates that effective systems thinking requires a strong foundation in reasoning skills (Benson & Marlin, 2017; Senge, 2000). There is concern that our educational methodologies are not providing an adequate foundation for systems thinking (Clark et al., 2017; Senge, 2000). Students need strategies to identify how complex systems are organized and function. Senge (2000) contended that, without facility in systems thinking, future generations will continue to confront protracted problems in scientific, environmental, social and political spheres of influence and lack the vision or skills to solve problems comprehensively (p. 89). The behavior of all systems is understandable, at times predictable, through standardized modeling of patterns of behavior and therefore can be articulated (Senge, 2000, p. 89).

In an effort to address the lack of systems thinking in current instructional models, there has been an increase in research exploring the introduction of systems thinking in K-12 education (Assaraf & Orion, 2010; Clark et al., 2017; Roychoudhury et al., 2017). Due to the demands of analytical thinking and synthesis required to apply systems thinking, some contended that students younger than high school level did not have the higher-order thinking skills necessary to grapple with systems thinking (Senge, 2000). New research is calling this contention into question (Assaraf & Orion, 2010; Roychoudhury et al., 2017). Roychoudhury (2017) asserted the need to continue further research into the development of systems thinking in the teaching of climate change to middle school students. Building system thinking vocabulary and skills into student learning at an early age can establish strategies for higher-order thinking and analysis (Assaraf & Orion, 2010; Clark et al., 2017; Senge, 2000).

### **Summary**

In the preceding sections, existing research was analyzed to answer the question, *how can systems thinking be applied through community engagement pedagogy to improve student higher-order thinking and foster student self-efficacy in their contribution to rural commons?*

A model for addressing the complexity of 21st-century thinking and problem-solving can be found in systems thinking (Meadows, 2008; Senge, 2000; Sweeney, 2001). Current research indicates that effective systems thinking requires a strong foundation in reasoning skills (Clark et al., 2017; Forrester,

2016; Meadows, 2008). Growing demand for systems thinking curriculum targeted to K-12 learning needs has led to research that contributes significantly to our understanding of student misconceptions about complex systems and their limited utilization of systems thinking skills (Assaraf & Orion, 2010; Clark et al., 2017; Meadows, 2008; Roychoudhury et al., 2017; Sterman, 2003). Incorporating systems thinking protocols into student learning lends itself to gains in higher-order thinking (Assaraf & Orion, 2010). In addition, planning a project lesson with systems thinking as the organizing structure allows for a higher degree of interdisciplinary integration (Clark et al., 2017). The following section will diagram the methods used to develop the systems thinking project tools.

## CHAPTER THREE

### Methods

#### Introduction

Chapter three describes the process for the capstone project in order to answer the question, *How can systems thinking be applied through community engagement teaching to improve student higher-order thinking and foster community engagement in rural commons?*

The methods of this capstone project are grounded in pedagogical best-practices for 21st-century learning. A fundamental goal is to guide students to be engaged in their learning and become stewards of their community. In pursuit of this goal, it makes sense that students learn thinking strategies necessary to navigate a complex world.

Systems thinking protocols can provide scaffolds for building meaning from information (Systems Literacy, 2015). Students can learn to recognize patterns of behavior that emerge from their experiences (Sweeney, 2001). How people feel and react to problems can affect their emotional stability (Chung & McBride, 2015; Zins, 2008). Learning tools to develop perspective in

problem-solving, can assist students in learning to govern their behavior, develop successful relationships, and find solutions to problems in their community (Theobald, 2006; Zins, 2008). Equally important, is helping students acquire self-efficacy as they build problem-solving skills (Casapulla & Hess, 2016). Too often, solutions to problems are determined without a full assessment of the factors influencing a problem. Through the use of systems thinking models, individuals can learn to develop a perspective of a problem (Senge, 2000). Successful solutions should not be merely reactive but should consider multiple influences and possible outcomes. It is in this way that students with robust problem-solving abilities become confident, value themselves, and maintain a sense of purpose in their contribution to their local community (Casapulla & Hess, 2016; Meadows, 2008).

### **School and Community Demographics**

The school is a Midwestern public charter K-8 STEM school established in 2009. Each year, open student enrollment is determined by a lottery process. During the 2017-2018 school year 346 students were enrolled. Class size is limited to 20 students per class in each class K-3 and 22 students per class in each class 4th grade through 8th grades. Pedagogical methods, in keeping with a STEM-focus, are inquiry, place and project-based. As referred to in earlier chapters, an encompassing pedagogical term for this approach is Community Engagement Teaching (Casapulla & Hess, 2016; Bandy, n.d.). Student learning is also structured to provide opportunities for hands-on experience. The design

project the students' engineered for their historical society project was an integral link to a hands-on, community-based activity. In keeping with best practices in social-emotional learning instruction, Responsive Classroom and Developmental Designs are age-appropriate pedagogical methods for social emotional learning (Developmental Designs, 2011). This curriculum is part of the daily practice of all teachers. It is an example of a school-wide, systemic practice. All teachers, trained in the Responsive Classroom or Developmental Designs curriculum, use similar semantics in an effort to reinforce expected behaviors (Developmental Designs, 2011). As a result, all students hear the same or similar phrases for correction and redirection of behaviors. Throughout the K-8, a common inquiry to a child who is going astray is, *What should you be doing now?* The intent of this line of questioning is to help the student take a reflective posture in the choices the student is making. The student is guided to remember expected behavior or specific instructions given by a staff member. The practice of using routine phrases has a powerful, calming effect on students who are struggling to make productive behavior choices (Developmental Designs, 2011).

Student demographics at the school change slowly due to the lottery system used for enrollment. During the 2017-18 enrollment year, where 346 students were enrolled, 184 were male and 167 were female. There were 47 students enrolled in special education services. 138 students or 39.3 percent were enrolled in the National School Lunch Program and received lunch for free or at a reduced cost. Racial demographics at the school were as follows: six African

American, 33 Latino, one Asian or Pacific Islander, three American Indian, and 303 white students (Annual Report, 2018). The percent of white students in the city population of the rural community where the school is situated is 72.6 percent (Faribault, 2017). Once again, the lottery system at the school can slow demographic change. The percent of white students in the total student population at the school is somewhat higher, 87.6%, than the citywide average (Annual Report, 2018; Faribault, 2017).

The founding charter for the school is authorized by a state Audubon Center. The mission of the authorizer fosters rigorous academic achievement and environmental literacy. Through experiential learning, instruction adheres to the Next Generation Science Standards, integrated state standards, and the five indicators established with input from the charter authorizer. The first indicator requires students to develop an awareness of the relationship between the environment and human life. An additional aspect of Indicator One is required time spent outside. School staff logs time spent outside along with the academic intent of the outdoor time. The objective of Indicator One aims for at least 85% of students spending at least 70 hours of outside instruction during the school year (Annual Report, 2018). Student learning also requires service hours. In the school annual report for fiscal year 2018, a notable change occurred in the student response to the question, “I am helping to make my school, neighborhood or city a better place.” The goal was 75% of students would respond either “very or often” or “always or almost always” to the above statement. The baseline to the

response was 72% yet, the report noted that the FY18 response was 57%. A significant change in response that merits examination to determine if classroom attitudes and behaviors can improve student perceptions. The goal of the community engagement learning systems project is to improve students' feelings of self-efficacy about their personal power to enhance their community (Annual Report, 2018).

The school is situated in a community considered an urban cluster by the U.S. Census Bureau. An urban cluster is any population settlement between 2,500 and 50,000 people. This delineation is further defined by the Office of Management and Budget as a micropolitan statistical area. The county where the research takes place fits the micropolitan criteria and therefore includes at least one location with a population of 10,000 to 50,000. Micropolitan Counties are considered rural (U.S. Census Bureau, 2017). In 2017, the population of the city where the school is located was 23,577 in 2017 and the median household income, \$10,000 below the national median income, was \$50,147 (U.S. Census Bureau, 2017). The dynamics of the school and community demographics are an integral part of understanding the rural commons where this project was developed.

### **Project Overview: Systems Thinking Toolkit**

Through the process of my capstone research, and development of the student unit, I saw merit in creating a set of supporting materials. An educator who lacks experience with systems thinking integration can benefit from the tools



and examples included in the toolkit. In an effort to keep the scope manageable for the intent of the capstone, the materials included in the toolkit serve as an introduction to the basic concepts of systems thinking. Also included are examples that educators can use or model to create lessons for their students or staff development. The text portion of the toolkit includes brief descriptions with added graphic images to display the models used in systems thinking. There are also audio-visuials included to enhance understanding, accessibility, and engagement.

Systems thinking is a complex topic that can be difficult to distill into understandable language. I was inspired by explainer videos developed to articulate complex ideas in a visual and succinct format (Why an explainer Video, 2018). In keeping with the principles of Universal Design in Learning, I also wanted to develop a tool that was engaging and accessible from a variety of modalities (UDL Guidelines, 2018). The introductory video that I developed for the tool kit is part of that goal. The video appears as an animated infographic - direct, succinct language, and vibrant images. The objective is to present complex concepts quickly, clearly, and memorably.

### **Project Overview: Engagement Education**

The community engagement and systems thinking project is designed to respond to the question: *how can systems thinking be applied through community engagement pedagogy to improve student higher-order thinking and foster student self-efficacy in their contribution to rural commons?* To successfully plan for the

chosen learning outcomes, the guidance for community engagement education will follow PARE - preparation, action, reflection, evaluation (Bandy, n.d.). Students will engage in learning activities to expand on local and historically relevant background knowledge. Direct action will occur as students engage in service projects creating learning tools for the STEM school community and the local historical society. Weekly reflections will include analysis of student learning and problem solving. Evaluation will be determined through student and teacher-created rubrics.

**Curriculum framework.** The community project for the local historical society was developed using the principles of Universal Design for Learning (UDL). UDL principles include a researched-based lesson development approach focused upon inclusive participant experiences through multiple means of representation, action and expression, and engagement for learning (UDL Guidelines, 2018). Universal Design for Learning offers a framework for learning design that addresses the elusive quality of engagement and can transcend the lesson development model that solely ensures accessibility (Rappolt-Schlichtmann & Daley, 2013). Through UDL exhibit design lesson designers can address multiple needs for accessing and engaging with museum learning. (Rappolt-Schlichtmann & Daley, 2013)

The unit design follows the model of backward design authored by Wiggins & McTighe (2000). The framework for Understanding by Design suggests an examination of ending objectives prior to lesson design (Wiggins &

McTighe, 2000). Lessons are developed with clear expectations for student outcomes. Performance tasks are crafted using the GRASPS model: goal, role, audience, situation, purpose, and standards for success. GRASPS was adapted from the UbD framework (Wiggins & McTighe, 2000).

The culminating project included a student-led Prototype Expo where specialized student groups displayed and presented information and resources focused on their area of expertise. The Prototype Expo is modeled on the five themes of place-based projects suggested by Smith (2002): cultural studies, nature studies, real-world problem solving, entrepreneurial opportunities, and induction into community processes (p. 587). The research and project will seek to find the intersection of methods in system thinking integration with community-engaged, place-based projects, and service learning in a rural community.

**Cultural studies.** The curriculum projects are grounded in a year-long investigation of industrial changes in U.S. history studies. From October to May, students engage in learning experiences to ground their understanding of 19th and 20th-century social, technological, political and industrial change. Through a close examination of the industrial and human shifts in the United States, students are able to apply the problem solving strategies inherent in systems thinking pattern recognition. The students explore concepts that require more than a linear, historical viewpoint. United States history standards combined with language arts oral and written communication standards demand instructional strategies that integrate learning. Students learn to use comparison and contrast skills, pattern

recognition, graphing, written language, and complex critical thinking and analysis skills. State standards in communication and language arts, mathematics, United States history, and environmental education were integrated into student learning activities.

Students travel to local sites and more distant urban museums in order to engage in experiential and place-based opportunities to visualize and more keenly grasp the meaning of industrial change, manufacturing design, human migration, and environmental impact. These explorations use a systems thinking models to help students see the larger systems that interact and the dynamic complexity of these interactions during a century-long period of enormous industrial growth and change in American history.

Included in cultural studies are student field trips to the local historical society to interview museum docents and the Executive Director. Students will create videography projects and still photography that ‘tells the story’ of the local company. Students will use the local company to demonstrate the design iteration process and the systems thinking problem solving strategies they learn in class.

**Nature studies.** Engagement in the natural environment is an ongoing experience for students at the STEM school. Students write nature reflection journals that require observation and reflection. During the historical society research project, students explore the manufacturing design and environmental impact of a local company founded in the 19th century. This exploration uncovers a unique environmental component. Students learn about the founding

of the company, established in 1894, through its nearly 100-year history. The company was sold in the early 1980's. Students will learn that the company was designated as a Super Fund Site under the Environmental Protection Agency guidelines. Students research the meaning of this designation and learn how the site was managed until the groundwater was cleaned, the smokestack was demolished, and the sludge was removed. The site was taken off the Federal Superfund register in 2017.

Students will identify the former location of the factory and develop a narrative about their learning by using Esri Story Maps™ (Storytelling, n.d.). Story Maps™ are an interactive cloud-based platform that houses map building tools and text integration. Students will use Story Maps™ to create a digital portfolio of their learning. From this investigation, students will learn how the formerly contaminated site is being reused. In an effort to add to their understanding of place and their community, students will experience a range of local environmental sites in a variety of settings on the school campus and at community locations. Trips to urban sites will add to student understanding and reflection of local manufacturing sites. Still more experiences are fulfilled through walking tours and guest speakers.

**Real-world problem solving.** Instructional materials for middle school students include systems thinking from a variety of sources. The Fifth Discipline Fieldbook: Schools That Learn, PBS Learning Media, and The Institute of Play. Additional system dynamics tools and resources are incorporated into lesson

planning as an organic extension of the learning plan. In addition, specific archetypes of systems thinking are integrated into student instructional practices to begin building the vernacular for systems thinking and structures (Meadows, 2008; Senge, 2000; Sweeney, 2003). These techniques are modeled from similar resources designed by systems thinking experts Meadows (2008), Senge (2000), and Sweeney (2003), and others who contribute to systems thinking instructional strategies. The capstone project includes tools for teaching systems thinking protocols. Project-based activities include research on industrialization, immigration, slavery, Reconstruction, racial segregation, and Westward expansion. As students explore topical issues, they use the tools of systems thinking to examine natural, social, cultural, and industrial patterns of behavior within systems. Students will model activities influenced by museum projects they experience at local learning sites near our school and at larger urban locations.

**Entrepreneurial opportunities.** Students will complete a simple machine kit for installation at the museum. The kit includes visual cues to the instructions and multiple entry points for varied ages and capabilities who might access the simple machines Knex™ tool kit. Students with an entrepreneurial interest focus on learning grant writing skills. The Executive Director at the Historical Society has suggestions to guide students in future grant writing efforts. Students will learn to write requests to procure funding for more kits and future projects. Students learned the Iceberg Model to discuss the problem solving process used

by Elijah Nutting to create the first Nutting Cart that solved a problem on the factory floor.

**Induction into Community Processes.** Service learning projects in the rural commons capitalize on the resources of local community assets. These opportunities can fit into Smith's (2002) five themes as cultural studies of local resources, as nature studies through environmental learning, and real-world problem solving with community asset contribution. All experiences are designed in order to foster social-emotional growth and engagement in adolescents. Projects include multiple entry points so that all learners who engage with the project can experience the concepts successfully. During the expo, the student culminating projects of the Nutting Truck and Caster Unit will be shared with museum staff and staff and students at the STEM school. Students will participate in a demonstration expo relying on their interest and expertise. The expo will include project demonstrations for simple machines, models of the Knex™ activity design for the historical society, grant writing for project funding, examples of primary and secondary sources for the local company research project, videography and photography of the museum installation of the Nutting Truck and Caster display. The student culminating projects of the Nutting Truck and Caster Unit will be shared with museum staff and the staff and students at the STEM school.

**Assessment and reflection.** An integral aspect of both engagement education and systems thinking strategies requires a debriefing and reflection

process. Bandy (n.d.) asserts that student reflection allows the student the opportunity to connect content learning to the community service learning project. Reflection journaling provides a tool for the instructor to offer insight and feedback. Finally, during a debrief of the engagement experience, students can rely upon their reflection journals to help them to develop tools to examine patterns of systems dynamics. Recognition of patterns of behavior are at the heart of systems thinking skill development.

During the project phases, students will respond to reflection questions and recorded their observations in a digital journal portfolio. Feedback is provided by the teacher and peer editors throughout the curriculum implementation. Students are provided with reflection rubrics. The rubrics are designed to give the students actionable feedback. Systems pattern recognition and problem solving tools: the iceberg model, causal loops, stock & flow, behavior-over-time graphs will be taught to students and used for reflection and problem solving activities. Students will complete written journal responses for each field trip. They will complete projects that display their understanding of the concepts we study as a class and in cooperative learning groups. Students convey their learning to peers using instructional tools that the students design. They will assess each other with student-written rubrics.

### **Summary**

The student engagement projects were developed to enhance student analytical skills and foster community engagement in rural commons. The



preceding description of project methodology was intended to answer the question, *how can systems thinking be applied through community engagement pedagogy to improve student higher-order thinking and foster student self-efficacy in their contribution to rural commons?*

As our systems thinking skills improve in the classroom, we gain a necessary 21st-century strategy for understanding the world, its complex problems, and a dynamic problem-solving tool. Some of the concepts of systems thinking include examining behavior-over-time graphs, collecting and clustering observations, examining feedback loops, and developing causal maps (QDesign Pack, n.d.). As a class, students learn these structures until they are familiar. The structures provide organization for the backwards design framework of standards-based learning goals. Systems thinking models are also used as assessment criteria. Students use analysis skills to demonstrate problem-solving strategies throughout the project.

## CHAPTER FOUR

### Conclusion

#### Introduction

As a middle school teacher, at a STEM school with an environmental focus, I create learning materials designed with our state standards, our school objectives, and our professional understanding of best practices for student learning. I chose a capstone project developed with engagement education methods because it combined the core aspects of methodologies that influence my teaching. At the STEM school, instruction is focused on place-based pedagogy that incorporates project-based learning, and utilizes local assets (Annual Report, 2018). Additional methods include service learning experiences and social-emotional development for youth. As I investigated community engagement pedagogy, systems thinking tools for problem analysis proved to be a compelling method to elevate the rigor of instruction. My research drew me to ask the question, *how can systems thinking be applied through community engagement pedagogy to improve student higher-order thinking and foster student self-efficacy in their contribution to rural commons?*

The larger goal of working with and teaching students is to enrich their understanding of the world around them. I saw the holistic perspective of systems thinking, and an early student introduction to its applications, as an ideal organizing principle for the complex task of developing integrated curriculum. I began by developing a unit that is place-based, with project components that teach the concepts and skills of English language arts and U.S. history standards. Along with the standards for humanities instruction, students examine the interaction of environment and society over the past 150 years. Through our interaction with community members we develop relationships and learn how to access local resources for our learning. Finally, students create end products as examples of their learning and as contributions to the rural commons. The project design is an ideal entry point for students to apply the models of systems thinking: iceberg problem-solving, behavior-over-time graphs, stocks and flows, and causal feedback loops (Senge, 2000). Throughout the year, the language and tools of systems thinking is used to prepare students for their own journey into modeling using systems thinking concepts.

### **Essential Learning**

In the past 30 years of systems thinking research an energetic movement advocating for K-12 systems thinking instruction has gained momentum. As an educator seeking strategies that can facilitate cross-cutting content integration, systems thinking instructional materials are valuable resources. Systems thinking, often attributed to scientific inquiry and understanding of complex natural

systems, is a crucial tool for understanding the complex systems that govern all life (Meadows, 2008, Senge, 1990). Thus, determining *how systems thinking can be applied through community engagement pedagogy to improve student higher-order thinking and foster student self-efficacy in their contribution to rural commons* is a driving inquiry of this capstone.

**Reflecting upon the literature.** Place-based research provides a rich trove of materials to mine for a starting point with engagement education. In his five themes for organizing place-based projects, Smith (2002) presented a coherent direction for planning. Preserving the rural commons and engaging with the community was a compelling position to ground the research in a lasting purpose. The work of Theobald (1997) and Carr & Kefalas & Kefalas (2009) added justification for situating the research in localized learning and accessing community resources to support student learning and civic development.

Systems thinking provides a rudder to steer student learning. Senge (1990) developed the five disciplines of a learning organization: personal mastery, team learning, mental models, shared vision, and systems thinking. When applied to education, the five disciplines offer a robust mindset for learning and instruction (Senge, 2000). Sweeney (2001) has continued research and material development for K-12 educators. These materials offer engaging and thoughtful entry points for teaching systems thinking at all grade levels (Sweeney, 2001).

Through the research into engagement education, I became convinced that the tools of systems thinking would provide students with a powerful resource for

analysis. Clark et al., (2017) explored the efficacy of systems thinking learning with 4th and 5th grade students. The results showed higher rates of understanding of the concepts and improved facility with systems problem-solving (p. 9).

Students use analysis and problem solving in the design, engineering, testing, and iteration phase of STEM projects. Modeling with systems thinking structures offers students a shared language to discuss their learning. Using shared language students can test and refine their thinking and look for leverage points for change in the system (Senge, 2000).

**Implications.** Prior to my research in the capstone project, I saw systems thinking as a skill that applied to mathematics and science. In the fields of environmental conservation and sustainability, there were clear applications of systems thinking. What I sought and gained in my research was both a deeper appreciation and a set of tools to teach systems vocabulary and modeling skills in any discipline. In my professional experience, systemic practices foster student mastery. This research has brought me full circle to teaching experiences I had using Thinking Maps with student writers. Students were taught a shared set of models and vocabulary to use in planning their writing in grades K-6. Through that shared language the students acquired a powerful tool for organized writing and communication. I saw the results of the systemic practices in improved student writing strategies. Systems thinking strategies offer a similar set of tools. Rather than offering a new gimmick, systems thinking is well recognized and

widely employed in many disciplines (The Thinking in Systems, 2016). Students with these skills can be successful anywhere doing what drives their interests.

**Limitations.** Although systems thinking has been in practice for more than 50 years, the modeling language of systems thinking has moved gradually into the mainstream. The language is complex: causal feedback loops, stocks and flows, behavior-over-time graphs are not concepts in daily use by most individuals (Meadows, 2008; Senge, 2000). The complexity has slowed integration (The Thinking in Systems, 2016). In order for systems thinking to enter the broader vernacular the language used to describe it needs to be familiar and understandable (Senge, 2000; Sweeney, 2001; The Thinking in Systems, 2016). That in turn suggests that those who teach systems thinking should be conversant in the tools of the modeling language.

**Future research.** My concern for the rural commons sparked a connection to systems thinking archetypes. A review of the eight archetypes of systems thinking is beyond the scope of this capstone research (Meadows, 2008; Senge, 2000; Taborga, 2011). However, students at the secondary level would benefit from understanding archetypes as a tool for systems analysis. Archetypes describe common patterns of organizational behavior (Taborga, 2011).

The tragedy of the commons is a classic economic theory and systems archetype, posited by Garrett Hardin (1968). The body of this capstone research focused upon preserving rural commons. Thus, the commons as perceived by Hardin (1968), factored into my research. The tragedy emerges from resource

exhaustion. According to the theory, a resource held by and used by all members of the commons will eventually be exhausted by all who use the resource (Hardin, 1968). The premise is derived from the assertion that without the element of personal ownership there is no incentive to preserve the resource (Hardin, 1968). This compelling theory is an integral aspect to environmental theoretical inquiry. The premise of the tragedy of the commons can be examined as a pattern of behavior with leverage points found through systems analysis. Building analysis skills into student learning is a process developed over time through scaffolded instruction in systems thinking (Systems Literacy, 2015).

Strategies that provide students with a systemic language for articulating problem analysis requires further research. Tools of systems thinking: causal feedback loops, the ladder of inference, stock and flow diagrams, archetypes, iceberg modeling, and computer models require a developmental approach to their introduction in student learning (Senge, 2000; Sweeney, 2011; Systems Literacy, 2015). The existing research supports introduction of systems concepts to K-12 students (Assaraf & Orion, 2010; Clark et al., 2017). The challenge is finding effective means to communicate the concepts.

Professional educators need to develop the tools of systems thinking communication. In order to teach students the analysis skills of systems thinking, professionals need to have confidence in creating models (Senge, 2000). The introduction of systems thinking concepts has begun to enter mainstream exposure. The Public Broadcasting Service, *Learning Systems*, lessons and

standards for systems thinking is narrated by systems educator, Sweeney (Systems Literacy, 2015). Notably, systems thinking concepts are now in the Next Generation Science Standards (NGSS, n.d.). Creative Learning Exchange is home to more than two decades of research and curriculum development for K-12 systems thinking integration (Creative Learning Exchange, n.d.). Continued efforts are needed to create tools for teachers to learn and use systems thinking across disciplines.

**Communicating the results.** The work of this capstone will be communicated in two ways. As a mentor-educator, I will use my role to introduce colleagues to the strategies for using systems thinking models with students during professional development. The project in this capstone includes materials to introduce systems thinking to educators. In addition, I will continue my outreach to community members who can support student learning in cultural, nature, and civic learning.

The project materials created by students will be shared with local assets through service learning at the school and at the historical society. Students will present their learning in a demonstration expo. During the expo, student culminating projects for the Nutting Truck and Caster Unit will be shared with museum staff and the staff and students at the STEM school. Students will demonstrate in their area of interest and expertise: project demonstrations for simple machines, grant writing for project funding, research of primary and secondary sources, videography and photography of the museum installation for



Nutting Truck and Caster, and an interactive Knex™ activity kit for community education.

Students will complete a simple machine instructional kit for installation at the museum. The kit includes visual cues to the instructions and multiple entry points for varied ages and capabilities to learn from the simple machines Knex™ tool kit. Another application of the kit is to teach simple machines to younger grades at the STEM school. Some students will learn grant writing skills. The Executive Director at the Historical Society has offered to guide students in future grant writing efforts in order for students to procure funding for more kits and future projects. Still other students will create videography to tell the story of the local company. Students will use the local company to demonstrate the design iteration process and the systems thinking problem solving strategies they learn. Student will learn the Iceberg Model to discuss the problem solving process for industrial design. Students are presented with the problem Nutting confronted on the furniture factory floor. The students then learn to extrapolate the problem solving process Nutting might have used to create the first Nutting Cart in 1894.

**Benefit of research to education profession.** Through community engagement pedagogy - place-based, project-focused, service-oriented, and civic-minded - dynamic systems modeling enhances higher-order thinking (Casapulla & Hess, 2016; Bandy, n.d; Richmond, 1993; Senge, 2000). The elusive nature of developing deep thinking skills that transform an activity into a relevant engaging project is addressed with sound structures for problem-solving and

pattern recognition found in systems thinking (Richmond, 1993; Senge, 2000). Given the inclusion of systems thinking as a cross-cutting concept in the Next Generation Science Standards instructional confidence with systems thinking models moves to the foreground (NGSS, n.d.). The universality across disciplines makes systems thinking models a powerful communication and problem solving tool for future learning.

### **Summary**

Through my capstone writing journey, I have discovered an enhanced interest in writing. The research and writing process has strengthened my informational writing skills. As I build my repertoire of systems lessons I intend to write about my experience and continue sharing with educators. I look forward to developing professional development materials to share with my colleagues.

I have learned how to effectively apply the structures of systems thinking to my classroom instructional practices. My research and practice of systems strategies, provides me with a set of tools for systems thinking modeling. I will use systems tools with integrated lesson planning for social-emotional learning, environmental education, social studies, language arts, and mathematics instruction.

Explicit and clear models are essential for student learning. As students work to master the concepts in subject-specific content they benefit from visual tools. They also are more engaged in their learning when they are active in their learning experiences. It falls to educators to harness the tools that will help their

students succeed in mastering concepts. Systems thinking models cut across all content areas and they can be readily adapted to the criteria of universal design in learning. That makes the models and resulting analysis skills applicable tools for all learners.

Grounded in place, with a vocabulary to articulate their observations, students will be better prepared and more inclined to think creatively about complex problems. With an educational experience steeped in service and rich with cultivated assets, students can become the visionary thinkers and doers we crave in this complex world. Their inclination will lean toward the robust rural commons they have contributed to rather than a flight to distant locations that may or may not have a use for their thinking and vision.

## REFERENCES

- Assaraf, O. B., & Orion, N. (2010). System thinking skills at the elementary school level. *Journal of Research in Science Teaching*, 47(5), 540-563.
- Bandy, J. (n.d.). Community engaged teaching step by step. Retrieved from <https://cft.vanderbilt.edu/cft/guides-sub-pages/community-engaged-teaching-step-by-step/>
- Black, G. (2005). *The engaging museum developing museums for visitor involvement*. New York, NY: Routledge.
- Cannon River STEM School World's Best Workforce and Annual Report. 2018. [PDF file]. Retrieved from <http://cannonriverstemschool.org/wp-content/uploads/2018/11/FY18-Annual-Report-and-WBW.pdf>
- Carr & Kefalas, P., & Kefalas, M. (2009). *Hollowing out the middle : The rural brain drain and what it means for America / Patrick J. Carr & Kefalas and Maria J. Kefalas*. Boston: Beacon Press.
- Carter, E., Sweden, B., & Moss, C. (2012). Engaging youth with and without significant disabilities in inclusive service learning. *Teaching Exceptional Children*, 44(5), 46-54. doi:10.1177/004005991204400505

- Casapulla, S., & Hess, M. E. (2016). Engagement education: A model of community-youth engagement in rural appalachia. *Journal of Community Engagement and Scholarship*, 9(2), 42-52.
- Chung, S., & McBride, A. M. (2015). Social and emotional learning in middle school curricula: A service learning model based on positive youth development. *Children and Youth Services Review*, 53, 192-200.  
doi:10.1016/j.chilyouth.2015.04.008
- Clark, S., Petersen, J. E., Frantz, C. M., Roose, D., Ginn, J., & Daneri, D. R. (2017). Teaching systems thinking to 4th and 5th graders using Environmental Dashboard display technology. *Plos One*, 12(4).  
doi:10.1371/journal.pone.0176322
- Creative Learning Exchange. (n.d.). Retrieved from <http://www.clexchange.org/>
- De La Paz, S., & Hernández-Ramos, P. (2013). Technology-enhanced project-based learning: Effects on historical thinking. *Journal of Special Education Technology*, 28(4), 1-14. doi:10.1177/016264341302800401
- Developmental Designs. (2011). Middle grades research journal [PDF file].  
Retrieved from  
[https://www.originsonline.org/sites/default/files/downloads/mgrj\\_summary\\_findings\\_1.pdf](https://www.originsonline.org/sites/default/files/downloads/mgrj_summary_findings_1.pdf)
- Taborga, J. (2011, August 15). Eight systems archetypes and their story lines [Blog post]. Retrieved from

<https://www.saybrook.edu/unbound/systems-archetypes/>

Elias, M. J., Zins, J. E., & Weissberg, R. P. (1997). *Promoting social and emotional learning: Guidelines for educators*. Alexandria, VA: Association for Supervision & Curriculum Development. Retrieved from <http://ebookcentral.proquest.com/lib/hamline/detail.action?docID=3002111>

Forrester, J. (1994). *Learning through system dynamics as preparation for the 21st century* [PDF file]. Retrieved from [thesystemsthinker.com/learning-through-system-dynamics-as-preparation-for-the-21st-century/](http://thesystemsthinker.com/learning-through-system-dynamics-as-preparation-for-the-21st-century/).

Gallay, E., Marckini-Polk, L., Schroeder, B., & Flanagan, C. (2016). Place-based stewardship education: Nurturing aspirations to protect the rural commons. *Peabody Journal of Education*, 91(2), 155-175.  
doi:10.1080/0161956X.2016.1151736

Karaman, A. (2014). Community service learning and the emergence of systems thinking: A teacher education project in an urban setting in Turkey. *Systemic Practice and Action Research*, 27(5), 485-497.  
doi:10.1007/s11213-013-9309-5

Kingston, S. (2018). Project Based Learning & Student Achievement: What Does the Research Tell Us? [PDF file]. PBL Evidence Matters. 1(1), 1-11.  
Retrieved from <https://files.eric.ed.gov/fulltext/ED590832.pdf>

- Krauss, J. (2013). *Thinking through project-based learning: Guiding deeper inquiry*. Thousand Oaks, CA : Corwin.
- McBride, A. M., Chung, S., & Robertson, A. (2016). Preventing academic disengagement through a middle school-based social and emotional learning program. *Journal of Experiential Education*, 39(4), 370-385.  
doi:10.1177/1053825916668901
- Newell, R. J. (2003). *Passion for learning: How project-based learning meets the needs of 21st century students*. Lanham, MD: Scarecrow Press.
- Quigley, D. (2010). *Project-based learning and student achievement* (Doctoral dissertation). Retrieved from  
<https://search.proquest.com/docview/741546820>
- Rappolt-Schlichtmann, G., & Daley, S. G. (2013). Providing access to engagement in learning: The potential of universal design for learning in museum design. *Curator: The Museum Journal*, 56(3), 307-321.  
doi:10.1111/cura.12030
- Read the standards. (n.d.). Retrieved from  
[https://www.nextgenscience.org/search-standards?keys=&tid%5B%5D=106&tid\\_4%5B%5D=43](https://www.nextgenscience.org/search-standards?keys=&tid%5B%5D=106&tid_4%5B%5D=43)
- Richmond, B. (1993). Systems thinking: Critical thinking skills for the 1990s and beyond. *System Dynamics Review*, 9(2), 113-133.

doi:10.1002/sdr.4260090203

Riley, B. L., Willis, C. D., Holmes, B., Finegood, D. T., Best, A., & Mcisaac, J. D.

(2017). Systems thinking and dissemination and implementation Research.

*Oxford Scholarship Online*. doi:10.1093/oso/9780190683214.003.0009

Roychoudhury, A., Shepardson, D., Hirsch, A., Niyogi, D., Mehta, J., & Top, S.

(2017). The need to introduce systems thinking in teaching climate

change. *Science Educator*, 25(2), 73-81.

Rural school and community trust. (2016). Retrieved from

<http://www.ruraledu.org/>

Senge, P. M. (1990). *The fifth discipline: The art and practice of the learning*

*organization*. New York, NY: Doubleday/Currency.

Senge, P. M. (1994). *The fifth discipline fieldbook: Strategies and tools for*

*building a learning organization*. New York, NY: Currency/Doubleday.

Senge, P. (2000). *Schools that learn: A fifth discipline fieldbook for educators,*

*parents, and everyone who cares about education*. New York, NY:

Doubleday.

Showalter, D., Klein, R., Johnson, J., *Why rural matters: Understanding the*

*changing landscape 2015-2016*. [PDF file]. Retrieved from

[https://www.ruraledu.org/user\\_uploads/file/WRM-2015-16.pdf](https://www.ruraledu.org/user_uploads/file/WRM-2015-16.pdf)



Smith, G. A. (1993). *Public schools that work: Creating community*. New York, NY: Routledge.

Smith, G. A. (2002). Place-based education: Learning to be where we are. *Phi Delta Kappan Magazine*, 83(8), 584-594.  
doi:10.1177/003172170208300806

Smith, G. A., & Williams, D. R. (1999). *Ecological education in action : On weaving education, culture, and the environment*. Albany, NY: State University of New York Press.

Sobel, D. (2004). In Orion Society (Ed.), *Place-based education : Connecting classrooms & communities*. Great Barrington, MA: Orion Society.

Sterman, J. (2003). *Bathtub dynamics: Initial results of a systems thinking inventory* Massachusetts Institute of Technology (MIT), Sloan School of Management.

Storytelling that resonates. (n.d.). Retrieved from <https://storymaps.arcgis.com/>

Sweeney, L. B. (2001). Understanding how systems work through children's stories. *Reflections*, 3(2), 56-63. doi:10.1162/15241730152695243

Systems Literacy. (2015) WGBH Educational Foundation with a grant from the Kendeda Foundation. Retrieved from <https://tpt.pbslearningmedia.org/collection/systemsliteracy/>

Systems thinking. (n.d.). Retrieved from

<http://learningforsustainability.net/systems-thinking/>

Theobald, P. (1997). *Teaching the commons : Place, pride, and the renewal of community / paul theobald*. Boulder, Colo.: Boulder, Colo. : Westview Press.

Theobald, P. (2006). A case for inserting community into public school curriculum. *American Journal of Education*, 112(3), 315-334.  
doi:10.1086/500711

The "Thinking" in Systems Thinking: How Can We Make It Easier to Master?

(2016, August 16). Retrieved from

<https://thesystemsthinker.com/the-thinking-in-systems-thinking-how-can-we-make-it-easier-to-master>

UDL Guidelines. (2018, August 31). Retrieved from <http://udlguidelines.cast.org/>

US Census Bureau (2017). -

<https://www.census.gov/programs-surveys/metro-micro/about.html>

What is Place-Based Education? (n.d.). Retrieved from

<https://promiseofplace.org/>

Zins, J. E. (2004). *Building academic success on social and emotional learning : What does the research say? / edited by joseph E. zins ... et al.]; foreword by daniel goleman*. New York: New York : Teachers College Press.

Wiggins, G. P., & McTighe, J. (2000). *Understanding by design study guide*.

Association for Supervision and Curriculum Development.

Why an Explainer Video? (2018, July 04). [Blog post]. Retrieved from

<https://www.switchvideo.com/explainer-video/>

## BIBLIOGRAPHY

- Anderson, S., & Gurnee, A. (2016). Home-grown citizens. *Educational Leadership*, 73(6), 72-75.
- Andre, L., Durksen, T., & Volman, M. (2017). Museums as avenues of learning for children: A decade of research. *Learning Environments Research*, 20(1), 47-76. doi:10.1007/s10984-016-9222-9
- Art, S. (2000). *Dr Art's guide to planet earth*. Chelsea Green.
- Blair, D. J. (2015). Reservoirs of meaning: Engaging students in historical inquiry at museums. *Theory & Research in Social Education*, 43(2), 284-288. doi:10.1080/00933104.2015.1033821
- Carole Henry. (2000). How visitors relate to museum experiences: An analysis of positive and negative reactions. *Journal of Aesthetic Education*, 34(2), 99-106. doi:10.2307/3333580
- Das, S. (2015). Using museum exhibits: An innovation in experiential learning. *College Teaching*, 63(2), 72-82. doi:10.1080/87567555.2015.1005044
- Donovan, E. (2016). Learning to embrace our stories: Using place-based education practices to inspire authentic writing. *Middle School Journal*, 47(4), 23-31. doi:10.1080/00940771.2016.1202657

E. Louis Lankford. (2002). Aesthetic experience in constructivist museums.

*Journal of Aesthetic Education*, 36(2), 140-153. doi:10.2307/3333763

Elder, G. H., Jr., & Conger, R. D. (2000). *Children of the land: Adversity and*

*success in rural america. studies on successful adolescent development*

*Going public : Civic and community engagement* (2013). In Fitzgerald H. E.,

Primavera J. (Eds.), . East Lansing, MI: Michigan State University Press.

Retrieved from

<http://ebookcentral.proquest.com/lib/hamline/detail.action?docID=333832>

6

Gray, M. J., Ondaatje, E. H., Fricker, R. D., & Geschwind, S. A. (2000).

Assessing service-learning: Results from a survey of “Learn and serve

America”. *Change: The Magazine of Higher Learning*, 32(2), 30-39.

doi:10.1080/00091380009601721

Innella, V. (2010). Curriculum and the gallery space: A service-learning

partnership. *Art Education*, 63(3), 46-52.

doi:10.1080/00043125.2010.11519070

An investigation of the contingent relationships between learning community

participation and student engagement on JSTOR. Retrieved from

<https://www-jstor-org.ezproxy.hamline.edu/stable/41483786>

Jacoby, B. (2014). *Service-learning essentials questions, answers, and lessons learned*. Hoboken, NJ: Wiley.

Kelly, L. (2004). Evaluation, research and communities of practice: Program evaluation in museums. *Archival Science*, 4(1), 45-69.  
doi:10.1007/s10502-005-6990-x

Long, C. (2012). Teach your students to fail better with design thinking: Design thinking combines collaboration, systems thinking, and a balance of creative and analytical habits. and it might just help your students make the world a better place. *Learning & Leading with Technology*, 39(5), 16.

Martin, A. J., Durksen, T. L., Williamson, D., Kiss, J., & Ginns, P. (2016). The role of a museum-based science education program in promoting content knowledge and science motivation. *Journal of Research in Science Teaching*, 53(9), 1364-1384. doi:10.1002/tea.21332

Morag, O., & Tal, T. (2012). Assessing learning in the outdoors with the field trip in natural environments (FiNE) framework. *International Journal of Science Education*, 34(5), 745-777. doi:10.1080/09500693.2011.599046

Mujtaba, T., Lawrence, M., Oliver, M., & Reiss, M. J. (2018). Learning and engagement through natural history museums. *Studies in Science Education*, 54(1), 41-67. doi:10.1080/03057267.2018.1442820

- Page-Adams, D., & Sherraden, M. (1997). Asset building as a community revitalization strategy. *Social Work, 42*(5), 423-34.  
doi:10.1093/sw/42.5.423
- Pekarik, A. J., Doering, Z. D., & Karns, D. A. (1999). *Exploring satisfying experiences in museums* doi:10.1111/j.2151-6952.1999.tb01137.x
- Reed, P., & Butler, T. (2014). Flipping the script: When service learning recipients become service learning givers. *Theory into Practice, 54*(1), 0.  
doi:10.1080/00405841.2015.977663
- Ryan, M. (2012). *How five states are moving forward*. Denver: Education Commission of the States.
- Sample McMeeking, L. B., Weinberg, A. E., Boyd, K. J., & Balgopal, M. M. (2016). Student perceptions of interest, learning, and engagement from an informal traveling science museum. *School Science and Mathematics, 116*(5), 253-264. doi:10.1111/ssm.12176
- Schreiber, J. B., Pekarik, A. J., Hanemann, N., Doering, Z., & Lee, A. (2013). Understanding visitor engagement and behaviors. *The Journal of Educational Research, 106*(6), 462-468.  
doi:10.1080/00220671.2013.833011

- Society, O. (1998). *Stories in the land : A place-based environmental education anthology / introductory essay by john elder*. Great Barrington, MA: Orion Society.
- Steiner, M. A., & Crowley, K. (2013). The natural history museum: Taking on a learning agenda. *Curator: The Museum Journal*, 56(2), 267-272.  
doi:10.1111/cura.12024
- Stringfellow, J., & Edmonds-Behrend, C. (2013). Service learning: Extending the classroom to the community. *Delta Kappa Gamma Bulletin*, 79(3), 42-45.
- Tal, T., & Morag, O. (2007). School visits to natural history museums: Teaching or enriching? *Journal of Research in Science Teaching*, 44(5), 747-769.  
doi:10.1002/tea.20184
- Van Gundy, K. T., Rebellon, C. J., Jaffee, E. M., Stracuzzi, N. F., Sharp, E. H., & Tucker, C. J. (2016). Perceived local job prospects and school connectedness in a struggling rural economy: A life-course perspective. *Peabody Journal of Education*, 91(2), 224-245.  
doi:10.1080/0161956X.2016.1151748
- Walker, A. B. (2015). Giving literacy, learning literacy: Service-learning and school book drives. *Reading Teacher*, 69(3), 299-306.  
doi:10.1002/trtr.1394