Beyond the Four Walls:
Examining the Use of Authentic Learning Modules
by
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ABSTRACT

While attempting to provide real world experiences in STEM, educators face numerous challenges including adhering to curriculum requirements and working with potentially limited resources. The purpose of this action research study was to examine how the addition of authentic learning modules to the existing University of Arizona Middle School Engineering 101 (UA MS engineering 101) unit on energy efficiency can provide students with real world experiences as active participants. During an instructional workshop, participating teachers were introduced to strategies they use in their classroom so students could engage with individuals from both inside and outside of the school to create solutions for energy issues the students have identified within their own schools. This study used a series of observations, interviews, and focus groups with the teacher participants to gather data in determining how and in what ways students were able to obtain real world experiences as active participants through the authentic learning modules. Because there are numerous teachers within the UA MS engineering 101 group, a future goal was to assist these additional teachers in providing this innovation to their students.
ACKNOWLEDGMENTS

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I also want to give tremendous thanks to all my participants for believing in this study, in themselves, and their willingness to take risks to make the world of education and learning a better place. I view my relationship with my participants similar to that of a choreographer and dancers. A choreographer can have the most outstanding vision, yet it is only with dedicated dancers, ones who share in the vision and belief, bring it to fruition.

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DEDICATION

This dissertation is dedicated to the three most important people who have ever been in my life. They are the people who have influenced me to be a better and stronger person each and every day. I love each of you beyond words.

This is dedicated to my da (dad), mom, and husband Phil.

First and foremost to my da, who was the ultimate role model especially demonstrating the importance of a college education, “With a college degree there isn't anything you can't do.” I love you forever.

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Introduction

Tell me and I forget,
teach me and I may remember,
involve me and I learn.
~Benjamin Franklin

American students in the K-12 educational sector are failing to perform at proficient levels in the academic areas of science, mathematics, engineering, and technology, which are collectively known as STEM. According to the National Assessment of Educational Progress (National Center for Education Statistics, National Assessment of Educational Progress, 2011), approximately 75% of eighth grade students in the U.S. are not meeting proficiency standards in mathematics. The issue is further compounded when the educational progress of U.S. students is examined on an international level. In 2011 for instance, the Trends in International Mathematics and Science Study (TIMSS) reported that only 10% of U.S. eighth grade students have achieved benchmark proficiency in science (National Research Council, 2011). When compared to 32% of Singapore’s eighth grade students achieving proficiency in science, it is evident that American students clearly trail well behind students in other parts of the globe such as Singapore, China, and India (National Center for Education Statistics, National Assessment of Educational Progress, 2011), and the need to close this gap is now finally being addressed daily at both the state and national levels through such initiatives as Prepare and Inspire (President’s Council of Advisors on Science and Technology, 2010) and the Next Generation Science Standards (n.d., http://www.nextgenscience.org/next-generation-science-standards).
Statistics and findings such as these have created a perception that new educational policies are needed. Furthermore, the area of STEM education has been charged with the goal of developing a more competitive class of students. There is, however, another side to this issue. For example, even though U.S. eighth grade students fall below other countries such as Singapore and China in mathematics, U.S. students nevertheless do score slightly higher (525) than the mean of the TIMSS standard scale, (500), and have done so since 2007 (U.S. Department of Education, 2012). Although the tendency in the U.S. is to continuously compare the academic victories and failures of countries as if it were an Olympic standing, this has not been the intention nor is it the goal of TIMSS.

The main purpose of TIMSS international testing and comparisons has been to obtain a greater understanding of how educational policies and instructional practices emanate and evolve (Mullis et al., 2012). The developers of TIMSS recognize and acknowledge that each country differs vastly in all aspects, including the many key elements that impact educational policy such as economics and the structure of government (Mullis et al., 2012). Although a number of other states do participate in TIMSS, it should be noted that Arizona is not one of them. Rather, NAEP scores paint a more pragmatic portrait of Arizona schools since it is used on a national level. In this regard, eighth grade students in Arizona have scored slightly below the national average on both the mathematics (144) and science (279) portions of NAEP. The standard these scores are compared to are 151 and 283 respectively (National Center for Education Statistics, National Assessment of Educational Progress, 2011). Students in the U.S.
potentially may not be sufficiently prepared to enter STEM fields due to declining scores in science and mathematics beginning as early as the eighth grade.

In recent years, numerous national organizations have attempted to define STEM education. Although there are a variety of interpretations, the President's Council of Advisors on Science and Technology (2010) described STEM education as including the academic areas of mathematics, chemistry, and physics, which are currently core curricula at the K-12 level. Additionally, STEM education includes a knowledge and understanding of critical concepts within the fields of engineering, computer science, and environmental science. As the U.S. continues to struggle in defining and describing STEM, there continues to be a shortage of American students entering STEM fields, possibly due to their being academically underprepared to meet the challenges of the STEM workforce.

One possibility to consider, however, is whether the STEM crisis is accentuated by standardized testing. The emphasis of standardized testing is placed on *testable* content areas, which can easily be scored through selected responses to multiple choice questions (Nichols & Berliner, 2007). STEM, on the other hand, is reliant on problem solving ability, which is the very element rarely assessed on standardized tests. Emphasis on standardized testing has resulted in drastic alternations of the types of courses K-12 schools have decided to offer. In 2004, for example, Providence, Rhode Island eliminated elementary science and technology enrichment classes in order to provide additional time for courses that are *testable*. And in 2006, freshmen high school students in Kansas were required to take several core English classes at the expense of electives in order to achieve improved test scores (Nichols & Berliner, 2007).
Berliner’s description of U.S. schools placing the lack on fostering problem solving skills and creativity in our classrooms is closely related to the issue in my study (Nichols & Berliner, 2007). It is essential that teachers be given the autonomy to create classroom environments, which foster problem-solving skills rather than merely the learning of rote memory skills. Placing emphasis on the “E” in STEM (engineering) provides opportunities for individuals to think differently, view issues through another lens, and to approach problem solving in something other than the typical orthodox manner for finding the one right testable answer. Furthermore, thinking and solving problems in a manner similar to that of an engineer is an approach that can be applied even to non-engineering careers. National reports such as Prepare and Inspire have sought to address teacher preparation as part of the overall need to improve STEM education (2010). In order to prepare students both academically and motivationally, teachers need greater support in deepening and strengthening both content knowledge and pedagogy skills.

**Problem of Practice**

The issue of our students lagging in STEM education has prompted President Obama to initiate the program known as Prepare and Inspire (President’s Council of Advisors on Science and Technology, 2010). One key recommendation of Prepare and Inspire is to provide support to middle and high school teachers to strengthen their STEM pedagogy skills by establishing common standards that target a blend of both conceptual understanding and procedural skills (President’s Council of Advisors on Science and Technology, 2010). This key recommendation has been the impetus for the Next Generation Science Standards (NGSS, n.d.) initiated in 2011 that are available for
adoption by the individual states (Next Generation Science Standards, n.d.). One of the standards found in NGSS is an engineering strand, thereby offering a further opportunity for teachers to strengthen their pedagogy skills in STEM. However, since Arizona has not yet adopted NGSS, eighth grade science instruction is still governed by 2004 State Science standards, which provide the guidance for standardized testing on science topics. Since science classes in Arizona still need to adhere to 2004 standards, many schools have attempted to nevertheless take advantage of the Prepare and Inspire recommendations by offering STEM classes as electives.

Unlike state standards, the engineering strands within NGSS target STEM learning using student performance expectations, which should be expressed the way “science is practiced and experienced in the real world” (National Science Teachers Association, n.d., http://www.nsta.org/about/positions/ngss.aspx). While including NGSS in a STEM elective course results in a steep learning curve for most teachers, authentic STEM experiences incorporated into lessons is essential for students to be able to do STEM. This incorporation is required because STEM-based learning involves many abstract conceptual skills, which pose extraordinary challenges to middle school students (Breiner, Johnson, Harkness, & Koehler, 2012). Without real world applications, these challenges will remain as obstacles to students’ STEM learning opportunities (Barker & Ansorge, 2007). The result of this dilemma has been a random array of middle school STEM programs, ranging from computer programming to robotics, as a means of addressing the NGSS stated expectation that students obtain real world experiences.

Since the initiation of NGSS, instructional components that provide students with real world experiences are just now starting to emerge in U.S. classrooms. Yet real world
experiences have been commonplace in international classrooms for several years (Darling-Hammond, 2010). While the U.S. concentrates on teaching a great number of subjects, international schools teach fewer subjects, but each one in greater depth, therefore providing time for real world applications (Darling-Hammond, 2010). Overall, the teaching profession, teaching responsibilities, and instructional supports are extremely different outside the U.S., which might very well be influencing the variance in student scores of STEM-related subjects. Governments in countries such as Singapore demonstrate the value placed on the teaching profession by paying for 100 hours of professional development (Darling-Hammond, 2010). And in Singapore, teaching responsibilities foster the development of collaboration amongst colleagues through reduced instructional time. Teachers have the ability to collaborate with one another and observe each other’s classrooms on a regular basis since they are provided 20 hours per week within their instructional schedule for such collaborative work.

U.S. teachers across all grade levels, on the other hand, often work in isolation. Even during planning hours, teachers rarely leave their classrooms except for required meetings. In countries such as South Korea the fostering of collaboration amongst teachers is demonstrated in the configuration of their physical work environment (Darling-Hammond, 2010). Teachers share a workspace during the non-instructional time because they travel from class to class while the students stay in a fixed location/classroom. While something of that nature may cause an extreme change for our U.S. middle and high schools, teachers participating in learning circles is something more attainable within our system. In Singapore a portion of the work schedule of teachers consists of time devoted to learning circles where teachers discuss pertinent issues,
propose solutions, and enhance the reflective nature of their practice (Darling-Hammond, 2010).

By comparison, the evolution of the U.S. educational system is quite a bit different. Even though the U.S. educational system currently faces a multitude of issues, there is still much debate regarding progressive versus traditional education. As the U.S. workforce has changed, it has resulted in changes within the educational system. Lower skilled jobs once requiring only basic assembly line skills, such as following simple directions, now have evolved in ways requiring workers to work cooperatively and utilize greater problem-solving skills (Darling-Hammond, Ancers, & Falk, 1995). As a result, schools have begun to create and adopt authentic assessments. These assessments are termed authentic in that their intention is to reflect what students are required to know, understand, and demonstrate as a part of their performance in the real workforce (Darling-Hammond et al., 1995).

Facets of traditional learning such as rote memorization and the identification of facts are becoming overshadowed by a more progressive movement wherein students develop the ability to demonstrate their knowledge in real world contexts. Yet as with many approaches, ultimately there is no one particular theory, philosophy, or epistemology that reigns supreme. Traditional learning, rooted in Thorndike’s behavioral psychology theory, focused on developing vast tools for the measurement of skills, and stressed drills and repetition (Tomlinson, 1997). Despite the progressive changes appearing in the field of education, these traditional practices still have value because such approaches can provide the fundamental basics for all innovation, problem-solving, and collaborative discourse being suggested by the more progressive followers of Dewey
on the opposite side of the spectrum (Tomlinson, 1997). Traditional learning has provided the foundational framework for progressive education, which encompasses problem solving and innovation skills.

Because a great emphasis is placed on the “E” in STEM (engineering) which promotes individuals to work collaboratively, think differently, view issues through another lens, and to problem solve to develop practical solutions, STEM-based learning pairs extremely well with action research. For the simple fact that STEM has yet to possess an official definition clearly suggests the strong influence of local context within STEM-based learning. What may be STEM-based learning in one school will look quite differently in another school based upon the context.

Local Context

During the 2012-2013 school year, I began my first administrative position as an assistant principal of a small under-performing charter school serving Grades 7 through 12. I immediately became captivated by the STEM-based class led by the mathematics teacher, a former engineer. As a former engineer, this teacher drew upon strategies more inherent in the engineering field rather than traditional instructional strategies. As a result, the classroom culture resembled that of an engineering company where students were challenged to collaborate in ways much different from their other classes. This initial administrative position provided subsequent opportunities for me to serve in roles such as an instructional specialist to work with teachers to develop and implement instructional best practices in STEM-based programs.

In 2013, The University of Arizona Middle School Engineering 101 (UA MS 101) was developed to address the real world experiences recommended by NGSS. The
program was developed in collaboration with the UA College of Engineering and the UA College of Education that began in the fall of 2013. According to Jim Baygents, one of the program developers, the main goal of the program was to prepare teachers for the steep learning curves inherent in NGSS by focusing on the engineering design process. As part of the UA MS 101 program, a development team consisting of six middle school STEM teachers, created a four-week engineering unit on energy efficiency called The Great Arizona Ice House Challenge. In addition to the development team of teachers, other stakeholders have been involved to provide further support to the teachers in implementing the UA MS 101 unit. My role in the project was to serve as an instructional specialist within the UA MS 101 program and provide teachers general instructional guidance. My positionality within my study was that of an outsider since I am not affiliated with any of the teachers’ schools and have a relationship described as one that will “create new understanding and work together to form action plans, with outsider facilitation” (Herr & Anderson, 2015 p. 51).

During previous iterations of this study, I conducted interviews with teachers where they reported that while the UA MS 101 program provided students with opportunities to gain a greater sense of being an engineer through using the engineering design process, the program still had shortcomings. Even though students were provided opportunities to use engineering notebooks, the teachers expressed during the interviews that the program still lacked relevant connections to real world experiences. Additionally, in response to a survey I conducted, the students themselves reported that such real world experiences were very important to their understandings of the lesson's academic content.
The outcomes of these previous iterations prompted the evolution of my proposed innovation for this current study.

**Purpose of Study and Research Questions**

The purpose of this action research study was to learn about how and in what ways do teachers use and adapt various collaborative strategies within their middle school STEM instruction in order to create a classroom culture of real world experiences with active participation. My innovation was a two-hour workshop, which I provided, to guide teachers in creating their own co-curricular authentic learning modules, which utilize the instructional strategies as scaffolds.

The structure of the two-hour workshop was for me to provide a quick review of how the Great Ice House Challenge utilizes the engineering design process. The engineering design process is an iterative process consisting of steps by which engineers follow as a guide in solving problems (My NASA Data, n.d., mynasadata.larc.nasa.gov/engineering-design/). The first three steps of the engineering design process (ask, explore and plan) were used to identify and propose solutions. Using the first three steps of the engineering design process provided a foundation for teachers to create authentic learning modules. For each of the three stages, I introduced teachers to several different instructional strategies, which fostered the development of real world experiences.

During the first stage of *ask*, teachers sought to identify a STEM-based issue in local school environment. During this stage, the teachers and I engaged in the strategy of think-pair share. Teachers then used this strategy in the classroom to foster both independent and collaborative thinking processes. During the second stage of *explore*,
teachers worked on changing the classroom culture to foster expert student groups. During this stage, the teachers and I engaged in the strategy of jigsaw. Teachers then used this strategy to develop a classroom culture similar to that of an engineering firm, where there are groups of leading experts within different departments.

Lastly, during the third stage of plan, teachers collaborated to establish a proposed solution to the STEM-based issue within their local school environment. During this stage, the teachers and I engaged in DeBono’s Six Thinking Hats. Teachers then used this strategy to develop a community of practice, as students and teacher wore various colored hats representing different perspectives in attempting to brainstorm a solution as to an issue in their local school environment. To conclude the workshop, the teachers and I collaborated on other instructional strategies the teachers recommended as applicable to develop the authentic learning modules within these three stages. We also spent the remainder of time continuing to modify, reshape and/or reconfigure the three strategies modeled in the workshop.

Participants in this study then utilized the authentic learning modules developed in the workshop to implement during their instruction of the existing UA MS 101 Ice House Challenge unit.

The research questions that guided this study were as follows:

Research Question 1 asked, *How and in what ways do teachers utilize existing collaborative strategies to provide students with real world experiences?*

Research Question 2 asked, *How and in what ways do teachers utilize existing collaborative strategies to provide students with opportunities for active participation?*
Research Question 3 asked, *How and in what ways do I transform as an instructional specialist and researcher as a result of collaborating with teacher leaders?*

**Literature Review**

Particularly in the field of education, numerous instructional shifts are relegated to top-down change initiatives, which quite often can foreclose any opportunity by those most closely affected from participating in solutions to problems. To avoid such a foreclosure, action research served as a foundational base for this study and was supported by the theories of experiential learning and communities of practice (Herr & Anderson, 2015; Kolb, 2009; Wenger, 2001). Together, these theoretical frameworks, with the process of action research, provide a powerful lens for enacting change. First in this literature review, the theoretical frameworks of experiential learning theory (ELT) and communities of practice (CoP) themselves, followed by description of the action research, are discussed. Second, action research studies, which illuminate tenets shared by both the theories of ELT and CoP, are highlighted. Finally, supporting scholarship illustrates how teachers have successfully utilized a number of the collaborative instructional strategies discussed within this study.

**Experiential Learning Theory**

Experience, described by Kolb and Kolb (2008), is the central focus of experiential learning in that knowledge is created and transformed through performance. Individuals learn best when actively engaged in everyday relevant tasks and not merely some arbitrary hands-on activity. Tasks become relevant when what is learned directly affects the students’ lives to the point where they are able to claim ownership over what they have learned. Kolb most accurately defined experiential learning theory (ELT) as
“the process whereby knowledge is created through the transformation of the experience. Knowledge results from the combination of grasping and transforming the experience” (D. Kolb, 1984 p. 38). Yet, experiential learning theory is much more complex than just adding experiences to learned knowledge. Three main tenets support ELT (A. Kolb & Kolb, 2008). First, learning is a process and not a procedure simply focused on outcomes. Second, learning relies on the relationship formed between people and their environments. Third, new knowledge is created by the learner and is not simply transmitted to the learner.

The first and most prominent feature of ELT is found in the differing learning styles employed (A. Kolb & Kolb, 2008). ELT consists of four principal styles, or domains, including concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE; A. Y.Kolb, Kolb, Passarelli, & Sharma, 2014). These styles, however, are not mutually independent or stagnant but are rather components of an ongoing process, which over time have grown to include five additional learning styles to recognize the flexibility demands and stages within a given learning process. These five additional styles include initiating, imagining, analyzing, deciding, and balance, which is at the central focus of the cycle. Even though individuals tend to gravitate towards a specific mode of learning, with the addition of five other facets, the learning cycle tends to mirror the actual process of acquiring knowledge through a myriad of experiences and relationships.

John Dewey speaks of experiential learning’s second tenet of context in terms of relationships, of relating to the environment (Dewey, 1977). According to Dewey, any experience occurs because of the interaction that accompanies it. Specifically in relation
to science, Dewey suggested that the learning of facts and information needs to be coupled with everyday applications in order to gain a true and deep understanding of the subject. Granted, students may interact with their environment on a regular basis as they participate in projects, collaborate with others, and attend fieldtrips, but students actually gain the greatest benefit from experiences that are cumulatively connected to each other and are ultimately the catalyst for further experiences. In an effort to foster greater relationships in the classroom, the educator role profile was created to complement instructional delivery with the learning cycle (A. Y. Kolb et al., 2014). Even though it is necessary for teachers to utilize the roles of subject expert and standard-setter, teachers can establish the most effective collaborative learning environments by utilizing the roles of coach or facilitator.

Lastly, ELT’s third tenet of new knowledge occurs when learners create new understanding, which is built upon experiences (Dewey, 1977). ELT is not just about learning styles or traits one possesses, rather it is about the dynamic interaction taking place on a constant basis between people and their environment, which Kolb and Kolb (2009) defined as the learning space. In the educational field, Kolb and Kolb (2009) defined the learning space as one, which is shaped by both the teacher and learners. Such learning spaces foster new knowledge learners create for themselves. Even though teachers create the learning space with information and activities, it is the learners who complete the shape of the learning space by interpreting the space through their experiences.
Communities of Practice

Communities of practice are built through the participation of its members within a social community as defined by Wenger (1999). Through varying degrees of participation, members of the community develop a shared or vested interest in what they do. The practice being shared amongst its members is two-fold. First is through the explicit rudimentary procedures and functions of the practice. Second are the unspoken, implicit protocols of that particular practice, which cannot be clearly articulated or, otherwise, transferred to another community. There are three main tenets that support CoPs (Wenger, 1999). The first main tenet is demonstrated in the engagement of the participants with the CoP. Second is how communities are reshaped by the interaction amongst the participants and their environment. Lastly, the third tenet is within the levels of membership participants maintain in CoPs.

A first key feature of communities of practice involves the engagement of participants, which is much more dynamic than mere collaboration. Active participation within a community of practice includes dialogue and conflict in addition to cooperative action (Wenger, 2001). Dynamic classroom discussions, dialogue, and debate, which extend past the prescribed collaborative activity, contribute to this type of engagement. When participants of a practice are provided opportunities for dynamic, active engagement, it opens the door for them to develop new interpretations of what they have learned as it pertains to the future (Wenger, 1999). The aspect of levels of participation is rather unique to communities of practice. Levels of participation including full participation, non-participation, periphery, and marginality are dynamic and many times
overlap. All levels of participation play an integral role in contributing to the community of practice itself.

Developing new interpretations is an essential element for the second key feature of reshaping communities. As a result of participation, the community itself changes, evolves and is reshaped. This reshaping becomes a cyclical action since, as the community now becomes re-shaped, the participants themselves become transformed due to the recursive effect of reshaping the community (Wenger, 1999). Much of this recursive action is a result of the negotiated joint enterprise, which ultimately keeps the community of practice together (Wenger, 1999). The many other facets individuals bring to their community such as their perspectives about being valued, boredom, and money all play a role in how they view their community. Combining both the harmonious and disharmonious aspects each individual brings forth will change the shape and dynamics of the community on a constant basis. In communities of practice, the disagreement and dilemmas individuals share are just as valued and productive as the harmonious agreements.

Wenger (2001) noted that, third, communities are expected to be much richer when the participation is constant through different types of membership. Classrooms that foster a community of practice are ones where participants engage in their practice in an ongoing fashion, not just when directed to do so, because as Wenger stated, “Participation is not something we turn on and off” (p. 57). Since there are a countless opportunities for participation, for this reason participation can remain constant with the community. Besides engaging in the multi levels of membership, brokering is another facet of participation within communities of practice. Brokers are essential in forming relationships with others who are outside of the community of practice (Wenger, 1999). Similar to that of a mediator, the job of
the broker maintains a constant flow of communication, interaction, and negotiation of the practice within the community.

Ultimately, robust classroom communities are comprised of students and teachers who share in the responsibility of establishing a culture where experiences and participation foster an evolutionary process of new knowledge. A classroom where all parties function as a community of practice is one where the teacher serves as a guide, a facilitator, who provides students with opportunities to respond to challenges in their own environment by drawing upon various instructional approaches.

**Action Research**

The overall approach of action research is remarkably different than other methodologies. The three key features that make action research distinct are active participation, importance of local context, and the actionable outcomes. The first notable feature of action research is that the researcher is an active participant. Action research is a messy process that focuses more on the action of being and doing, by all involved, researcher and participants, rather than observing with the researcher being removed from all action (Grant, 2007). Action research is not a clear-cut process following a cookbook approach because it not driven by the researcher. Action research is driven by its participants and thus results in an unpredictable process. Because the researcher is an active participant in the entire process, it is imperative that positionality is clearly defined (Herr & Anderson, 2015). Because positionality can easily shift during the process, it is important to gain a keen understanding of one’s own identity as both a researcher and practitioner before the process begins as well as throughout (Ragland, 2006). Being candid about one’s positionality is first and foremost because it will provide the lens for
the entire study from how the researcher will interact with participants to methodological choices (Herr & Anderson, 2015).

The second integral feature of action research is the importance placed on local context. Such importance of local context parallels the interaction between the learners and their environment within experiential learning theory. Likewise, a community of practice relies upon the situated context in order to negotiate the meaning of the norms within one’s practice. Action research is conducted in workplaces or within organizations where the participants and researchers have a direct influence (Riel, 2010). The aim of action research is to gain greater understanding on how to improve the practice within one’s local context. Much emphasis is placed on how one can improve his or her own practice and how such changes affect the local context. Being less concerned about the generalizability and transferability of finding, action research focuses more on collaborating to determine practical solutions to issues pertinent within an organization.

The third feature is that action research results in actionable outcomes, which produces a change in the practices of the individuals involved. Just as experiential learning theory focuses on doing, and individuals who share the same goals form communities of practice to produce action taken by the participants, action research focuses on the actionable outcomes. The outcomes express the stories shared amongst all participants with the researcher much like the conduit for the individuals involved. Action researchers rely on constant member checking in a variety of approaches to maintain the integrity of participants’ experiences because ultimately the outcomes are a negotiated process between researcher and participants (Carlson, 2010). Even though the outcomes of action research impact the local context, the full extent of such outcomes is
much more far reaching. The actionable outcomes of action research studies create impact on the personal, organizational, and scholarly levels (Riel, 2010). Such actionable outcomes produce fundamental change within the social structure of organizations.

Action research, experiential learning theory, and communities of practice share many of the same tenets. The active participation of action research bares similar resemblance to the levels of membership within and emphasis on one’s interaction with his or her environment found in experiential learning theory. Situational context within communities of practice and the learning space environment within experiential learning theory parallel the importance of local context, which is key in action research. Finally, the actionable outcomes, which evolve from action research studies, are also seen in the new knowledge created in experiential learning theory and the reshaping of communities of communities of practice. The following action research studies illuminate the three key tenets shared amongst the theories of ELT and CoP, which are the commonalities of participation, context, and practice.

**Action Research Studies Supporting the Tenet of Participation**

Particular action research studies illuminate the aspect of participation. Cahill’s (2007) action research study of Makes Me Mad: Stereotypes of Young Urban Woman of Color offers an example of how participants created their own inquiries and discovered their own solutions for the issues they were encountering by actively engaging in all levels of the research itself, in an applied fashion. The ebb and flow of the study itself emanated from the participants’ degree of involvement. Even though many participants noted they disliked the data analysis process, they still maintained full membership during the process of creating the final outcome of the stereotype stickers. Yet
engagement of participants is much more dynamic than mere collaboration. Active participation within a community of practice includes dialogue and conflict in addition to cooperative action (Wenger, 2001). When participants of a practice are provided opportunities for dynamic, active engagement such as classroom discourse and debate that extend past the prescribed collaboration activity, it opens the door for them to develop new interpretations of what they have learned as it pertains to the future (Wenger, 1999).

**Action Research Studies Supporting the Tenet of Context**

Dyke’s action research study provides an example of the importance of context when examining the duality of top-down and grassroots initiatives (Herr & Anderson, 2015). As Dyke noted that while there is a substantial need for imposed improvement plans and directives within an organization, increased ownership occurs when people affected by issues initiate a collaborative effort and utilize an iterative process in negotiating a resolution. The necessity for solving issues evolves from the concerns of the people within the situated context. Yet, as Kolb and Kolb (2009) pointed out, the situated context and learning spaces noted in ELT and CoP extend far beyond the relationship between teacher and a classroom. Knowledge developed and reshaped through the communities of practice one develops within their trade or practice evolves out of the various levels of membership achieved, from apprentice through journeyman to master.

**Action Research Studies Supporting the Tenet of Practice**

Lewin’s approach to action research views problems as the reframing of community issues, where the solutions are dependent upon the interactions of individuals invested in those problems (Lewin, 1947). Framing issues in such a democratic fashion
provides individuals with the opportunity to approach problems in an ongoing fashion
rather than always seeking an end-all solution (Glassman, Bartholomew, & Hur, 2013).
Lewin’s theoretical approach to action research consists of a two-part stage: first,
identifying the problem or issue and second, the action accompanied to improve the
situation (Barton, Stephens, & Haslett, 2009). Similarly, ELT frames the action of
changing one’s practice through the collaboration of learning teams. Kolb and Kolb
maintained the perspective that learning teams are the communities consisting of spaces
where people can collectively reflect and share their experiences (Kayes, Kayes, & Kolb,
2005). Kolb’s concept of learning spaces parallels Wenger’s communities of practice
wherein people share the workings and norms of a trade or practice (Wenger, 2001). The
space where people collectively reflect and share experiences is demonstrated in both
qualitative and action research studies. First, in both qualitative and action research such
collective reflective processes are evident through member checking, particularly during
focus groups (Koro-Ljungberg & Bussing, 2009). Second, the practice of an action
researcher consists of reflexivity whereby the researcher consistently processes how their
own involvement is influencing the change efforts (Bradbury-Huang, 2010).

Changing and improving one’s practice in action research consists of practitioners
being partners in the process in order to create the new knowledge, which results in the
change (Bradbury-Huang, 2010). When the “pursuit of a collective goal” is carried out in
action, groups have a keen understanding as to what can be altered within their
environment and what cannot (Kayes et al., 2005 p. 340). Action always includes
recursive interplay between feedback and further action. Whether described by Lewin as
the power of a “group commitment,” Wenger’s community of practice or Kolb’s learning
teams, it is a collective force that brings forth the change in practice (Kemmis & McTaggart, 2007). School-based leadership is one example, which demonstrates collective force, when administrators collaborate with teachers.

As an administrator and action researcher, Street revealed through his study the power of distributed leadership (Herr & Anderson, 2015). Street recognized that a single administrator does not accomplish the improvement of schools and instruction. Street understood that even though teachers have a great deal of influence on student achievement, the administrators at schools create the tone and support for teachers to achieve success in what they contribute to the students’ learning. As the leader of the school, Street co-engaged with teacher leaders of the school to enact change within the culture of the school as they reshaped and redefined how distributed leadership was enacted within the school environment. The outcome was a change in the practice of leadership within their context, including Street’s own practice of leadership.

The most fundamental changes taking place within educational systems are ones that flourish on the tenets described within the commonalities of these three approaches of action research, experiential learning, and communities of practice. When individuals, such as teachers, are provided the opportunity to reframe issues within the context of their own practice, the resulting outcome is a change in practice for all involved. Such iterative cycles of a collective group wrestling with challenges and proposed solutions create the new knowledge. The following studies demonstrate how such collective groups of educators have utilized various common cooperative strategies to transform their practice of instruction and learning. The influential factors in producing fundamental change are the elements of participation, context, and practice embedded in these studies.
Supporting Scholarship

Using a variety of collaborative strategies within instruction is typical for most teachers within every content area and grade level. Just as with books and technology, the effectiveness of using such materials does not emanate from the particular item itself. Although purposefully planned out rationales for the use of a particular textbook, piece of technology, or a collaborative strategy is important, the most imperative factors lie within how such tools are modified and reconfigured to attain the specific goal. Teachers need time and support in identifying how to reconfigure such existing strategies to achieve particular outcomes. The following studies describe how several basic strategies can be reinvented in diverse ways from paper-pencil writing prompts and reflective practices to infusing 21st century technology to achieve real world experiences. Teachers most effective in re-engineering cooperative strategies have collaborated with their students and researchers and worked in teams overall. A combination of 21st century technologies, reflective writing practices, and the redesign of collaborative strategies have transformed basic cooperative approaches such as think-pair-share, jigsaw, and thinking hats so that students can achieve more real world experiences and obtain personalized learning as active participants.

Twenty-first Century Technologies

Schools have a wealth of technology to select from to enhance instruction since entering the 21st century. Although some schools’ budgets may advocate for money to be spent on other instructional materials, most schools possess an adequate access to technology to support teachers in delivering instruction. Using technology in conjunction with basic collaborative approaches can revolutionize such strategies. Too often,
however, the application of technology is simply applied in a fashion that simply changes the appearance of the strategy. Yet merely implementing the technology interface with collaborative strategies is nothing more than a superficial application and not substantial enough to create a long-term fundamental change in instructional practices and learning.

Gregory and Masters (2010) described how pre-service teachers used technology with one particular collaborative strategy in order to achieve different combinations of interactions between students and members of the outside community. Pre-service teachers in this study used DeBono’s Six Thinking Hats in both a face-to-face setting and a virtual setting. The Six Thinking Hats is a strategy to facilitate group discussions whereby each member maintains a particular role/perspective, which is representational of the different colored hats (DeBono, 1999). By comparing and contrasting this strategy in both the virtual and face-to-face settings, pre-service teachers were able to gain a better insight of the anticipated outcomes from students. The results of the study demonstrated three distinct ways in how both settings provided valuable benefits. First, the face-to-face environment provided for a more meaningful and engaging experience because participants were given the ability to read body language and intonations of voice. On the other hand, the second influence was that since the personal sensitivity factors inherent in body language and intonations are less of a factor in the virtual environment, participants had an opportunity to be more candid in their comments when physical aspects were removed. Third, a virtual setting provided the opportunity for individuals at a distance to join the dialogue. This study demonstrated how one strategy can be modified through the infusion of technology to address various personal sensitivities and achieve multiple interactions in the classroom.
Similarly, a study by Azlina (2010) focused on teachers who incorporated technology into the use of a think-pair-share cooperative strategy. In the think-pair-share (TPS) strategy, students are provided tasks or issues and first spend time thinking of proposed solutions independently. Students then pair with another student to discuss their individual ideas or understanding of the material. During this time pairs aim towards creating a mutual understanding or decision, which they then share out to either other pairs or the whole group (Slavin, 1995). In this study, teachers created virtual environments for students to utilize the strategy of TPS all within one virtual space. For the think phase students were given a private virtual space within the platform to document their thoughts. When pairing up with another student, a space configured for instant messaging was utilized; and finally for the sharing segment, students were provided a larger virtual space of a chat room. In this study as well as the Gregory and Masters’ study, technology provided greater flexibility when using the collaborative strategies by increasing accessibility of virtual space. Yet the Gregory and Masters’ (2010) study achieved a more accurate reflection of real world experiences by demonstrating how using one strategy with and without technology could foster various interactions and emotional responses.

Jigsaw is another cooperative strategy wherein individuals learn sections of information different from their teammates, thereby creating sub-sections of experts (Slavin, 1995). Once areas of expertise are established in each group, the original groups separate so that each homogeneous group of experts can gather for in-depth discussions, concluding with a reconvening of the original groups (1995). Although several variations of jigsaw exist, one study in particular by Huang, Liao, Huang, and Chen (2014)
demonstrated how jigsaw combined with technology can be highly effective in solving specific instructional goals.

This study by Huang et al. (2014) utilized the strategy of jigsaw paired with Google+ and tablets. Students and teachers at a university in southern Taiwan purposely selected both the strategy and particular technology to meet the specific needs of their context and academic objectives. The students and teacher participating in this study were studying the water system of the area. With the geographic layout of the water system being so expansive in Taiwan, the teachers wanted their students to have opportunities to share their developing expertise of the water systems while out in the field. Utilizing the jigsaw strategy enabled teachers to create various groupings so that students could develop expertise in their respective areas. Embedding Google+ on tablets facilitated student communication, using text and photos, which developed and maintained their jigsaw area of expertise while in remote areas. This study identified the precise needs within a particular context and how utilizing technology in a very specific manner can achieve the desired outcomes. Through a combination of complementary mixed methods of pre- and post-tests, surveys, and interviews, Huang discovered the use of this intervention resulted in increased positive outcomes for students who were otherwise in the low- to mid-academic range.

**Reflective Practices Through Writing**

Time is typically the greatest challenge teachers face when attempting to incorporate reflective practice and writing, whether using technology or not. By nature, both teachers and action researchers share the quality of being reflective practitioners (Kapranos, 2007). The necessity to implement reflective processes within instruction is a
challenge faced by teachers of all levels and disciplines, including engineering teachers (2007). Teachers are continually challenged by the element of time to incorporate reflection in their own practice, let alone within classroom instruction. The challenge remains in how teachers can bring forth reflective practices within their instruction to provide students with meaningful real world experiences.

DeBeer and Whitlock (2009) recognized the importance for students within the life sciences classroom to have their voices heard. Prior to this study, students were performing below grade level and not meeting requirements to enter the university. With a goal to increase motivation, indigenous knowledge was incorporated in the secondary level life sciences class, which integrated students’ cultural background. Realizing that discussions had the potential to become dynamically charged due to cultural conflicts, the researchers used DeBono’s six thinking hats. The researchers were selective as to when to apply the thinking hats during class and used it only when students discussed the option of Western medicine being included in South Africa. The researchers documented their iterative process using interviews, document analysis, and various observations (both structured and casual) to refine the process of using the six thinking hats to achieve their objective. During a series of observations the researchers noted predominance of the “red hat” (emotional) prior to the lab component of class. This discovery led the researchers to encourage students to create discussion prompts. Once students were assigned a hat, they took time to establish their perspective by creating a few discussion prompts before actively engaging in the discussion with their classmates. Outcomes from this qualitative study indicated that students exhibited a positive attitude about science, many describing the content as alive as a result of the innovation.
Blending higher order thinking skills, technology, and specific critical thinking theory in their study, Schellens, Van Keer, De Wever, and Valcke (2009) examined if the identification of the six thinking hats through tagging would improve college students’ critical thinking skills. Students were taught the basic structure of six thinking hats and then took part in their designated online discussion. Preceding the discussion the experimental group of students returned to the script to identify their own portions and labeled or tagged the excerpts as related to the hats. Extending beyond the lower level skill of identification and classification, once identified and tagged, students reflected on whether they had displayed a predominance of a particular hat, lack of a particular perspective/hat, and what contributions they made in aiming to solve the issue during the discussion. During the study, a control group had additionally been taught the six thinking hats yet were not instructed to tag their own portions of their discussion scripts. In determining the overall results of this study, the researchers related their findings to their theoretical framework, which identified five particular stages of critical thinking.

Researchers paralleled these five stages of critical thinking to each of the hats and used this to facilitate the content analysis. Through this analysis the researchers learned that even though both groups exhibited critical thinking skills during their online discussions, students in the experimental group achieved greater depth when relating to the phases of problem identification and problem exploration. Although Gregory and Masters’ (2010) study of using six thinking hats in an online fashion to diffuse the emotions and hesitancies assists students in developing an enhanced awareness of their viewpoints, tagging the script of the online discussion achieved further depth into analyzing and examining one’s own perspective of a situation. Achieving reflective
practice through writing with and without technology is key in cultivating a real world experience in the classroom considering that a great number of careers are dependent upon problem-solving ability. Gaining a great understanding of the finer points of collaborative work is essential in establishing real world experiences.

**Reconfiguration of Basic Strategies Through Collaboration**

The previous studies cited demonstrated how the integration of technology, writing, and reflection within collaborative strategies can meet some specific needs of students. Yet the most profound changes take place when collaborative strategies are modified through the collaborations and interactions teachers have with both their students and researchers. Such modifications can include the simplest of techniques. Ultimately the goal is not about utilizing an appropriate strategy, but by what means teachers arrive at an understanding of how the slightest re-engineering of instruction can achieve goals and change instructional practices.

A study by Baleghizadeh (2009) demonstrated how adult Iranian ELL students improved their vocabulary using think-pair-share through the use of a combination of narrative passage texts. Baleghizadeh utilized think-pair-share with the adult ELL students to develop word building and vocabulary skills. Of the 40 students, 14 students served as the control group and 26 in the experimental group. In addition to introducing the strategy of think-pair-share, Baleghizadeh collaborated with students addressing their specific needs. Once the strategy was introduced, class discussion centered on norms to decrease any likelihood of interpretive misunderstandings. Once the group understood and agreed upon the norms, Baleghizadeh introduced a fill-in-the-blank style narrative passage. These passages were relevant, meaningful, and designed for adult students. The
establishment of the norms was valuable because the relevant passages sparked various discussions on occasion. As a result, the $t$-test demonstrated that the experimental group had scored significantly higher on increasing vocabulary skills. Although the researcher did not audiotape the pair and share dialogues, observations and notes were made, especially noting the co-construction of knowledge and negotiation of meaning found in students’ conversations. Recognizing the need to establish norms as part of the think-pair-share strategy coupled with meaningful narrative passages to ignite discussions ultimately resulted in complex student discourse involving investigative and probing questions.

Many teachers are continually challenged with introducing vocabulary to students in meaningful ways. Teachers within STEM-based classrooms are inundated with introducing students to a vast amount of new terminology. The terminology and vocabulary in STEM-based classrooms are imperative in order for students to understand and apply that terminology in exploring their selected issues. The study by Baleghizadeh (2009) demonstrated how teachers of any discipline can use a strategy, such as think-pair-share, as a foundation to engage learners in a more meaningful and real world context. Yet, it takes a combination of continuous collaboration with others and several research cycles to polish and finely tune re-engineered strategies.

Eilks’ (2005) participatory action research study focused on how collaboration is crucial in developing changes in teaching strategies. The overall aim of the study was to examine if students’ attitudes about learning science improved by using an alternative teaching approach. The study included middle school science teachers as they examined new ways of addressing the teaching of atomic structure in their instruction. Because the
study of atoms was to be covered in the curriculum early in the school year, using jigsaw allowed for the creation of experts in many subgroup areas. Consistent with action research principles, Eilks acknowledged that the teachers knew their students and classroom content best and encouraged teachers to make the final decisions during the research process. This study demonstrated the collective process of action research when teachers decided they wanted to conduct a written test as part of the assessment after jigsaw was implemented. Eilks collaborated with the teachers in creating the assessment they desired. The study also included a questionnaire measuring student attitudes. Both the teachers and researcher analyzed this questionnaire consisting of both a Likert scale and open-ended responses. Additionally, Eilks and the teachers collaborated together in a number of planning meetings as the teachers prepared their science lessons to include the jigsaw strategy. Results from the post survey revealed that students’ attitudes were more positive about using jigsaw and the written exam demonstrated higher scores.

Even though this study provided an excellent example of the action research tenet of collaboration between researcher and teachers, my study provided greater substance in two particular areas the Eilks’ (2005) study was lacking. First, my study provided a delineation of what teachers already know about such collaborative strategies through the baseline questionnaire. Even though teachers had developed a written test, it was uncertain if students performed cognitively higher due to using jigsaw because there was a lack of baseline information. Second, through the use of observations, I was able to identify firsthand what types of real world experiences students might be gaining through such adapted instruction. Even though Eilks worked with teachers in planning meetings and provided pre- and post-surveys to students, the researcher never actually witnessed
what was documented from the data collection tools because context observations were not conducted. If observations had taken place, the combination would have provided greater triangulation, thus strengthening process validity (Herr & Anderson, 2015).

A action research study by Kohfeldt and Langhout (2012) emphasized the innovative use of the collaborative strategy of the five whys with young students. This youth participatory action research study (YPAR) utilized the cooperative strategy of the five whys in their work with fifth-grade students in California in order to enact second order changes within their school environment. Typically the five whys is not used as any type of classroom strategy. The strategy of the five whys was created by Sakichi Toyoda of the Japanese automobile company Toyota as a manufacturing method of conducting root cause analysis. Kohfeldt and Kanghout, however, anticipated that the five whys would nevertheless be a beneficial strategy to work with students in creating second order change because of the “Western social scientific notion that problems are see problems as unidirectional” and easily identified and solved through single methods of cause and effect (Kohfeldt, p. 318). Additionally, Kohfeldt and Langhout viewed Western problem-solving strategies as ones which place emphasis on human cause rather than process cause. At the beginning of the study, students were still conditioned to the Western way of thinking in relating root causes to human cause.

During the course of the study, Kohfeldt and Langhout (2012) collaborated with the students on all aspects of the data collection and analysis aspects. Several weeks into the study, Kohfeldt and Langhout taught students Photovoice and research ethics as a means to empower them as change makers. During the iterative data analysis process, the researchers worked with the students as they filtered and refined their discussions using a
process of discourse analysis. The students italicized statements identified and classified as human cause during the discourse data analysis. Consistent with the principles of action research where researchers work in collaboration and conjunction with groups of people, the researchers and students discussed both the italicized and non-italicized statements. Collectively, their goal was to cultivate conversations where there were less and less italicized statements. As a result, the students were able to distill the root cause analysis down to three major process-cause issues. This put the students on a course to develop and enact their objective of second order changes within their school environment.

Many of the cited studies exhibit how cooperative strategies have been modified and adapted to achieve their desired objectives. Technology, however, also provides objectivity and the ability to include geographically challenged participants into fruitful discussions as demonstrated in the studies of both Gregory and Masters (2010) and Azlina (2010). Yet, the study by Huang et al. (2014) addressed how the use of technology in conjunction with the cooperative strategy provides relevancy for the students being out in the field during science education. Thus, in each of the studies there is an absence of addressing what instructional supports were provided to individuals in order to reach their desired outcomes.

Even though the study by Schellens et al. (2009) is an exemplar model of how theory was applied to the analysis of students using the six thinking hats, the study did not assess what knowledge the participants had with the six thinking hats prior to the study. Similarly, the Eilks (2005) study provided an excellent demonstration of many key principles of action research such as collaborating with teachers in planning sessions to
create the cognitive test. In both studies, process validity would have been strengthened if researchers had a measure of prior knowledge and understanding of their participants through the use of a survey or questionnaire. Additionally, the importance of direct observation would have increased the process validity of Eilks’ study (2005). As demonstrated in the DeBeer and Whitlock (2009) study, it was only through observation that DeBeers was able to make the necessary changes in using the six thinking hats to achieve impartial student dialogues. Furthermore, declaration of researcher positionality is crucial in action research studies because self-reflection has a direct influence on any study’s trustworthiness (Herr & Anderson, 2015). In both studies by Schellens et al. (2009) and Kohfeldt and Langhout (2012) the positionality of researchers were not discussed. The baseline questionnaire to assess prior knowledge of using cooperative strategies, documentation of the instructional workshop classroom observations, and detailed researcher memos addressed the needs of my study, which are not demonstrated in studies closely related to mine.

The Present Study

The purpose of this action research study was to learn how and in what ways do teachers use and adapt various collaborative strategies within their middle school STEM instruction to create a classroom culture of real world experiences with active participation. Teacher participants utilized specific collaborative strategies that also integrated technology and reflective writing components. The various studies in the preceding section of the literature review demonstrate how teachers have re-engineered a number of collaborative strategies to provide greater opportunities for students to engage
in real world learning and applications. A number of the studies cited have, in fact, utilized the same collaborative strategies as I did in my study.

**Methods**

The methodological framework of action research involves a non-linear spiral of actions, consisting of planning, doing, acting, observing, and reflecting (Herr & Anderson, 2015). These actions are not defined steps or progressions; rather they are multi-dimensional and overlapping, providing guidance for the upcoming stages in the process. As an action research study unfolds, it is in the revisiting of many actions such as acting, observing, and reflecting, which moves the study forward. It is through the continuous cycle of such actions where outcomes become more apparent. The reason for the mixed methods action research approach for this study was to create a deeper understanding of the interpretations of study by drawing upon the complementariness of data in order to gain a deeper understanding and broader perspectives (Greene, 2008).

All portions of the study, including instruments and protocols were approved by the Institutional Review Board (IRB; Appendix A). This study consisted of four phases over the course of 16 weeks. An innovation timeline can be found in Appendix B followed by data collection inventory in Appendix C.

**Participants and Setting**

The eligibility requirements required all participants to be middle school teachers who were utilizing the UA MS 101 engineering program. Eligible participants learned of this study through an informational letter that was distributed to teachers involved in the UA MS 101 program. Refer to Appendix D for the informational letter. Additionally, instructional coaches and curriculum directors affiliated with the UA MS 101 engineering
program were included in the study. The innovation instructional session, I provided, was open to all UA MS 101 teachers and participants self-selected to be included in the study. Participants signed the informed consent at the time of the instructional session. Refer to Appendix E for letter of informed consent for teacher participants. Refer to Appendix F for the instructional coaches/curriculum director’s letter of informed consent. Pseudonyms were used in all reporting to maintain confidentiality.

The study consisted of three middle school teachers and two curriculum directors for a total of five participants. Of the middle school teachers, two of the three taught electives classes, one participant for only eighth graders and the other for a combination of sixth through eighth graders. The third participant taught a mandatory core class (science), exclusively to seventh graders. Two of the three teacher participants held elementary (K-8) certifications with endorsements in science and mathematics, whereas the third held a career and technical education (CTE) certificate. Only one of the three teacher participants held a M.A. degree. Participants possessed a range of years in the teaching profession, with two years as the shortest amount and 10 years as the longest. All participants had at least two or more years within their current district and specific school.

Measures/Data Collection Tools

**Instructional practices questionnaire.** This questionnaire consisted of five Likert six-point scale questions, asking participants to rank their familiarity with several different collaborative strategies that can be utilized within instruction. The four open-ended questions asked participants to describe how they became familiar with the strategies they were already aware of and how they used the strategies within their
instructional delivery. Eight demographic questions were at the end of the questionnaire. Examples of the demographics questions included total years of teaching, certifications held, and what types of classes they taught. The purpose of this questionnaire was to gain a greater understanding of the background experiences and knowledge of the instructional strategies, which were later used during the workshop. Refer to Appendix G for the instructional practices questionnaire.

**Instructional practices workshop.** This two-hour workshop focused on providing participants with the opportunity to engage in a number of different instructional strategies. The level of which these instructional strategies were utilized during the workshop was based upon the responses provided through the questionnaire. The instructional strategies participants engaged in during the workshop were ones they later implemented within their classroom instruction. The instructional strategies complemented the current UA MS 101 unit and engineering design process. The workshop was videotaped for documentation purposes, and the documents/artifacts created by participants during the workshop were photographed and later analyzed through a document analysis process. Refer to Appendix H for workshop outline and protocol.

**Classroom observations.** The classroom observations consisted of a series of two 30-minute observations. The observations were scheduled between each participant and myself. I scripted the observations by hand, which included a sketched diagram of the room layout. Participant observation is a data collection tool, which enables a researcher to learn firsthand about how the activities under investigation were being explored in the natural context/environment (Kawulich, 2005). Through the use of
classroom observations, I was able to identify how participants were using the instructional strategies. Using the classroom observation protocol (found in Appendix I), I set out to learn how and to what extent participants were applying and adapting the instructional strategies presented during the workshop in order to foster a classroom culture of real world experiences, which engage students as active participants. To make this determination, I specifically sought to establish whether teachers encouraged students to modify the strategies and what questions the teachers posed to promote dialogue on problem solving between teacher and student and/or student-to-peer.

The process I used for observations is one referred to as a focused observation. A focused observation is one that is supported by another data collection method driving the focus (Kawulich, 2005). The protocol served as an overall focus for both observations; yet during the first observation, the focus was driven by the workshop and the documents created within the workshop, which were previous data collection tools. The focus of the second observation was driven by the first semi-structured interview, which was the previous data collection tool. Lastly, field notes were written on all observations. All field notes were recorded within the researcher memos, which consisted of four parts. Field notes are found within the four-part researcher memos.

**Semi-structured interviews.** The semi-structured interviews consisted of a series of two approximately 60 minute in-depth interviews in order to gather rich accounts of the experiences of the teachers (Creswell, 2013). Interviews were individually scheduled between each participant and myself. In order to accommodate geographic distance and schedule demands, interviews were conducted by phone. The first semi-structured interview focused on Research Question 1, during which I aimed to
gain a greater understanding of what successes and challenges participants had experienced in utilizing particular learning strategies for students to obtain real world experiences. This interview also focused on the choices participants made when using the developed instructional strategies to guide the authentic learning modules. Additionally, my aim was to gain a greater understanding if these choices provided students with real world experiences.

The second semi-structured interview focused on Research Question 2, during which my aim was to gain a greater understanding of the choices participants had made in selecting and using particular instructional strategies to guide students to obtain opportunities for active participation. Questions were framed to address the successes and challenges participants had encountered using the instructional strategies. The flexibility provided by utilizing a semi-structured interview fostered a more interactive environment where participants can candidly share their experiences (Charmaz, 2014). The only data collection tool I employed with non-classroom teachers (instructional coaches/curriculum directors) was the semi-structured interview. The participants serving in the capacity of instructional coach and/or curriculum directors took part in one 60-minute phone interview. Refer to Appendix J for interview protocols and Appendices K and L for teacher interview questions. Refer to Appendix M for interview questions posed to instructional coaches and curriculum directors.

**Focus groups.** There were two focus group sessions, each lasting 120 minutes (two hours) in duration. Each focus group session was conducted in a semi-structured format. The first focus group also included a collaboration amongst the teacher participants at the Barnes & Noble inaugural Mini Maker Faire event. This event took
place prior to the formal focus group session. During the first focus group session, I asked participants to describe their overall experiences in applying the strategies provided to them in the instructional workshop during Phase 1 of this study, to achieve the authentic learning modules. During this focus group, I also asked participants what they thought the future directions should be for the authentic learning modules. The purpose for the second focus group session was member checking. The purpose of member checking is to receive input from participants to assure that there has been an accurate portrayal in the interpretation of the data (Creswell, 2007). Focus groups were selected because they are a preferred data collection tool for examining if and how the attitudes of individual participants might be affected based upon their interaction with others who share the same lived experiences (Linhorst, 2002). Focus groups provide the opportunity for participants to offer opinions and to pose their own questions within a particular social network (Barbour & Kitzinger, 1998). Refer to Appendix N for the focus group protocols and Appendices O and P for focus group questions.

Procedures

Phase 1. This phase consisted of two weeks beginning in late July 2015 and concluding in August 2015. During this time participants were recruited for the study. Eligible participants had received an informational/recruitment letter via email and through the group Facebook page. During this timeframe, invited participants were also informed of the details of the study and signed the informed consent on the day of the instructional practices questionnaire and innovation instructional strategies workshop. The University of Arizona had reserved three dates for teachers currently using the MS 101 program to obtain additional information, professional development, trainings, and
workshop sessions. This session was offered as an optional selection. During this phase, participants took the instructional practices questionnaire. The purpose of this was to obtain an understanding or measure to ascertain where they were in terms of their current teaching practices, especially with regards to the instructional strategies the participants were engaged in during the workshop. Following the questionnaire, participants engaged in the instructional workshop. The purpose of this workshop was to provide teachers with a foundational understanding of several strategies wherein they created their own co-curricular authentic learning modules to complement the existing UA MS 101 unit. Refer to Appendix G for the outline of the instructional workshop.

**Phase 2.** This phase consisted of five weeks beginning in early August 2015 and concluding during the middle of September 2015. During this phase, participating teachers implemented the authentic learning modules as an addition to the UA MS 101 unit, utilizing the strategies from the instructional workshop they attended in Phase 1. This phase consisted of a 30-minute classroom observation followed by a 45 to 60-minute semi-structured interview. The classroom observation was scripted using LiveScribe and the observation protocol. The semi-structured interview focused on what modifications had be adopted and modified to achieve real world experiences in the classroom.

Approximately the following week, I conducted a semi-structured 45- to 60-minute interview with each participant. This semi-structured interview was conducted over the phone. The semi-structured interview consisted of a few set questions in order to establish consistency with all interviews yet provide enough flexibility to allow for additional probing questions based on particular responses. The focus of this interview was with regards to Research Question 1. The interview focused on gaining an
understanding of the choices participants had made in selecting the particular instructional strategies and authentic learning components and if these choices provided students with real world experiences.

Interview questions included questions posed in a plus/delta style (Helminski & Koberna, 1995). The plus feature are the questions that address the successful aspects being encountered in any given situation. The delta feature consist of the questions that address challenges being faced. The conclusion of plus/delta fosters the development of suggestions for improvement regarding the situation. Using the plus/delta technique provided an opportunity for participants to reflect and express not only the successes and challenges they experienced but also the opportunity to provide their own ideas as to how they could improve their situation. The reorientation of viewing a situation one is involved in is key in fostering catalytic validity within action research studies (Herr & Anderson, 2015).

**Phase 3.** This phase consisted of five weeks beginning in the middle of September 2015 through end of October 2015. This phase consisted of a second 30-minute classroom observation and followed by second a 45-to-60 minute semi-structured interview. The second classroom observation consisted of a 30-minute visit in which I scripted the observation. This observation was followed by a 45-to-60-minute semi-structured interview. The purpose of this phase was to understand to what degree and depth teachers had used the instructional strategies from the workshop. Additionally, the purpose was to learn what modifications had been made to achieve the desired outcomes of achieving real world experiences and active participation in the classroom.
Approximately a week after conducting the classroom observations, I conducted a semi-structured 45-to-60-minute interview with each participant. This semi-structured interview was conducted over the phone. The semi-structured interview consisted of a few set questions in order to establish consistency with all interviews yet provided enough flexibility to allow for additional probing questions based on particular responses. The focus of this interview was with regards to Research Question 1. This semi-structured interview focused on gaining an understanding of the choices participants have made in selecting the particular instructional strategies and authentic learning components and if these choices provided students with real world experiences. Some of the questions posed to participants included the following:

1. Why and how did you decide to select the strategies you used?
2. Were there any strategies used that either you or students came up with? If so, what were they?
3. In what ways can you describe how using the strategies you selected provided authentic real world experiences for your students?

Interview questions included statements in a plus/delta style (Helminski & Koberna, 1995). The plus feature consists of the questions that address the successful aspects. The delta feature consists of the questions that address the challenges faced. Using the plus/delta technique provided an opportunity for participants to reflect on the successes and challenges. Examples of such questions used were as follows:

1. What, if anything has surprised you in using these strategies?
2. What successes have you experienced so far?
3. What challenges have you experienced so far?
4. What recommendations for improvement and/or changes would you suggest? Why?

Also during this phase is when I conducted the one semi-structured 60-minute phone interview with the instructional coaches/curriculum directors affiliated with this UA MS engineering 101 program. Some of the questions guiding these interviews included the following:

1. What types of collaborative strategies do you use with teachers to foster active participation within classroom instruction?

2. What types of instructional strategies do you use with teachers to foster real world experiences within classroom instruction.

3. What challenges do you face in fostering best practices instructional strategies in conjunction with the UA MS 101 engineering program?

**Phase 4.** This phase consisted of four weeks beginning in early November 2015 through the end of November 2015. During this phase, two focus groups took place with all teacher participants. Each focus group lasted 120 minutes in duration. Each focus group met face to face. The first focus group included an additional collaborative event at Barnes & Noble. The Barnes & Noble inaugural Mini Maker Faire took place at the east side location in Tucson. This event had been suggested by one of the participants with the purpose of sharing what they do in the classroom in a public forum. The formal focus group session took place shortly after the Barnes & Noble event. During the first focus group, I asked participants to describe their overall experiences in using the strategies provided in Phase 1 to implement the authentic learning modules. Additionally, during
this focus group, I asked participants what they thought the future directions should be for the authentic learning modules.

At the beginning of December 2015 the second focus group took place in Tucson. During this second focus group, I asked participants to review the data analysis through member checking to determine if we were in agreement as to whether or not I had correctly understood their comments, questions, and observations during all phases of this study. Additionally during this focus group session, I shared all the data analysis I had developed through a reporting of the data analysis.

**Data Analysis**

**Preparing and Organizing the Data**

Audio data was collected on a digital recorder and stored securely on my password-protected personal computer as audio files. All email correspondences were generated from my ASU email account. All email correspondences were then transferred and saved to a separate email folder. All interviews and focus groups were transcribed verbatim using the transcription service Cogi (2008-2016, http://legacy.cogi.com). Cogi is a fully secure transcription service that allows one to upload audio files for transcription. Also, all data were backed up on a daily basis via two secure external hard drives, one hard drive kept off site, not in my home, but in a locked drawer in my office at work.

I prepared the transcripts in a sentence-by-sentence format, having each sentence of the transcript numbered. Using a Word document I used the comments option for each sentence to create notes leading to a possible code. I also used additional features in Word such as highlighting colors, underscoring, and bolding to note specific thoughts.
used the comment option as a key for all colors, bold, and underscored. In addition to the Word document transcripts, I used Dedoose (n.d., http://www.dedoose.com) for the development of codes and extracted verbatim participate quotes.

**General Data Analysis Process**

I read the transcripts in their entirety twice before making any notes on them. The first read was for accuracy. During this time is when I would make any minor corrections, revisiting the audio footage. During this read-through is also when I would clean the transcript, meaning that I would check to make sure all aspects were de-identified and the transcript was formatted. During the second reading is when I would create my first set of comments, which consisted of memos or first thoughts that I had using the comment function in the Word document. During the third read of each of the transcripts I would formulate elaborations on previously constructed comments and also construct highlights or underscoring of particular quotes. Preceding the fourth read is when I would print the transcript to make any handwritten notes. Furthermore, maintaining a printed copy assisted in my transition to carry over comments as now possible codes working in Dedoose. Each transcript was uploaded into Dedoose so that I could create codes and extract verbatim quotes. The first step in the process of conceptualizing the data is to create a code, which is similar to labeling. The labeling is created for what the unit represents (Strauss & Corbin, 1990). I would create a label, which would describe the phenomenon as I went through the transcripts sentence by sentence.

Recording of all codes, categories, and subcategories were extracted and maintained in a running list format in Dedoose similar to that of mini-frameworks in
order to keep track of the analysis (Strauss & Corbin, 1990). There was only one project listing in Dedoose, and each transcript was a separate entry, titled as the collection tool (interview, observation, etc.) with the de-identifying code marking for each participant. I appropriated the color codes used in Dedoose to differentiate the following: data collection tool, memo notes, open codes, categories, subcategories, name of participant, in vivo extraction, properties, character, time, consequences, who, what, how, and emotions.

The coding process consisted of two coding stages: open and axial coding. During the open coding stage the guiding prompts I used in determining codes were who, what, how, and why (Strauss & Corbin, 1990). When using the questioning prompt of who in order to establish codes, I was seeking to determine if the occurrence was initiated either by the teacher or the student(s). When using the questioning prompt of what in order to establish codes, I was seeking to determine what strategies the teacher used in order to achieve the authentic learning experience and what happened as a result of using that particular instructional strategy. When using the questioning prompt of how, I was seeking to determine how was an authentic learning experience achieved? Finally, when using the questioning prompt of why, I was seeking to determine why particular decisions were made. Using the prompt of why was not used to place any type of value judgments; rather it was used to better understand the rationale for decision making.

The second step in the open coding process was to create categories, which combined codes together, which seemed to have a relationship to one another. The way I achieved this was to return to each sentence-by-sentence code and create a code or category for that paragraph. The code or category for that paragraph was derived and
determined by what codes had emerged from each sentence within each paragraph. I grouped similar codes together because of what they represented. This was a consolidation of similar themes in order to create these categories (Strauss & Corbin, 1990). I was then able to create sub-categories. In order to develop a set of sub-categories, I sought to identify the properties, attributes or characteristics within each the categories.

Axial coding was the second stage in the coding process where I reassembled the codes and made connections between the categories and subcategories (Strauss & Corbin, 1990). There are certain relationships, which connect categories and their subcategories. In achieving connecting categories and subcategories there must be an identification of particular relationships. To achieve this, I created an additional field in Dedoose to identify each relationship. For each category I identified the event or incident surrounding the occurrence and list it in the field. Considering that there might be several events associated with that category or particular phenomenon being examined I had listed and included all possible sources. Once I had determined the actions taken in response to phenomenon/category being examined, I was able to determine outcomes or consequences. These consequences are essentially the assertions, which have evolved from my analysis process. To fully support this, I have included In Vivo codes (Creswell, 2013), which are extractions from participant’s language, to support such consequential relationships in a separate field within Dedoose. A final codebook, in addition to a code sheet of descriptors, was created for each instrument.

**Instructional practices questionnaire.** The instructional practices questionnaire was administered via a hard copy form prior to the participation in the
instructional workshop. The responses from the questionnaire were de-identified and coded using lettering and numbering combinations related to participants’ school affiliation. Data were input into an Excel spreadsheet. Mean, mode, and range were calculated for statistical questions. The results of the questionnaire quantified the knowledge and level of understanding participants had about the instructional strategies provided the workshop. The results from this questionnaire provided guidance for the aspects within the instructional workshop. At the end of the study, the information gleaned from this questionnaire was triangulated with the other sources of data because questionnaires capture only surface data (Polkinghorne, 2005).

**Instructional workshop observations.** The workshop was documented through videotaping the session. After the workshop, I viewed the videotape first without making any notations. During the second viewing I made notations such as questions the participants asked, level of involvement by each participant, ideas posed by participants, and amount of time spent on each strategy. All notes were taken in a Word document using comment codes. All information was de-identified and coded using lettering and numbering combinations related to participants’ school affiliation same as the questionnaire. Using the basic structure of discourse analysis, I looked for patterns in the questions posed during the workshop and documented which individuals dominated the time and in what fashion (Ratcliff, 2009) I also took notes on specific phrases and the interactions of the participants within the workshop. Discourse analysis, especially conversation analysis (CA), particularly focused on the details of turn-taking within a specific context, in this case, a teachable working session (Wood & Kroger, 2000). Even though discourse analysis places importance on the content of the talk, there is greater
value given to the context. Because importance is placed on both context and function, another key aspect of discourse analysis was on the facet of multiple functions. Participants interacted on many levels during the workshop, including discussions, hands-on activities, review of handouts, and a perusal of resource books, which provided the opportunity to gauge why interruptions took place. When these interruptions would take place, I noted and analyzed why the interruptions took place and noted the length of time for any portions of time spent on discussion and activities, including which individual might have led that particular portion.

**Documents/artifacts.** All artifacts created during the workshop were included, which also comprised the notes and drawings on any of the marker boards. Written documents were photographed and de-identified at the time of photograph. All documents/artifacts were coded using lettering and numbering combinations related to participants’ school affiliation. The documents/artifacts were later analyzed through document analysis. Once the document artifacts were collected, I was able to examine the artifacts for particular shared themes and patterns (Bowen, 2009). The codes generated from the semi-structured interviews were the same codes used for the documents/artifacts, although notations were made to differentiate the instruments and sources in the data collections (Bowen, 2009).

**Classroom observations.** Observations were conducted using LiveScribe. These handwritten scripted observations were then transferred via ASU email account into a PDF document. All documents/artifacts were de-identified at the time of each observation. All observation documents were coded using a letter and number combination related to participants’ school affiliation. I also used an observation protocol
identifying how instructional strategies were used and modified. This protocol consisted of a three-column section including descriptive, interpretation, and concepts/themes. The scripting conducted during the observation was transferred into the protocol form. Annotations within the PDF consisted of reflections similar to field notes (Creswell, 2007). The scripted PDF Livescribe notes followed a chronological format. I sought to specifically identify patterns of behavior, language, interaction, and instructional strategies used during the observations.

**Semi-structured interviews.** After receiving initial transcription from Cogi, I listened to the audio recordings and transcription to make any necessary corrections and to include additional subtleties such as laughter, pauses, and voice inflection. Next, the verbatim transcripts were completely checked for accuracy. During the pre-coding stage, I would listen to the interviews and make comments as memos in the transcriptions within Word. I took notes on the use of repeated words/phrases, metaphors, analogies, and other verbal subtleties.

For these interviews, I used process coding. Process coding focuses on the actions people describe (Saldana, 2013). Since participants were describing their stories of what they did during the authentic learning modules, I used process coding to identify patterns of what actions they had taken in response to the situation of implementing the authentic learning modules. The actions that utilized *ing* words describe a wide range of actions from the concrete such as reading a book to the most abstract, such as describing an action as being perplexing.

**Focus groups.** After receiving initial transcriptions from Cogi, I followed the same process of reviewing and correcting the transcription as I did for the semi-structured
interviews. For the focus groups, I again used the method of process coding (Saldana, 2013). The way participants articulate their stories in the company of other participants provided insight on the meaningful points within their experience. Because the participants described their story of what they did during the course of the study, I used process coding to identify patterns of what actions they had taken in response to the innumerable situations, which had arisen during this implementation.

Four 4: Researcher’s memos. I also maintained a researcher’s journal, consisting of field notes throughout the study. The journal was coded/labeled into four categories: (a) observational notes, facts of what happened, (b) theoretical notes that attempted to derive meaning, (c) methodological notes that served as reminders to self, and (d) analytic notes that consisted of end-of-the-day reflections (Groenewald, 2004). I maintained my researcher memos in an ongoing Word document. At the end of each week I would code the entries to reflect the four categories as stated above. I used a number of prompts in order to categorize my writing into four codes. Prompts to identify observational notes were in my field notes, which included summaries of objective fact-based events that took place while out in the field. Prompts to identify theoretical notes revolved how I was processing my selected theories, and where and how aspects of the theories were surfacing. Prompts to identify methodological notes consisted of how I was reflecting on choice of methods and what challenges or successes I was facing as a result of my selection. Finally the prompts I used for analytic notes included my thoughts, feelings, apprehensions, anticipations, and philosophies. In some instances, the analytic notes were also coded as theoretical or methodological. All confirming and disconfirming data was documented in my researcher memos as I conducted data analysis. One
particular benefit, I derived from maintaining my researcher memos in this manner was that I only had to maintain one journal during the entire study rather than several separate memos, journals, or logs. Maintaining constant and concise researcher memos was imperative in answering my research Question 3, which was about how I had changed as a researcher and practitioner as a result of my own study. Refer to Appendix Q for the researcher reflection questions.

**Results**

This section presents the results from the analysis of both the quantitative and qualitative data collected from the study. Overall, the results are organized by the three research questions:

**Research Question 1**, *How and in what ways do teachers utilize existing collaborative strategies to provide students with real world experience?*

**Research Question 2**, *How and in what ways do teachers utilize existing collaborative strategies to provide students with opportunities for active participation?*

**Research Question 3**, *How and in what ways do I transform as an instructional specialist and researcher as a result of collaborating with teacher leaders?*

For each research question, the related quantitative data are reported first. Results analyzed from the quantitative data consisted of descriptive statistical data from three teacher participants who responded to the instructional questionnaire. Qualitative data are reported second. These results consisted of rich descriptions representing participants’ experiences utilizing instructional strategies framed by themes, theme-related components, and assertions made by the data collection instruments, including the
workshop, artifacts, observations, semi-structured interviews, focus group sessions, and researcher memos that included the field notes.

**Quantitative Results**

An instructional practices questionnaire was administered at the onset of the study to acquire preliminary information to determine the familiarity of the proposed strategies to be utilized during the instructional workshop. There were three sections of the questionnaire consisting of a total of 16 questions. The first section included five questions using a six-point Likert scale with 1 indicating *not at all familiar* and 6 indicating *extremely familiar*. The second section consisted of three open-ended response questions asking participants to elaborate how they became familiar with any of the strategies and how they had used them in classroom instruction. The third section included eight demographic questions.

Figure 1 describes the participants’ ratings of the five Likert scale items on the instructional questionnaire. Participants were asked to rank their familiarity with each instructional strategy on a scale of 1 to 6 (*1 = Extremely Unfamiliar, 2 = Somewhat Unfamiliar, 3 = Slightly Unfamiliar, 4 = Slightly Familiar, 5 = Somewhat Familiar, 6 = Extremely Familiar*). As demonstrated by the mean, the instructional strategy the majority of participants were most familiar with prior to the instructional workshop was think-pair-share (\( \bar{x} = 4.00 \)). The next strategy participants were most familiar with was the five whys and the five hows (\( \bar{x} = 2.33 \)) followed by the six thinking hats (\( \bar{x} = 2.00 \)). Strategies that participants were least familiar with were jigsaw (\( \bar{x} = 1.66 \)) and the nine windows (\( \bar{x} = 1.33 \)). Because there was a wide span in overall responses per participant in ranking each of the instructional strategies, Likert scale response totals were run for
each scale response per participant. In terms of familiarity per participant, Z1 was most familiar with the strategies ($\bar{x} = 3.6$) followed by A1 ($\bar{x} = 1.8$) and S1 with the least amount of familiarity ($\bar{x} = 1.4$).

![Scale responses by participant](image)

Figure 1. Individual participant responses for each instructional strategy. ($n = 3$)

**Qualitative Results**

The qualitative data collection tools that were analyzed included a workshop, semi-structured interviews, observations, and focus groups. These analyses identified a total of three overarching themes, each consisting of three theme components as related to the first research question.

The reliability of the qualitative data was established during two events, preceding the first semi-structured interviews and at the end of the study. During each second semi-structured interview, member checking of the first semi-structured interview was conducted for accuracy of the content and acknowledgment of the general themes from
initial coding. Member checking took place once again at the end of the study during a second and final focus group sessions. During the final focus group, participants were asked once again to review all transcripts for accuracy of content and also to review the preliminary data analysis. In reviewing the preliminary data analysis, participants were asked to contribute their thoughts regarding the analysis. Participants were also asked if there were any items of data and information they felt needed to be highlighted or altered in any fashion.

**Research Question 1.** Research Question 1 asked, *How and in what ways do teachers utilize existing collaborative strategies to provide students with real world experience?* The analysis produced a total of three overarching themes, each consisting of three theme components as related to this first research question. Table 1 displays each of the themes, three-related components, and assertions. This section identifies and describes each of the assertions, themes, and theme-related components. Supporting the assertions and themes are selected quotes and extractions from observations.

Table 1

*Research Question 1: Themes*

<table>
<thead>
<tr>
<th>Theme</th>
<th>Theme-related components</th>
<th>Assertions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facilitating instruction</td>
<td>1. Teachers embedded HOTS in the instructional strategies.</td>
<td>Teachers facilitated instruction by incorporating HOTS, creating cross-curricular connections, and encouraging students to participate in shared decision-making.</td>
</tr>
<tr>
<td></td>
<td>2. Teachers identified opportunities for cross-curricular connections.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Teachers encouraged students to engage in shared decision making.</td>
<td></td>
</tr>
<tr>
<td>Fostering independence</td>
<td>1. Teachers encouraged student initiative.</td>
<td>Teachers fostered student independence by encouraging student initiative and creating non-judgmental environments that provide students to take</td>
</tr>
<tr>
<td></td>
<td>2. Teachers created an environment that allows students to take ownership of their learning.</td>
<td></td>
</tr>
</tbody>
</table>
3. Teachers demonstrated non-judgment ownership of their learning when guiding students.

Table 1 (continued)

**Research Question 1: Themes**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Theme-related components</th>
<th>Assertions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>1. Teachers encouraged communication through the use of prompts.</td>
<td>Teachers maintained open lines of communication through the use of prompts, expressing the value of student input and emphasizing the importance of understanding failure.</td>
</tr>
<tr>
<td></td>
<td>2. Teachers placed importance on student input.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Teachers emphasized the importance of understanding the concept of failure.</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Research Question 1: How and in what ways do teachers utilize existing collaborative strategies to provide students with real world experience?

**Research Question 1: Assertion 1. Research Question, Assertion 1**

Teachers facilitated instruction by incorporating higher order thinking skills (HOTS,) creating cross-curricular connections, and encouraging students to participate in shared decision-making.

Teachers expressed the necessity for using a combination of HOTS, cross-curricular connections, and shared decision making in any and all types of collaborative strategies in order to provide students with real world experiences. Comments, such as “They had to tell me what modifications they made, and I asked them why to justify their decisions based on their perspective”; and “So have you reached a decision? Have you come to a consensus?” demonstrated how teachers supported the collaborative strategies using HOTS and shared decision-making. Furthermore, exploring different perspectives using Six Thinking Hats empowered students to engage in discussions revolving around issues such as potential litigation and conflicting political views regarding charges for water.
use. Such discussions lead students to an understanding of how real world experiences include various cross-curricular connections. Once students realized this, they posed questions, such as “It’s interesting because they [students] ask, ‘So if all these things are connected, why are they taught separately?’” This question itself demonstrated higher order thinking skills—recognition that the real world experiences are not based upon soloed information, but rather drawn upon numerous connections.

Facilitating instruction: Teachers embedded higher order thinking skills (HOTS) in their instructional strategies. The first overarching theme derived from the qualitative data sources was the description of how participants facilitated instruction when utilizing the collaborative strategies that they selected. More specifically, teachers described how they facilitated instruction by using probing questions and stimulating discussions, which encouraged students to utilize higher order thinking skills. Teachers’ use of higher order thinking skills within the collaborative was depicted in the “facilitated instruction – higher order thinking (HOTS)” code (01. FAC-HOT.01). For entire code book and code sheet descriptors, please see Appendix R.

They [the students] had to tell me what modifications they made on their project, and I asked them why so they [the students] had to justify their decisions based on their perspective [i.e., based on whatever color of the six hats they happened to be wearing]. (Participant Z1, second semi-structured interview)

Another participant described how higher order thinking skills were used in conjunction with technology.

I’m using technology . . . [SimCity glasslabgames] for students . . . to interpret [their progress] for themselves. They have to evaluate their . . . progress (as) that is shown in the program [software]. They have to draw upon lots of different angles to arrive at their conclusion. They make their own group decisions off of the progress displayed on the projected progress chart. (Participant A1, second observation)
The importance of utilizing higher order thinking skills wherein the teachers posed such process-based questions regarding their own practice was depicted in the “teacher reflections—question use” code (03. TRS-QUU.01). For entire code book and code sheet descriptors, please see Appendix R.

Okay, it still worked [think-pair-share], but not as much as I thought. It didn’t go as deep as I thought. Were my expectations too high? Did I not pose enough questions? The right questions? (Focus group 1)

Participants continued to elaborate on how their own reflective process influenced how they approached higher order thinking skills in the classroom. Another participant during the focus group offered the following comment:

I found that if I don’t ask them [the student], “What do you think this could be applied to, or what else could this be applied to?” you know, the deeper questions when using any strategy, if I don’t include that, things will be flat. I have to ask those questions because I can’t assume their responses are going to address those deeper aspects. I have to make sure it is in there somewhere. (Focus group 1)

Facilitating instruction: Teachers identify opportunities for cross-curricular connections. This second theme-related component of the overarching theme of facilitating instruction was demonstrated in the cross-curricular connections teachers created when using the collaborative strategies. As evidenced in observations, teachers facilitated instruction emphasizing cross-curricular connections through discussions about solar energy with regards to materials and geographic location (Participant Z1, first observation). Through the use of the collaborative strategies, students were able to garner deeper connections to factors impacting environmental issues. In another observation, the participant noted that while students explored different perspectives using Six Hats, the class discussion turned to how there can be litigation and conflicting political views regarding charging for water use (Participant S1, second observation). Once clear cross-
curricular connections were established, students themselves began to openly question reasons for such isolated content matter within school: “It’s interesting because they [students] ask, ‘So if all these things are connected, why are they taught separately?’” (Focus Group 1). The identification of such connections is depicted in the code of cross-curricular connections (01. FAC-CCC.02). For entire code book and code sheet descriptors, please see Appendix R.

There have been a few teachers, like one of the social studies teachers [who asked] . . . what were you doing in your class because I mention this [the subject of solar energy] . . . with regards to the economy, and kids just took off with it. They not only knew so much about [the subject] because of the science aspect, but how it related [to] and affects the economy and geographic areas. (Participant Z1, first interview)

The importance of making cross-curricular connections was cited wherein teachers posed global thinking based questions during their collaborative strategy classroom dialogues. Such questioning strategies encouraged students to address numerous aspects about the issue and discuss such issues in a non-linear approach. Such questioning strategies are depicted in the “questioning strategies—global thinking” code, (07. QUS-GLT.01). For entire code book and code sheet descriptors, please see Appendix R.

Some of them asked about the cost to the environment regarding solar. A lot of them were focused on budget and cost. When we did jigsaw only one article talked about it, the other two didn’t. I asked them how they made such connections. It’s like economics meets science. (Participant Z1, first interview)

*Facilitating instruction: Teachers encourage students to engage in shared decision making.* The third theme-related component of the overarching theme of facilitating instruction was demonstrated in how teachers encouraged students to engage in shared decision-making when using collaborative strategies as depicted in the “shared
decision making” code (01. FAC-SDM.03). For entire code book and code sheet descriptors, please see Appendices Q.

In examining what ground rules would need to be established regarding using social media on their cell phones in class, the justification students used [using the green creative hat of the Six Thinking Hats] for social media was that it’s okay to take a selfie as long as it is you and your project is in it so that you [the students] could share it out with family. That way families get to see what you [students] are doing in school because it’s not practical for them [families] to always get over to the school to see what you are doing every day [blue and white hats—use of factual information]. (Participant Z1, second interview)

The encouragement for shared decision making was also documented in a classroom observation.

The teacher was observed asking, “So, have you reached a decision? Have you come to a consensus?” [which] Z1 asked a group of students working together while encouraging them to pull together all information and perspectives in order to make a collective decision. (Participant Z1, second observation)

**Research Question 1: Assertion 2.** Research Question 1, Assertion 2 states,

In order to provide students with opportunities for real world experiences, teachers will need to foster student independence by encouraging student initiative and creating a non-judgmental environment that will allow students to take ownership of their learning.

Teachers indicated that the fostering of independence was a necessary component in providing students with the opportunities for real world experiences. Creating a non-judgmental environment so students take initiative and claim ownership of their learning is imperative in fostering independence. One example of how these three aspects were clearly demonstrated was during an observation when the teacher informed students that their project had to be affordable, and students had to determine, without the direction of the teacher, what that meant for themselves through dialogue using different perspectives.
Another example was when students advocated and negotiated for the use of cell phones during class time. The teacher explained that when they were justifying their decisions from their perspectives, one student advocated for being able to use the camera feature and possibly social media by saying, “We can take pictures of our projects to show our parents,” and my response was “What else?”

Such non-judgmental environments, as demonstrated in this example, encouraged students to take the initiative and claim ownership for their own learning.

*Fostering Independence: Teachers encourage student initiative.* The second overarching theme was fostering independence when utilizing the collaborative strategies. More specifically, the teachers described how they fostered student independence by encouraging students to take initiative through open brainstorming discussions and providing support for fellow peers through the contributions of ideas as depicted in the student initiative code (03. FOS-STI.02). For entire code book and code sheet descriptors, please see Appendix R.

When we were brainstorming one day about the possibility of them [the students] using their cell phones in the classroom, one student offered an idea [while in a Six Hats perspective] and my response was “What else?” so that everyone would keep going. (Participant Z1, second interview)

In a subsequent interview, the same participant elaborated on how students took initiative in helping other peers.

During one of the projects I told them [one group of students] what another group had in mind [as possible solutions] and I asked if they could see any problems with it. They not only brought up the problems [in wearing Six Thinking Hats] but then also made suggestions on how to fix it. I think they felt better about offering potential solutions because they were able to identify the issues more clearly. (Participant Z1, second interview)

*Fostering Independence: Teachers create an environment that allows students to take ownership of their learning.* This second theme-related component of the
The overarching theme of fostering independence was demonstrated in the ways teachers crafted a classroom environment, which enabled students to take ownership of their learning: “What I found is that if I give them more ownership and allowing them to run with it [ideas and conversation] they feel like they’re the expert [in using jigsaw] so that they value everything more” (Participant Z1, second interview). The fostering of independence through taking ownership is in the “taking ownership” code (03. FOS- TAO.01). For entire code book and code sheet descriptors, please see Appendix R.

During the first round of classroom observations, participant Z1 discusses the cost and budget of the student project. Z1 stated that the project needed to be affordable so that students had to determine what that meant for themselves and how it applied to their own particular project through providing information [expert information using jigsaw] and dialogue using different perspectives [Six Thinking Hats]. (Participant Z1, first observation)

*Fostering Independence: Teachers need to be non-judgmental when guiding students.* This third theme-related component of the overarching theme of fostering independence was demonstrated in the ways teachers refrained from judgment when guiding students during the collaborative strategies as depicted in the code of “non-judgment” (03. FOS-NON.03). For entire code book and code sheet descriptors, please see Appendix R.

I've told them, no, it's not for points [the project], we just need to learn things. I reassure and encourage their viewpoint and that what we are doing is not for some grade. So it's just trying to get them used to that, so that they enjoy actually finding out about things and exploring the topics. Knowing there is no grade attached or being right or wrong is encouragement for them to stay with their viewpoint and that particular perspective. (Participant Z1, first interview)

Further elaboration on non-judgment was described in this second interview.

So I tell them [the students], “Who cares if it doesn't work, you know?” Okay. Now we know that, you know, there's x, y, and z that doesn't work or people don’t agree with you. And, you know? We move on from there. Just move forward. (Participant Z1, second interview)
Research Question 1: Assertion 3. Research Question 1, Assertion 3 states,

In order to provide students with opportunities for real world experiences, teachers will need to use prompts, value student input during the communication process, and emphasize the importance of developing an understanding of the concept of failure.

Teachers indicated that communication was key in establishing opportunities for students to gain real world experiences. Teachers used prompts to elicit various dialogues such as developing a deeper understanding of the concept of failure and negotiations where student input was valued. Teachers conveyed the importance of acknowledging and learning from failure by communicating to students statements, such as

Don't be afraid to fail, and if you do fail, embrace it and write it down, because failure leads to success. . . . Don’t change your view because you think you might fail as a result of having that viewpoint or belief.

Using such opening prompts as “Hey, what’s the best way you think you can do this, achieve this, or say this?” can lead to student input, which teachers have expressed they value. For example,

When I brought it up to them [negotiating cell phone use in classroom], they said, “Well, we can't be playing games?” so I said, “Okay, so we know games are out. What else?” They said, “Well, we probably shouldn't be on Facebook.” I said, “Okay, so no Facebook.” I said, “So what would you guys want to use these for?”

These examples demonstrated that teachers need to incorporate communication that involves a combination of teacher prompts to encourage students to maintain their perspectives and views. Even though maintaining such viewpoints risk failure, all input is important and valued and success at some point is attainable.

Communication: Teachers encourage communication through the use of prompts.

The third overarching theme was communication when utilizing the collaborative
strategies. Teachers encouraged open lines of communication amongst students by utilizing discussion prompts when using the collaborative strategies as depicted in the code of teacher prompts (08. COM-TEP.01). For entire code book and code sheet descriptors, please see Appendix R.

I ask [students] what was with this word, what does it mean, what does it mean to them, or what's with this picture, what’s the deal with it, why did they draw it, and stuff like that. And they explain from their perspective. And as long as it relates to the lesson or content, that's perfect. (Participant S1, first interview)

Besides the use of general prompts to elicit dialogue and encourage communication, teachers utilized specifically defined prompts, which included questions to stimulate discussions related to problem solving. The specific prompts, teachers communicated during instructional strategies, are depicted in the code of “questioning strategies–problem solving” (07. QUS-PRS.02). For entire code book and code sheet descriptors, please see Appendix R.

There is a particular process to engineering design that seems to be really helpful for teachers to use in coaching or guiding students in discussions . . . asking questions, to defining problems, to come up with constraints and requirements. Asking something as simple as “What’s the problem, describe some constraints, what are the basic requirements?” Having students partner up to determine this and then sharing out. (Participant TU, interview)

Communication: Teachers value student input. This second theme-related component of the overarching theme of communication was demonstrated in the ways teachers emphasize and convey the importance and value of student input when utilizing collaborative strategies. By using a combination of restating student suggestions and encouraging collaboration of ideas, teachers validated the input students provided when they presented ideas during discussions. The value of student input is depicted in the
“value student input” code (08.COM-VSI.03). For entire code book and code sheet descriptors, please see Appendix R.

When I brought it up [negotiating cell phone use in classroom] to them [the students], they said, “Well, we can’t be playing games,” so I said, “Okay, so we know games are out. What else?” They said, “Well, we probably shouldn’t be on Facebook.” I said, “Okay, so no Facebook.” I said, “So what would you guys want to use these for?” They floated through different perspectives. (Participant Z1, second interview)

*Communication: Teachers emphasize the importance of understanding failure.*

This third theme-related component of the overarching theme of communication was demonstrated in the ways teachers conveyed the concept of failure when guiding students while utilizing collaborative strategies. More specifically, in the collected data the teachers described how they communicated how to cope with failure, overcome failure, and to provide encouragement to students to recognize and define failure for themselves. This communication of the concept of failure is represented in the code of understanding failure (01. FAC-HOT.01). For entire code book and code sheet descriptors, please see Appendix R.

If you [students] see another group or another student make a mistake, it’s great that they made that mistake because not only do they have the potential to learn from it, but you can learn from other people’s mistakes as well. Find out what led that group to make that mistake. What prompted them to make the choices they did. Find out what choices they made that led up to that mistake. Were they too positive, too creative, not creative enough, playing devil’s advocate [Six Thinking Hats]. (Participant S1, second interview)

Learning from failure was also described in this following interview.

Everything that doesn't work, every thought that you have that fails, or every perspective shot down, I encourage students to write it down, put it down. Use it. Use it to move forward to maybe flip your perspective the opposite way—if concentrating on lots of facts and not enough creativity got you in that position, make it opposite. Try being more creative and less emphasis on the facts. Just try it. (Participant S1, first interview)
The importance of communicating and understanding the concept of failure was also demonstrated in how teachers reflected, expressed, and communicated what they believed the concept of failure to be and how it influenced their own instructional practices. As teachers reflected and communicated on how they defined and coped with failure in their own practice influenced how they dialogued with students on the concept: “You put it down on paper in a lesson plan and everything looks good, but then, of course, the kids work at their own pace and then everything changes” (Focus Group 1). This reflective practice on how teachers grappled with their perceptions of failure to meet expectations is represented in the code “teacher reflective practice—accepting failed expectations” (06. TRP-AFE.01). For entire code book and code sheet descriptors, please see Appendix R.

**Research Question 2.** Research Question 2 asked, *How and in what ways do teachers use existing collaborative strategies to provide students with opportunities for active participation?* The analysis produced a total of two overarching themes each consisting of two theme-related components as related to this second research question. Table 2 displays each of the themes, theme-related components, and assertions. The analysis of the qualitative data collection tools included documents, artifacts, open-ended questionnaire responses, the workshop, semi-structured interviews, observations, and focus groups.
### Table 2

**Research Question 2: Themes**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Theme-related components</th>
<th>Assertions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Engagement</td>
<td>1. Teachers fostered engagement by providing multiple opportunities for choice.</td>
<td>Opportunities for active participation occurred when teachers provide students with the</td>
</tr>
<tr>
<td></td>
<td>2. Teachers encouraged the use of technology for students to explore solutions and affirm</td>
<td>choice making ability to engage with peers and use technology.</td>
</tr>
<tr>
<td></td>
<td>students’ own conclusions.</td>
<td></td>
</tr>
<tr>
<td>Instructional Supports</td>
<td>1. Teachers created conducive classroom culture/environment prior to and during the use</td>
<td>Opportunities for active participation occurred when teachers cultivated collective</td>
</tr>
<tr>
<td></td>
<td>of collaborative strategies.</td>
<td>classroom cultures that provided students with scaffold supports.</td>
</tr>
<tr>
<td></td>
<td>2. Teachers provided the instructional supports to encourage processing time when using</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the collaborative strategies.</td>
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</tr>
</tbody>
</table>

*Note.* Research Question 2: How and in what ways do teachers utilize existing collaborative strategies to provide students with opportunities for active participation?

**Research Question 2: Assertion 1.** Research Question 2, Assertion 1 states,

Opportunities for active participation occur when teachers provide students with the choice-making ability to engage with peers and use technology.

Teachers indicated that providing students the freedom to make their own choices during instruction and in how the students chose to use collaborative strategies fostered active participation in the classroom. Offering students the opportunity to utilize technology to engage in discussions with peers further developed active participation. Teachers encouraged students to “look things up online” and “work with fellow peers,” including engaging in occasional “side conversations.” These examples demonstrated how active participation was achieved when teachers supported students’ choices in interacting with peers and using technology.
Student engagement: Teachers foster engagement by providing students with 
multiple opportunities for choice. The first overarching theme was the aspect of student 
engagement. Teachers fostered student engagement by providing a vast amount of 
choices in which students could explore the collaborative strategies. Included in these 
choices was the freedom for students to have side conversations during an observed TPS 
collaboration. On a number of occasions, students ended up integrating aspects of the 
side conversations they had into the discussion while using the TPS strategy. (Participant 
A1, Observation 2). Teachers also fostered student engagement by allowing students to 
interact with one another on a variety of levels while utilizing strategies. Such ability to 
make choices was depicted in the code of “Student Engagement–Choices” (08.STE-
CHO.01). For entire code book and code sheet descriptors, please see Appendix R.

Teacher A1 tells students that working independently doesn’t necessarily mean 
solo. Explains how students can make the choice to work independently while 
still engaging in the partner and sharing portions of TPS. Thought process and 
writing are a few ways students can still work independently while working with 
others. (Participant A1, Observation 2)

Student engagement was recorded in an observation with another participant as 
well.

Participant S1 encourages students to work together with peers more than with 
teacher. By working with own peers, students can gain information from through 
a variety of way including talking, listening, and writing during jigsaw. Also by 
interacting with more people, it gives individuals the opportunity to learn how to 
deal with different personalities similar to that of a business meeting setting. 
(Participant S1, Observation 2)

Participants also suggested a number of ways students could possibly create 
choices in how to use the strategies. Some of these choices involved how students might 
decide to interact with fellow classmates. Participants sought to develop an array of 
potential choices students could make in using the strategies based on their particular
needs, strengths, challenges and overall abilities: “Using Todays Meet [free online site for backchanneling discussions] can be great for introverted kids who you try to get to speak all year” (Participant Z1, workshop). Participants continued to endorse ideas that enabled students to explore the strategies to complement their own skills set. An action plan document produced by one participant during the workshop stated one of the goals of using the strategies was “offering alternate formats so students aren’t afraid to ask questions” (document artifact from workshop). Participants’ ideas to support students’ needs in making the most suitable choices while using the strategies was demonstrated in the code “goals for student exploration–general” (03.GOА-GEN.01). For entire code book and code sheet descriptors, please see Appendix R.

**Student engagement:** Teachers encourage the use of technology for students to explore solutions and affirm students’ own conclusions. This second theme-related component of the overarching theme of student engagement was demonstrated in how teachers encouraged students to use technology to explore and affirm their own conclusions. Teachers encouraged students to explore a variety of online sources using a multitude of technological devices ranging from school laptops to cell phones. “They [the students] went so far as to look stuff up online about that work [a particular area of engineering using jigsaw] using a variety of sources such as videos and text” (Participant Z1, second interview). The support teachers provided students in exploring technology while using the collaborative strategies is depicted in the code “Student Engagement–Technology Use” (08. STE-TEU.02). For entire code book and code sheet descriptors, please see Appendix R.
**Research Question 2: Assertion 2.** Research Question 2, Assertion 2 states,

Opportunities for active participation occurs when teachers cultivate collective classroom cultures that provide students with scaffold supports.

Teachers expressed the importance of cultivating a classroom environment, which consisted of a collective culture, so that students felt they were supported in developing active participation. Scaffolds that support reflection and processing time are integral to engaging students in active participation. Teachers created a balance of both think time and active time during all instructional activities. Teachers created a classroom culture that was supportive of students taking the necessary time to process information before making decisions. Comments such as “spend some time thinking” and “this is our classroom” communicates to students that active participation is supported by such approaches.

**Instructional supports: Classroom environment.** The second overarching theme was instructional practice and supports when utilizing the collaborative strategies. The aspect of classroom environment was one theme-related component. Teachers fostered an environment and classroom culture that was conducive for active participation when using the collaborative strategies.

My philosophy is that it’s not my classroom, it is our classroom. It’s just how I am with the kids. It’s our area, our time to work. It’s like setting the stage before anything else can happen. Like an overture. (Participant Z1, second interview)

The code “classroom environment” was used to describe the classroom culture participants set (09. INS-CLE.01). For entire code book and code sheet descriptors, please see Appendix R.
In the open-ended responses from the questionnaire, teachers who had previously utilized the collaborative strategies described the ways they used them, including using the strategies as a filler, placing younger students in reading pairs, and especially emphasizing the application of concepts. Teachers elaborated on the importance of teaching students how to use strategies so they could decide for themselves when and how to use such strategies in addition to helping other peers use strategies to the best of their ability. In the open-ended responses, one participant elaborated on how reading partners of mixed abilities benefited from using think-pair-share (TPS). Students who had more advanced reading skills discovered very specific skills their lower level reading partner could focus on during the TPS activity.

*Instructional supports: Processing time.* The second theme-related component for the overarching theme of instructional practice and supports was in teachers providing ample processing time for students when using the strategies: “I time the groups so they get a balance of think time and work time” (Participant Z1, first interview). Teachers advocated that processing time for students would provide them with sufficient time to develop their thoughts, ideas, perspectives, and provide justification for their decisions.

And maybe sometimes students are just making a slight site adjustment. They have to have time to decide if that is information they need to write down or just go ahead and continue on. You [students] have to figure things out for yourself, however long you think about things and then doing something, how much time you will spend on each of that. (Participant UA, interview)

Such reflective time is depicted in the code “processing time” (10. INS-PRT.02). For entire code book and code sheet descriptors, please see Appendix R.

**Research Question 3.** Research Question 3 asked, *How and in what ways do I transform as an instructional specialist and researcher as result of collaboration with*
teacher leaders? The analysis produced a total of three overarching themes, each consisting of two to three theme-related components as related to this the research question. Table 3 displays each of the themes, theme-related components, and assertions. The analysis of the qualitative data collection tools included a workshop, semi-structured interviews, observations, focus groups, and researcher memos including field notes.

Table 3

Research Question 3: Themes

<table>
<thead>
<tr>
<th>Theme</th>
<th>Theme-related components</th>
<th>Assertions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenges</td>
<td>1. Gained a deeper understanding of factors facing teachers, which contribute to time constraints.</td>
<td>As teachers faced challenges that influenced their decision-making, I was challenged in how I could best support them in meeting their needs.</td>
</tr>
<tr>
<td></td>
<td>2. Developed a deeper understanding of the factors affecting the availability of technology to the teachers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Gained an enhanced understanding of the degree of administrative support available to teachers.</td>
<td></td>
</tr>
<tr>
<td>Sharing</td>
<td>1. Gained an understanding of the factor of sharing both with and between colleagues.</td>
<td>It is essential that I continue to provide teachers with opportunities for organic collaborations and leadership.</td>
</tr>
<tr>
<td></td>
<td>2. Acquired an understanding of the factor of sharing amongst colleagues having a common interest.</td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>1. Cultivated a deeper self-perception awareness</td>
<td>My collaboration with teacher leaders has fostered a deeper awareness of the changes in my self-perception and the confidence of others.</td>
</tr>
<tr>
<td></td>
<td>2. Recognized participants’ strengthened sense of confidence</td>
<td></td>
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</tbody>
</table>

Note. Research Question 3: How and in what ways do I transform as an instructional specialist and researcher as a result of collaboration with teacher leaders?

Research Question 3: Assertion 1. Research Question 3, Assertion 2 states,

As teachers faced challenges that influenced their decision-making, I was challenged in how I could best support them in meeting their needs.
I gained a deeper insight on the numerous challenges facing teachers during this study. Teachers indicated that challenges influenced the decisions they made within their practice. Such challenges ranged from varying degrees of support from their administration, variances in the accessibility to technology and the demands of time. Over the years many educators developed their own personal practical theories. I was continually challenged when participants inquired as to when to use such theories at the most acceptable points in time. Discussions with teacher participants on how they could embed their own personal practical theories within existing educational theories prompted me to re-evaluate my perspectives on theory itself. In striving to seek solutions to such challenges, teachers needed ongoing support from instructional specialists such as myself, in developing solutions to their challenges. Comments such as “lacking the technology” and “I had to explain to my administration” demonstrated the challenges facing teachers. Additional comments such as, “It makes sense for students to use their cell phones” and “Can I just provide my admin with examples of what’s happening in my classroom to show that this is working” demonstrated how these challenges influenced the decisions teachers make in attempt to solve their own issues. In addressing the challenges teachers faced, I discovered the way I collaborated with them went through a metamorphosis. I was no longer portraying myself as the expert who led teachers towards proposed solutions, rather I am engaging with these teacher leaders to support them in determining their own resolutions.

**Challenges:** Gaining a deeper understanding of factors facing teachers, which contribute to time constraints. The first overarching theme was the aspect of challenges faced during the study. The first theme-related component was time constraints. “I think
the biggest challenge that I faced is time–time” (Focus Group 1). I recognized and acknowledged as both an instructional specialist and researcher that teachers face numerous time constraints, which impede them from implementing new ideas or delving further into such ideas. Other instructional specialists who participated in the study also recognized the issue of time constraints: “I think the overwhelming amount of accountability tasks [back-to-back classes, testing] that teachers are required to do day to day” (Participant TU, interview). I realized that no matter how much teachers possess a desire to implement new strategies, the amount of time they have remaining after meeting the overwhelming expectations is scarce. “How can I find a way for these teachers to share what they know and understand with others at their schools while under such time constraints?” (Researcher memos). Such challenges described as time constrains are depicted in the “time constraints” code (05. CHL-TIC.01). For entire code book and code sheet descriptors, please see Appendix R.

Furthermore, within the area of the challenges of time constraints, I became more conscious of the belief that teachers expressed the feeling of being burdened and held responsible for delivering such tasks. These particular obstacles were imposed on teachers by local school administration and district-wide initiatives. Teachers believed they had very little control in changing such supposedly non-negotiable aspects, which detracted from time spent in the area of instruction.

We are required to do so much outside the realm of teaching, like all these committees, like the safety committee and having club meetings during lunch sometimes because there is something after school we have to attend. Things fall on our shoulders, if things go wrong, lots of times administration looks at us [teachers]. (Focus Group 2)
Because teachers felt they had very little control in changing such non-negotiable aspects, as a team we discussed how they could educate their administrators on what they were accomplishing. These particular challenges are depicted in the code of “obstacles–accountability” code (01.OBS-ACC-01). For entire code book and code sheet descriptors, please see Appendix R.

I found myself no longer offering suggestions as the instructional specialist leader. Rather proposed resolutions were beginning to evolve as participants and myself worked together as a seamless team. One proposed solution that evolved from our discussion was the following:

Maybe you can somewhat renegotiate in creating teams to meet the duties for committee? Maybe team up with the teacher you created a partnership with during this study? That way it can strengthen that bond even more. (Donna, during Focus Group 1)

Challenges: Developing a deeper understanding of the factors affecting availability of technology to teachers. This second theme-related component of the overarching theme of challenges was demonstrated in the ways teachers expressed overcoming obstacles through the availability and support using technology. Some technology issues can be considered to be major roadblocks. As one participant stated, “Our district doesn’t allow WiFi access” (Focus Group 1). As an instructional specialist, I discovered my challenge within this area was to work with teachers in developing approaches that would use the existing technology and also to redesign the strategies making them less dependent on technology. As a researcher, my goal was to collaborate with teachers so they felt empowered to advocate for changes impacting the current status of technology. The challenges teachers faced in accessing and using technology were rooted in several areas including, but not limited to, infrastructure, outdated technology,
limited amount of technology, and district restrictions. The following quotes reflect problems and solutions using technology:

Even though I have an iPad, I have one of the older better generation iPads. So instead of testing [the technology for student self-assessment] with my iPad and scanning with my iPad, I learned from the science teacher that it is easier to do from my phone. My phone works better than my iPad because I have an older generation iPad compared to a lot of teachers that are here. For some reason I have an older one. So I use my phone. (Participant S1, second interview)

One possible recommendation was the following:

If we come up with some ways you can do the same thing but without the technology, that would be great, although it sort of defeats things, if you know what I mean. By coming up with alternate ways to avoid the technology battle, it allows everyone off the hook. Although if it is structured the right way, it can come across with the message of “Hey, this is very effective as is.” Imagine if we could do x, y and z with [emphasized] technology. What do you think? (Donna during S1’s second interview)

The challenges teachers encountered using technology is depicted using the code of “availability of technology” (05. CHL-AVT.02). For entire code book and code sheet descriptors, please see Appendix R.

Challenges: Gaining an enhanced understanding of the degree of administrative support available to teachers. The third theme-related component of the overarching theme of challenges was demonstrated as to how teachers were overcoming obstacles related to support and gaining the understanding of their administration. As administrators set the tone for schools, teachers followed suit within that culture. This trickle-down effect was observed in one such participant’s comment, “The high school teachers here don’t give a rat’s ass about what junior high schools are doing” (Focus Group 1). The support teachers received from administration can be quite varied, due to a number of factors. Some of the suggestions that evolved were directly related to the relationships participants created with other colleagues during the study. In recognizing
the formation of relationships, it was suggested that teachers utilize the power of those associations as leverage towards potential solutions.

Electives, tend to feel and are treated like they have throw-away weeks, you know, every quarter, you know, as we get ready for testing. That’s the time when it is fine and acceptable for core teachers to borrow students in my class and I can’t get students too worked up and excited about things because they [students] need to keep their focus on the tests. (Participant A1, second interview)

Another participant described how it was difficult for administration to understand the rationale for particular instructional choices.

When I had my observation . . . that's when [assistant principal] said, “Oh, with your class you do this?” and he said about making this suggestion of putting kids in roles, which they really don’t fit just because that is something that supposedly works. He said like you know one of the researched things they talk about in PD and I said, “Oh, of course, I do.” It's a bunch of BS. No, I'm not going to punish my kids; it’s not a realistic way to divide up roles because it is contrived somehow. You get a kid shutting down because he don't like working with these people in some prescribed group and sterile type of grouping.” (Focus Group 1)

One proposed solution discussed during the focus group included their use of the relationships established during the course of the study.

Maybe instead, try talking to your admin to explain all that you do, look at establishing a group of student representatives to explain and advocate. (Focus Group 1)

This particular challenge is depicted in the code “degree of administrative support” (05. CHL-DAS.03). For entire code book and code sheet descriptors, please see Appendices Q and R.

**Research Question 3: Assertion 2.** Research Question 3, Assertion 2 states,

It is essential that I continue to provide teachers with the opportunities for organic collaboration and leadership.
Teachers placed importance on the need to share their knowledge, resources, experiences, and common interests with other like-minded teachers. Teachers expressed the need for various platforms, which would enable them to share resources, such as instructional materials, but also the common interests they shared in the educational realm. It became evident to me during the course of the study that it was important for teachers to receive support in continually creating opportunities to share with other like-minded individuals as well as the general public. As an instructional specialist, one of my goals was to provide as many platforms for sharing as possible. Creating an environment for such sharing was evident in numerous comments teachers expressed, “We should start a group email” and “Let’s join the Barnes and Noble event,” that demonstrated the teachers’ need to form informal spaces to collaborate, share, and support one another. My role now was to work with teachers in discovering new opportunities for interaction and encouraging them to use those platforms, however, that best served their needs.

*Sharing: Gained an understanding of the factor of sharing both with and between colleagues.* The second overarching theme from these qualitative data sources was with the first theme-related component of sharing amongst colleagues. This type of sharing took place between the participants and myself. At the onset of the study, participants began the sharing process as it was noted during the workshop I provided. “Yeah, let’s talk more” and “you and I, we can help each other out” were statements made. It was evident that participants continued to share on their own without my intervention. Although when it was brought to my attention that such sharing was taking place, I encouraged the organically developed relationships to continue. Statements, such as, “I got this lesson from A1” (Participant S1, Observation 2) received supportive and
encouraging responses from me, such as “What else could you share? I am sure you could share more? When do you guys plan to talk more?” (Donna, during S1’s second interview). Participants thrived on the opportunity to share ideas and resources with one another including myself. This type of sharing of ideas extended to other teachers within their own schools. The following two quotes typify teachers wanting to share ideas and resources:

She’s [science teacher at my school] been doing STEM for awhile, lots of aviation, trajectory, stuff like that. I started talking to her about all this because A1 and I talked about all this aviation stuff. (Focus Group 1)

Maybe the two of you can team up to share out more of this with others at your school or with the other science teachers in the district. (Donna, during Focus Group 1)

Such sharing amongst colleagues is depicted in the code “sharing with colleagues” (02. SHA-COL.01). For entire code book and code sheet descriptors, please see Appendix R.

Sharing: Acquiring an understanding of the factor of sharing amongst colleagues having a common interest. This second theme-related component of the overarching theme of sharing demonstrated how myself as the researcher and participants shared various experiences. These experiences extend further than sharing of resources and instructional ideas. Teachers shared the mutual interests that were common amongst them being professional in the field. This type of sharing demonstrated a very clear shift in my role working with these teachers. The participants were now enacting changes put forth as a group rather than initiated by me.

My involvement in the Barnes and Noble event festival was in leading a discussion like a TED Talks about the role of STEM in our American educational system. My one participant was involved in the discussion offering quite a bit of viewpoints being a classroom STEM teacher. Mine was from the lens of instructional coach and campus-based administrator and his perspective was from being a teacher. Some of the audience members included were former engineers,
former community college instructors, and teachers from the Vail School District. (Researcher memos)

Another participant described the benefits of social media tools for sharing and collaborating.

The Facebook page is a place where they could share, and kind of share some pictures of what they were doing, or share some stories or even anything else kind of related to engineering or science, whatever they are doing, which will benefit education. Any types of programs. It [Facebook] provides the social network platform, easy to access to communicate and share. (Participant UA, interview)

I continued to explore platforms where teachers could interact, collaborate and share on a regular basis.

Since they [teachers] were initially interested in some sort of Google circle email group, maybe something of that nature should still be pursued, like Edmodo, some type of platform where they can just click and share ideas or thoughts really quickly. Nothing like in it being something that is one more thing to do. It can’t be a burden. It has to be really organic to them. Some sort of ongoing sharing platform. (Researcher memos)

The sharing of such mutual commonalities is depicted in the code “common interests” (02. SHA-COI.02). For entire code book and code sheet descriptors, please see Appendices Q and R.

**Research Question 3: Assertion 3.** Research Question 3, Assertion 3 states,

Collaboration with teacher leaders fostered deeper awareness of the changes in self-perception and confidence.

The teacher leaders and myself experienced a number of changes in both self-perception and confidence as a result of collaborating. Both participants and myself noted acknowledgement and deeper awareness of such changes, which took place during the course of the study. Several opportunities, which arose unexpectedly, produced beneficial outcomes, altered positionality, self-perception, and confidence levels. Both participants
and myself experienced a myriad of changes in our identity as teacher and instructional leaders. Comments, such as “This event really had an impact” and “They consider me to be the expert” illuminated how individuals perceived themselves during the course of the study.

Changes: Cultivating deeper self-perception awareness. The third overarching theme was the theme-related component of the changes that took place about my self-perception as an instructional specialist and researcher. The constant evolution of my self-perception shifted and transitioned throughout the course of the study.

They [participants] sort of consider me the expert and/or leader with the idea that “you know best” and it has been like this in previous cycles. I think what may contribute to this is that I am in the role of an instructional coach. Much of this has affected the member-checking process so this time I had to be really explicit in my directions for it and still it was like, “It's fine and okay, you know best.” But really, they are the ones who know a great deal and who need to be sharing all this out. They are much more experts than they realize. (Researcher memos)

I recognized why a shift in my positionality took place during my study.

As a practitioner for the most part I was an outsider/within but towards the end of the study I believe I moved closer to being an insider. I think the pivot shift was the Barnes and Noble collaboration especially since it basically was the brainchild and suggestion of one of my participants. (Researcher memos)

The transition of my self-perception is represented in the code “self-perception” (04.CHA-SEP.02). For entire code book and code sheet descriptors, please see Appendix R.

I also recognized how my views of instructional strategies had changed during the course of my study.

Instructional strategies is not a term I would choose to use any longer. Not the way I have seen these people use these. I totally believe these are now what should be referred to as learning strategies. The reason is because they [teachers] have put them [strategies] in the hands of the students, where they really should be. It’s a new term with a whole new meaning. Learning strategies . . . (Researcher memos)
Additionally much frustration surfaced during the course of my study. These frustrations were mainly with regards to logistics and geographic constraints, which I faced during the study.

Failed attempts at getting everyone on board for the focus group session. Had to reschedule. Everyone is on such different places, literally, geographically. I feel like there is no central hub for anything here. We are all just on our own islands and still very separate from one another. No central portion of the web, if that makes sense. (Researcher memos/field notes)

The frustration, which resulted from extenuating circumstances during the course of the study, is expressed using the code “circumstances” (03. FRU-CIR.01 ). For entire code book and code sheet descriptors, please see Appendix R.

*Changes: Recognizing participants’ strengthened sense of confidence.* This second theme-related component of the overarching theme of changes noted how participants’ levels of confidence changed during the course of the study. “I think the big thing for me was just seeing like, all right, it worked with this dynamic of students. That’s great! Why did it end up working so well?” (Focus Group 1). Participants’ level of confidence changed as they interacted with members of the public, colleagues, and myself. At the unplanned Barnes and Noble event, which took place on November 7, participants felt confident in showcasing the program because it truly has had an impact on what is happening in the world. Students are influencing the shape of the world way beyond just doing regular school work. (Researcher memos). Such changes in confidence is denoted in the code “participants confidence” (04. CHA-PAC.01). For entire code book and code sheet descriptors, please see Appendices Q and R.
Discussion

In my context, the problem of practice evolved from the need to improve pedagogy skills of teachers so that students could achieve a real world understanding of both conceptual and procedural skills in the STEM-based classroom using the UA Middle School Engineering 101 program as a foundation. The quantitative data source of the instructional practices questionnaire and several qualitative data sources were used to gather data to provide answers to the three research questions posed in this study:

Research Question 1, How and in what ways do teacher utilize existing collaborative strategies to provide students with real world experiences?

Researcher Question 2, How and in what ways do teachers utilize existing collaborative strategies to provide students with opportunities for active participation?

Researcher Question 3, How and in what ways do I transform as an instructional specialist and researcher as result of collaborating with teacher leaders?

The purpose of this study was to examine the ways teachers utilized existing collaborative strategies in the classroom to create authentic learning modules, which provided students greater opportunities to obtain real world experiences. In the next section, assertions are recapitulated by research question through the triangulation of the complementarity of quantitative and qualitative data. Following this section theoretical implications are addressed by discussing the outcomes of this study in relation to the theoretical frameworks and the additional scholarship selected to support this study. In addition, practical implications and lessons learned, strengths and limitations, future directions, and final conclusions are presented.
Complementarity of Quantitative and Qualitative Data

Although this study mainly consisted of qualitative data, the quantitative data from the instructional practices questionnaire provided the impetus for the structure of the workshop. Overall, mixed methods were used for the purpose of development. The sequential order of methods provided valuable information for each following method (Greene, 2008). The information gleaned from the questionnaire at the onset of the study provided essential insight on the subsequent measures that took place throughout the duration of the study, especially the instructional practices workshop that preceded the questionnaire.

Particularly in action research, it is an intentional choice to select methods to measure different facets of the same complex issue (Greene, 2008). In the case of observations during this study, I sought to examine what strategies were being used and the interactions taking place between the teacher and the student or between a student and his or her peers. Within the interviews I sought to understand to what degree teachers identified the strategies as being successful and improved, based on the events during the observed instruction. Taken into account with other methods, a complementarity of two or more datasets provided not only a completed account, but also one with more details of the overall outcomes and if the innovation created a fundamental change.

Research Question 1. Research Question 1 asked, How and in what ways do teachers utilize existing collaborative strategies to provide students with real world experiences? Results from the initial instructional practices questionnaire indicated that participants possessed very little familiarity of the five collaborative strategies and even less experience in utilizing the strategies. During the two-hour instructional workshop, as
documented from analysis of the videotape, participants spent a total of 29 minutes exploring and discussing the Six Thinking Hats (workshop video analysis). This strategy was used by all participants in the study because “it produced the best opportunities for class discussion, debate, and was overall the most flexible and adaptable” strategy (Focus Group 1). I also witnessed the strategy in use during one particular classroom observation. During this observation, students drew upon information obtained from outside news sources that they applied in their six hats roles. Participants believed that framing issues using the perspectives of the Six Thinking Hats mirrored the discussions common in real world problems. Using this particular strategy also resulted in students convincing an administration to modify the cell phone policy at their school.

Although it may not necessarily be considered disconfirming data, there was conflicting evidence pertaining to the theme-related component of how teachers emphasized the importance of understanding failure. Participants’ emphasis on students’ grasping an understanding of failure was only brought up in the semi-structured interviews. Although the concept of understanding failure, as related to the use of the collaborative strategies, was discussed in great detail and length, the topic was not found through in other segments of the data collection instruments, except for during one observation. During one particular interview, when I asked probing questions about how greater insight was obtained in learning and how students viewed failure through the use of the collaborative strategies, the response was “that is a good question and that it never occurred to me to ask them [students]” (A1, Interview 1). During one focus group session, teachers discussed how they continued to grapple with how they personally coped with the concept of failure and as one teacher said, “You put it down on paper in a
lesson plan . . . and then everything changes” (Focus Group 1). Because teachers continued to process how they reflected on their own failures, some of the influencing factors about how students were applying the concept of failure to real world learning could have evolved from teachers’ own personal views of failure.

Overall, the corroboration of data exemplifies the assertion addressing the first research question wherein teachers first had to establish a classroom culture that fostered student independence in order to further develop real world experiences. The classroom environment of the participants in this study was one where teachers worked to facilitate learning experiences with students. Through mindful guidance and clear communication, teachers were able to achieve an unrestricted atmosphere encouraging students to take initiative in their learning.

**Research Question 2.** Research Question 2 asked, *How and in what ways do teachers utilize existing collaborative strategies to provide students with opportunities for active participation?* The second research question addressed how teachers provided students with opportunities for active participation. Results from the instructional practices questionnaire revealed that participants possessed limited knowledge and experience with the five strategies explored in the workshop. Participants who had prior experience in using the collaborative strategies used them to elicit active participation. This likely enhanced the application of knowledge with their reading partners (document artifact from workshop). However, in their efforts to provide students with opportunities for active participation, the teachers explored all but one of the strategies during the duration of the study. The only strategy participants did not explore was The Nine Windows mainly because “it could potentially be too complicated and require too much
time to teach with all the already existing time constraint challenges” (Focus Group 1). The fervent attempts teacher participants made in exploring the strategies resulted in a much broader scope of inclusion for students who struggled academically, emotionally and socially. Teachers “offering alternate formats so students aren’t afraid to ask questions” [document artifact from workshop] supported students in making their own choices in using the strategies to address their individual needs. The data produced for Research Question 2 supports the assertion that opportunities for active participation were established when the teachers cultivated collective classroom cultures containing appropriate instructional support where students could engage with their peers in making choices that included the use of technology.

Research Question 3. Research Question 3 asked, How and in what ways do I transform as an instructional specialist and researcher as a result of collaborating with teacher leaders? In examining the quantitative data, it was clear that each participant was entering the study with diversely different backgrounds in pedagogy. Upon learning this information, I questioned how I could become more effective in working with these teacher leaders. Specifically, data gleaned from the quantitative instructional practices questionnaire indicated a dynamic range in participants’ foundational knowledge of the five collaborative strategies. When comparing, one participant had 75% familiarity with the strategies, another participant had no familiarity. In the past, as an instructional specialist my approach would have been to provide further training on the collaborative strategies in which my participants needed help. Implementing further training to remedy areas of weaknesses is a typical strategy in most educational settings. My interaction with
these teacher leaders as an action researcher, however, was to instead encourage their usage of these strategies so that they could evolve more organically.

To start with, I used the results from the quantitative data to develop the structure of the instructional practices workshop. I created a flexible plan to accommodate the interests and directions the participants wanted to take. The overall goal of the workshop was two-fold. The first goal was to provide ample time for participants to gain knowledge and explore the strategies. The second goal was for the participants to collaborate in leading the workshop in the direction where they would gain the greatest amount of benefit. Even though the goals were to include and introduce strategies that were not so familiar, I needed to be cognizant in my approach in doing so. I needed to maintain my role as a facilitator to a greater degree than that as an expert leader working solely as an instructional specialist. Based upon the results of the questionnaire, I designed the workshop to consist of handouts describing each strategy and examples of how each could be used. I embedded higher order thinking skills using questioning prompts that were supported by previous studies. Additionally, I included reference materials (books) that provided examples of some of the least familiar strategies and experiences. After the workshop a natural evolution was evident in the qualitative data whereby each participant continued to progress at their own pace and apply the collaborative strategies to their specific contexts. One such example was demonstrated in how participants interacted with their administrators in communicating the impact of using the strategies in their instruction. This ranged from successful negotiations in modifying school cell phone policy to “my assistant principal doesn’t get it” (Focus Group 1).
During the course of the study, I examined the evolution of how I worked with the teacher leaders along an action research continuum (Herr & Anderson, 2015). In the past, as an instructional specialist, my work would have fallen somewhere in the range of compliance or more so as consultation (Herr & Anderson, 2015). Typically, I would have set the agenda on how teachers should strengthen their areas of weaknesses in using the collaborative strategies. Rather, as a result of my study, I now encourage my participants to make their own choices.

Shortly after the onset of the study, I moved along the continuum entering the mode of participation into the realm of cooperation. For example, during the workshop, my participants and I worked together as a team in deciding how they wanted to approach using the collaborative strategies. During this time, my practice had moved from a relationship considered for local people to one that was with the local people (Herr & Anderson, 2015).

When the opportunity of the Barnes and Noble event arose where one particular participant took the lead, the occasion created an even greater shift for me as I moved into the mode considered as co-learning (Herr & Anderson, 2015). As an instructional specialist operating within the mode of co-learning, my participants and I worked together to create new understanding (Herr & Anderson, 2015). Although I continued to engage with my participants as an outside facilitator, they were now initiating action. As an instructional specialist I supported teachers during this time by encouraging them to take initiative in programs and events (Barnes and Noble Makerspace Event) where they could demonstrate their leadership skills. I quickly realized how the contribution in environments outside of their isolated workplaces inspired and further motivated
teachers. In the literature it is commonly proposed that teachers in the U.S. are faced with working in isolation and have a lack of accessibility to quality collaborative professional development with fellow colleagues (Darling-Hammond, 2010). Opportunities such as the Barnes and Noble event provided participants with the chance to lead, share, and connect with others outside of their classrooms. The data produced for the third research question supported the assertion that teachers are faced with numerous challenges and obstacles. Given these obstacles, I as an instructional specialist need to continue to develop new avenues for teacher leaders to support how they can share their knowledge, resources, and experiences with individuals from both inside and outside educational institutions.

Complementary qualitative and quantitative data provided a well-defined representation of the unique paths teachers took in using the collaborative strategies to offer students opportunities to engage in real world experiences as active participants. This data also provided me a greater understanding of how I evolved into an effective action research instructional specialist. I continue to foster growth in both my participants and myself to reach the collective action stage on the continuum where participants will be able to set their own goals and objectives with or without my facilitation (Herr & Anderson, 2015).

**Theoretical Implications**

The three theoretical frameworks guiding this study were experiential learning (ELT), communities of practice (CoP), and action research. There are a number of facets shared amongst these three theories, including the importance placed on context, levels of membership participants share within a practice, new knowledge created by the learner,
and actionable outcomes (Herr & Anderson, 2015; Kolb, 2008; Wenger, 1999). Even though the key features of these theories were demonstrated, particular aspects were especially illuminated.

The theory of ELT is recognized for placing emphasis on learning styles, fostering relationships in the context of relating to the environment and learners creating new understandings that are extracted from their own experiences (Kolb, 2008). One particular tenet of ELT highlighted in this study was the relationships learners had with their environment and the creation of new knowledge. The creation of new knowledge had been fostered in the learning space. Consistent with ELT, participants created a classroom environment that promoted shared decision-making, trust, and collaboration. I observed these qualities when teachers and students used first person plural language during class, such as “we” and “us,” as well as viewing the classroom as a “community.” The use of plural language demonstrated how the teachers and students shaped their shared environment together. When teachers worked with students to solve the real world local problem of the lack of technology within the school, they collectively established fundamental changes within the learning space and in relation to their environment. As a result, the school’s cell phone policy was modified and the classroom became a model for others on the campus. Other teachers wanted to learn how to establish a similar type of environment. This level of relevancy, which has a direct influence on learners in claiming ownership, is central to ELT’s view that individuals must go beyond the rudimentary hands-on activities (Kolb, 2008).

Guiding principles within communities of practice (CoP), such as engagement of participants, developing new interpretations and participation through different levels of
membership provide for a deeper understanding of how individuals work collaboratively (Wenger, 1999). As with ELT, many salient concepts of CoP were identified in this study and some quite powerfully illustrated, such as various levels of membership and brokering. The role of a broker is a person with an influential position in a community of practice that communicates and negotiates with members who are inside and outside of the practice (Wenger, 1999). Various levels of membership and brokering were illustrated in four distinct ways. First, participant teachers and students collaborated as a community of practice by aiming to solve real issues. Second, a community of practice formed amongst participants as they began sharing and communicating with each other. Third, participants developed communities of practice through collaboration with other colleagues on their respective campuses. Finally, the role of a broker became a newfound identity for several participants. As indicated in the literature review, Wenger (1999) described brokering as the key component in forming relationships with others who are outside of the community of practice. The first example of participants acting as brokers occurred when one teacher negotiated the re-evaluation of the cell phone policy, speaking as a representative for the students in class. The second instance was when another participant communicated with the public at the Barnes and Noble event. Ultimately, coming together as in this particular CoP, the participants themselves were brokers. Lastly, because participants came from their own distinct districts and created a new CoP, I served within the capacity of a broker by the bringing all participants together.

Action research, as discussed in the literature review, is noted for bringing forth change in one’s local context (Herr & Anderson, 2015). Action research draws upon the involvement of participants to be an agent for the change process. The actionable
outcomes create sustainable transformations within one’s organization. Because the participants in this study did not teach in the same school district, numerous and diverse contextual experiences arose. As a result, each participant encountered unique needs, obstacles, and interpretations. Such differences posed various challenges ranging from “our district doesn’t allow WiFi” to “we have the technology but mine is outdated.” As an action research study, it was irrelevant that the participants were from different districts. Most importantly was the fact that participants had direct influence on their own situations and the impact of action research created fundamental changes (Riel, 2010). Such fundamental change was evident during this study as one school completely modified their cell phone policy as a result of a well-developed community of practice, which involved the teacher as the broker.

The collaborative strategies used in this study and emphasis on technology were supported by scholarship in the literature review. Specifically, the studies by Huang, Liao, Huang and Chen (2014) and Eilks (2005) both used the collaborative strategy of jigsaw in unique ways. Huang and colleagues’ (2014) study focused on students sharing their jigsaw expertise through the technology of Google+ while out in the field; whereas, the Eilks’ action research study (2005) concentrated on working collaboratively with teachers on how to assess student progress and achievement during such uses. In my study, jigsaw was also utilized in a unique fashion, yet differently than in previous studies. Instead, one teacher participant in my study guided students in identifying the information that was lacking while in their expert groups: “When we did jigsaw, only one article talked about it [cost related to solar], the other two didn’t. I asked them [students]
how they made such connections. It’s like economics meets science” (Participant Z1, first interview).

Theories and scholarship provide a lens that guide researchers and participants in how a study will evolve. Overall, the outcomes from this study reflected the essential components of the theories and scholarship selected. Participants created fundamental changes within their own local contexts, developed as a community of practice, and created relevant learning experiences for their students.

**Practical Implications/Lessons Learned**

As a practitioner and researcher in the field of education, it is important that one understands and values action research principles on both conceptual and practical levels. Through the development of authentic learning modules, which were based upon using collaborative strategies, I learned that most teachers desire their STEM-based classrooms to operate much like an action research study. STEM-based learning mirrors the iterative process found within action research, especially because there is such importance placed upon using the engineering design process. It was evident from this study that teachers now place a greater amount of importance on taking as much time as necessary to allow students to process information, revisit, revise, re-evaluate, solve problems collaboratively and to take ownership of local issues within their schools. Both the teaching and learning within the classroom is a continuously negotiated process, which many times leads us in unplanned directions including uncharted territories.

**Defining the role of instructional specialist.** The role of an instructional specialist can be a rather unique and complex position. I have developed a deeper understanding of the scope of my role as an instructional specialist as a result of
this study. There are two important lessons I learned, which have redefined my viewpoint and philosophy of my role. First, I learned that the true role of an instructional specialist is to help teacher leaders reach their fullest potential. The role of an instructional specialist is not about imparting knowledge to teachers, rather it is about drawing upon their strengths and capabilities. Refining the talents and skills of teachers while providing them with the opportunities to share with others is an essential trait an instructional specialist must possess. In retrospect, I realized I had missed an opportunity to have a participant who entered the study with knowledge and experiences that she could have shared with the others. Second, I have learned teacher leaders need further opportunities to share their knowledge and experiences with administrators. Far too often administrators and other professional development leaders provide the learning experiences for teachers. Instead instructional coaches should be preparing teacher leaders to provide such learning experiences for administrators.

Evolution of an action research practitioner. During the course of these three years, the professional experiences I experienced have shaped me as an action research practitioner. When I was first accepted into this program, I was serving in my first administrative position. Now, as I conclude the dissertation cycle of this study, I am in my third workplace. The outside partnerships I formed through my professional network have been the thread within my action research study. Both my study and I have evolved and sometimes faced radical challenges due to job changes. Even though such changes altered my study, continuous involvement in my professional network proved to foster growth and expansion within my context. Many times we do not realize how extensive and powerful our network is until we are faced with obstacles. Originally, my
study was situated within one district. Due to changes, which I originally believed to be negative, my study evolved to include teachers and curriculum specialists representing four K to 12 districts and one higher education institution. Expecting the unexpected, capitalizing on obstacles, and accepting the ebb and flow of ambiguity, has made me a prolific and insightful action research practitioner.

**Strengths and Limitations**

**Strengths.** As an instructional specialist I was not in an evaluation role with my participants. Not being in a hierarchical role allowed my participants to demonstrate honest and candid responses because there was no concern for judgment. They simply aimed to achieve their best in this study because they were genuinely interested in this area of learning and education. Their eagerness to extend their knowledge and take risks had been widely known by many individuals within the UA MS Engineering 101 program. One curriculum director described teachers in the UA MS Engineering 101 program to be “very independent and very confident . . . they have just taken it (the UA program) and run” (TU, non-interview).

Ideally action research studies consist of all five criteria for validity, but in many cases, quality action research studies can still achieve acceptance with three of the five (Herr & Anderson, 2015). There are also degrees to which validity is demonstrated in any given study. This section discusses to what degree the types of validity are demonstrated as a strength or limitation. All action research studies possess both strengths and limitations. The positionality of the researcher within action research studies also affects aspects of validity (Herr & Anderson, 2015). It is also common for a researchers’
positionality to change during a study or be multi-faceted. How a researcher declares their positionality can either serve as a strength or limitation.

This study consisted of four strengths and one limitation in terms of validity. Overall, the four strengths of this study included dialogic, outcome, process, and catalytic validity. Since my positionality changed vastly during the course of the study, within each strength and limitation, my positionality is discussed.

First, dialogic validity was demonstrated within two distinct intersections during this study. The first intersection was during the second interview, which provided the opportunity to engage in dialogue about the data analysis of the previous interviews and enhanced the dialogic validity through member checking. The benefit to conducting interviews is that they are not neutral and meanings are socially constructed and negotiated among the parties involved, notably the researcher and participants (Herr & Anderson, 2015). The second intersection, was at the end of the study whereby I brought all participants together in a final member checking session, which included a dialogue of the overall data analysis representation (Carlson, 2010).

Second, outcome validity was established through teachers using particular strategies within authentic learning modules to achieve the goal of having students obtaining real world experiences as active participants. At the end of this study, there was generation of new knowledge, which demonstrated that the authentic learning modules functioned differently based on how teachers chose to use them. Different than just solving problems, outcome validity relies on the fact that the researcher and participants are continuously seeking ways to reframe the problem (Herr & Anderson, 2015).
Third, catalytic validity was demonstrated within the unexpected Barnes and Noble collaboration. This public forum platform provided an opportunity for both participants and myself, to re-examine the ongoing issues and potential solutions. Catalytic validity involves a reorientation of the issues as the researcher and participants continue to progress in their understanding of themselves and the issues (Herr & Anderson, 2015). Since my positionality was that mostly of an outsider for most of the study, it was essential that I documented how I had fit within the organizational structure and my ongoing interactions with participants during the course of the study. Journaling within my researcher memos was the approach taken to maximize the threat to catalytic validity by documenting and monitoring the changes in the dynamics of the setting (Herr & Anderson, 2015). The Barnes and Noble event was a pivotal point within the study where my positionality had shifted from an outsider to an outsider/within. Leading up to and during the event, participants and myself collaborated and led as partners in roles equal to one another.

Fourth, process validity was demonstrated in the recursive nature of this study and the use of multiple data points for triangulation, which provided participants the opportunity for ongoing learning (Herr & Anderson, 2015). Process validity was demonstrated in three distinct intersections of this study. The first intersection was achieved during the semi-structured interviews, where I sought the convergence of the results with the data drawn from the observations. Because I began the study as an outsider, I selected a very complementary positionality during the observations. There are several roles or positionality a researcher can take during observations ranging from a complete observer to a complete participant.
My positionality within the observation was that of an observer as participant (Kawulich, 2005). There were three reasons for my rationale in selecting such positionality. First, I was able to gain a greater understanding of the activity through engagement in it to some degree. Second, insiders are typically more willing to share attitudes and beliefs with involved strangers because the involvement possesses low risk for vulnerability (Baker, 2006). This counteracted the typical limitation where functioning as an outsider results in only brief and limited encounters rather than providing a greater degree of breadth and depth of the entire situation (2006). Third, choosing the role of an observer as participant enabled me to augment my synthesis of theories and action research as a methodological choice for this study. Observing as a participant emphasizes the key aspects of collaboration within action research, the relationship to one’s environment inherent in experiential learning theory, and lastly peripheral membership with communities of practice.

Further, the second intersection of process validity was achieved during the focus groups, where I sought a convergence of information gleaned from the interviews. The final convergence of data took place at the end of the study when all data points were triangulated. This data analysis process provided me the ability to develop a recursive interaction with the data whereby I was able to compare data sets on a continuous basis thus strengthening the process validity of the study through data triangulation (Creswell, 2013). By using the consistent approach of open and axial coding, I was able to compare the results from each data collection tool.

**Limitations.** As a result of the small and rather homogeneous sample, the main limitation of the study was in the area of democratic validity. Using a small self-select
sample creates a limitation within democratic validity. Researchers achieve democratic validity when they include input from multiple stakeholders who share interest in the issue (Herr & Anderson, 2015). The participants were all passionate about their profession, growth, and willingness to experiment with innovation approaches. Described as “confident and independent who are already comfortable with engineering concepts” by one of the curriculum specialist in an interview during the study, these participants were already on a track to achieve success simply by their fortuitous attitudes. Because my study utilized only three classroom teachers and two instructional coaches/curricular specialists, who were already ardent supporters of the attainment of real world experiences, this produced only one particular perspective. Multiple perspectives might have resulted from acquiring a larger participant group or from a more diverse participant group, which could have included other stakeholders such as the students or the administrators. Adding to this limitation was my positionality of an outsider for the majority of the study. Positionality relates not only to how one connects to the individuals within a given study but also within the organization itself (Herr & Anderson, 2015). As an outsider to all the school districts involved, I felt I had limited access to interact with other stakeholder to build strength within the area of democratic validity.

In action research, one must be flexible with the research design if the study is truly a co-learning or collective action of the individuals within the study (Herr & Anderson, 2015). Since action research is recursive, one must continually re-evaluate and be willing to make modifications in the research design to achieve the greatest degree of creation of new knowledge from the participants themselves. In retrospect, I may have missed opportunities to further advance the new knowledge created by the participants.
Because I had a small sample of participants, whose familiarity with the different strategies varied greatly, offering subsequent workshops during the duration of the study would have provided participants the opportunity for greater direct involvement. Such workshops could have been organized and led by the participants themselves. Also, by inviting the curriculum directors to be part of these workshops, they would have had the opportunity to gather teacher-led information to bring back to the other teachers within their districts. The deficit in establishing more cohesive methods described above decreased the dialogic validity (Herr & Anderson, 2015).

There were additional limitations in my research design especially in relation to addressing the second research question. Although I was able to garner an adequate amount of information to sufficiently answer the research question, modifying the instruments used and selecting an additional data collection instrument would have emphasized and created greater depth to the results. The classroom observations I conducted within my data collection were fruitful for viewing the active participation displayed while teachers utilized collaborative strategies, yet 30-minutes was too brief. Extending the time from 30 to 60 minutes would have painted an entire picture of the observation. In addition to extending the observation time, I would have included a data collection tool using photographs (Creswell, 2013). Participants would have taken photos during times they believed students were most actively participating. Accompanying the photo, participants could have included a brief written description about what was occurring and why they believed it was a reflection of active participation. I would have encouraged participants to share and discuss these photos during a focus group.
Future Directions

There was a great deal of collaboration that took place amongst participants during the course of the study. Additional collaboration took place mainly in the form of email correspondences with one another. An additional means for such communication took place through the use of a Facebook page designated for the UA MS Engineering 101 teachers. Such collaborations influenced four areas, which are considerations for future cycles. These areas included (a) encouraging further teacher leadership, (b) implementing such strategies with the special education student population, (c) introducing such strategies as a focal point for guest speakers visiting classrooms, and (d) teacher leaders providing professional development for administrators.

First, participants gained a great amount of value through sharing as a group, venturing into the public eye to share their stories and creating bonds with fellow colleagues to demonstrate the cross-curricular connections. It is my goal as an instructional specialist to coach these teachers in leading professional development sessions with larger audiences, namely the colleagues within their own schools. As part of the professional development session, teachers will discuss how potential technology issues can be addressed and how the strategies can maintain integrity and vitality by being utilized without technology. Teachers could provide professional development, individually or in pairs and partnerships established during the study.

Second, participants gained a greater insight of the benefits the reconfiguration of the strategies had when introduced to students facing academic and emotional challenges, including special education students. The students who may not be as confident to engage in verbal dialogues in class or who have difficulty maintaining a particular stance or
position/viewpoint, felt more included when given the support to utilize the strategies to suit their needs and strengths. The goal is for teachers to work collaboratively with the special services team to provide them with insight on how they used the strategies to achieve a greater degree of inclusion.

Third, participants discussed the importance of guest speakers during the first focus group session. Even though participants recognized that the main focus of the study was on collaborative strategies, they believed that guest speakers provided students with very pertinent real world experiences. Participants discussed how collaborative strategies could be infused with the idea of guest speakers. During the first focus group, participants brainstormed how the strategies could be introduced to guest speakers so they can engage in class discussions on the same level as the students. Discussions can start out as simple as a guest speaker choosing to wear a particular color hat from the Six Thinking Hats as they engage in a dialogue with students. Participants expressed eagerness to explore this future area with guest speakers.

Fourth, participants felt that administrators had different views on what should be taking place in the classroom. Through developing teacher leadership, teachers could bridge this gap between the teachers’ and administrators’ objectives. Teachers could accomplish this by providing informational and professional sessions to educate administrators of the practicality of using collaborative strategies. In presenting professional development sessions, teachers could include relevant classroom examples and deliver this type of session as individuals or as cross-curricular pairs as established and fostered during this study.
Conclusion of an Action Research Dissertation

As an action researcher I have learned that there are no such actual conclusions. Our conclusions are the culmination of experiences from a particular cycle, which result in plateaus from which to work, and lead us into yet another cycle of never ending learning, sharing, and further investigation. As I go forth continuing to serve as a practitioner of educational action research, I look forward to the challenges, collaborations, and potential innovative solutions that are on the road ahead.
REFERENCES


President’s Council of Advisors on Science and Technology. (2010, September). *Report to the President: Prepare and inspire: K-12 education in science, technology, engineering, and math (STEM) for America’s future*. Retrieved from https://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf


APPENDIX A

IRB LETTER
EXEMPTION GRANTED

Scott Marley
Division of Educational Leadership and Innovation - Tempe
Scott.Marley@asu.edu

Dear Scott Marley:

On 5/26/2015 the ASU IRB reviewed the following protocol:

<table>
<thead>
<tr>
<th>Type of Review:</th>
<th>Initial Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title:</td>
<td>Beyond the Four Walls: Examining the Use of Authentic Learning Modules</td>
</tr>
<tr>
<td>Investigator:</td>
<td>Scott Marley</td>
</tr>
<tr>
<td>IRB ID:</td>
<td>STUDY00002687</td>
</tr>
<tr>
<td>Funding:</td>
<td>None</td>
</tr>
<tr>
<td>Grant Title:</td>
<td>None</td>
</tr>
<tr>
<td>Grant ID:</td>
<td>None</td>
</tr>
</tbody>
</table>

Documents Reviewed:  
• IRB question pertaining to my study.pdf, Category: Off-site authorizations (school permission, other IRB approvals, Tribal permission etc);  
• Letter of Informed Consent.pdf, Category: Consent Form;  
• Additional Protocols.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);  
• Recruitment letter.pdf, Category: Recruitment Materials;  
• HRP-503a-TEMPLATE_PROTOCOL_SocialBehavioralV02-10-15-2.docx, Category: IRB Protocol;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 5/26/2015.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,
IRB Administrator

cc: Donna Jagielski
    Donna Jagielski
APPENDIX B

INNOVATION TIMELINE
<table>
<thead>
<tr>
<th>Dates</th>
<th>Action</th>
<th>Data Collection Tools/Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase One:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two weeks</td>
<td>- Introduce study</td>
<td>Informational/Invitation Letter (Appendix D)</td>
</tr>
<tr>
<td>Late July 2015 – early August 2015</td>
<td>- Informed consent</td>
<td>Informed Consent (Appendix E)</td>
</tr>
<tr>
<td></td>
<td>- Participation in instructional practices questionnaire</td>
<td>Instructional Practice Questionnaire (Appendix F)</td>
</tr>
<tr>
<td></td>
<td>- Participation in instructional session</td>
<td>Description of Instructional Workshop (Appendix H)</td>
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<tr>
<td></td>
<td></td>
<td>Researcher Journal (Appendix O)</td>
</tr>
<tr>
<td>Phase Two:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Five weeks</td>
<td>- Observation #1</td>
<td>Protocol for Observations (Appendix I)</td>
</tr>
<tr>
<td>Early August 2015 – middle of September 2015</td>
<td>- Semi-Structured interview #1</td>
<td>Protocols for Interviews (Appendix F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Questions for Interview #1 (Appendix G)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Researcher Journal (Appendix O)</td>
</tr>
<tr>
<td>Phase Three:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Five weeks</td>
<td>- Observation #2</td>
<td>Protocols for Observations (Appendix I)</td>
</tr>
<tr>
<td>Middle of September 2015 – Late October 2015</td>
<td>- Semi-Structured interview #2</td>
<td>Questions for Interview #2 (Appendix L)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Researcher Journal (Appendix O)</td>
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<tr>
<td>Phase Four:</td>
<td></td>
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<tr>
<td>Four weeks</td>
<td>- Focus group #1</td>
<td>Protocols for Focus groups (Appendix K)</td>
</tr>
<tr>
<td>Late October 2015 – late November 2015</td>
<td>- Focus group #2</td>
<td>Questions for Focus group (Appendix L &amp; M)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Researcher Journal (Appendix O)</td>
</tr>
</tbody>
</table>
APPENDIX C

DATA COLLECTION SURVEY
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Description</th>
<th>Inventory</th>
<th>Involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional Practices Questionnaire</td>
<td>To obtain baseline data as to participants understanding and usage of instructional strategies.</td>
<td>Duration: Approximately 15 minutes Total: 1 per participant</td>
<td>Researcher serves as a participant researcher</td>
</tr>
<tr>
<td>Appendix G</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructional Practices Workshop</td>
<td>Provide in-depth engagement in various instructional strategies participants will use within classroom instruction.</td>
<td>Duration: 120 minutes (2 hours) Total: 1 per participant</td>
<td>Researcher serves as a participant leader</td>
</tr>
<tr>
<td>Appendix H</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Documents/Artifacts from Instructional Workshop</td>
<td>I will photograph any teacher/participant created documents/artifacts created during the instructional practices session</td>
<td>Unknown</td>
<td>Researcher serves as participant researcher</td>
</tr>
<tr>
<td>Appendix</td>
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<td></td>
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<tr>
<td>Phase 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classroom observations</td>
<td>Identify how and to what extent instructional strategies are being used within classroom instruction.</td>
<td>Duration: 30 minutes Total: 2 per participant</td>
<td>Researcher serves as a participant researcher</td>
</tr>
<tr>
<td>Appendix I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 2 and 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-Structured Interviews</td>
<td>Face-to-face, phone or virtual interview to gather in-depth understanding of how instructional strategies have been used within classroom instruction.</td>
<td>Duration: 60 minutes each Total: 2 per participant</td>
<td>Researcher serves as a participant leader</td>
</tr>
<tr>
<td>Appendix J, K, L and M</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Phase 2 &amp; 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focus Groups</td>
<td>Focus group #1 will consist of a face-to-face meeting for participants to share their overall experiences in how they used instructional strategies in the development of the authentic learning modules. Focus group #2 will be a face-to-face final member checking and my sharing of the data analysis representation model.</td>
<td>Duration: Focus Group #1: 120 minutes (2 hours) Focus group #2: 120 minutes (2 hours) Total: 2 per participant</td>
<td>Researcher serves as participant leader</td>
</tr>
<tr>
<td>Appendix N, O &amp; P</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Phase 4</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

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| Research Journal Appendix Q All phases | I will keep researcher notes including field notes about the process and reflection during the course of this study using a Word document. | During all 16 weeks | Researcher serves as participant researcher |
APPENDIX D

INFORMATIONAL LETTER
Dear UA MS Engineering 101 Team:

As some of you may already know from our collaborative work within the UA MS engineering 101 program, I am a doctoral student at Arizona State University. The focus of my action research dissertation involves an innovation, which is the inclusion of authentic learning modules in conjunction with the UA MS 101 Arizona Ice House Challenge unit. I am seeking you as a collaborator in this study so that students achieve real world STEM experiences during the authentic learning modules where they active participants in the experience.

Please contact me for the details of the study by July 10\textsuperscript{th}, 2015 either by phone or email. I look forward to hearing from you and collaborating with you on this important and exciting study.

You will be compensated for your time!

Donna Jagielski

Email: djagiels@asu.edu or via cell at 847-204-8079
APPENDIX E

LETTER OF INFORMED CONSENT (TEACHER PARTICIPANTS)
Dear Participant:

As some of you may know from our collaborative work within the UA MS Engineering 101 program, I am a doctoral student at Arizona State University in the Leadership & Innovation program through the Mary Lou Fulton Teachers College. The purpose of my action research dissertation involves an innovation utilizing instructional strategies complementing the engineering design process used within the UA MS 101 Arizona Ice House Challenge unit. As a teacher leader of the UA MS Engineering 101 program, I am inviting you to participate in my action research study and be a collaborator on utilizing instructional strategies to create authentic learning modules so that students achieve real world STEM experiences as active participants. I have received approval from UA to contact the teachers who participate in the UA MS Engineering 101 program.

Should you choose to participate in this research study, the communication and commitment will be as follows beginning late July – mid November 2015:

- Participation in the instructional workshop – 120 minutes – face-to-face
- Two interviews – 60 minutes each – face-to-face, phone or virtual
- Two focus group sessions – 120 minutes – face-to-face
- Two 30 minute classroom observations
- Brief survey/questionnaire – approximately 15 minutes to complete

Your participation in this study is completely voluntary. You may choose to leave the study at any point in time without penalty. Pseudonyms will be used to maintain confidentiality. All materials will be de-identified. Do understand that complete confidentiality cannot be guaranteed due to the group nature of the workshop, focus
groups and observations. All audio recording, videotaping and photographs of notes/materials will be for the purpose of data analysis within my dissertation. Results from this study will be published in this dissertation and has the potential to make an impact with middle school STEM based learning in schools across the state. All data acquired from this study will be electronically stored securely through ASU server system, which is password protected. There are no known risks associated with this study. Although I cannot promise benefits to you, however possible benefits are greater understanding of pedagogy skills through the use of instructional strategies. Since I recognize that your time is valuable and greatly appreciated during this study, you will receive the following compensation for your participation in this study: a general Visa/American Express gift card of the following denominations will be issued: instructional session ($20.00), two observations ($5.00 each = $10.00) two interviews ($15.00 each = $30.00) and two focus groups ($30.00 each = $60.00). Breakfast will be served at the instructional workshop and during both focus groups.

If you have any questions concerning this study, please contact Donna Jagielski at djagiels@asu.edu. You may also contact J. Jill Rogers (College of Engineering Academic Affairs office) at: jillrogers@email.arizona.edu. You may also contact my chair, Dr. Scott Marley at scott.marley@asu.edu. If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the Chair of Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance at 480-965-6788.

Donna Jagielski, Mary Lou Fulton Teachers College Arizona State University 847-204-8079
Informed Consent Signature Page

Your signature documents your permission to take part in this research:

Name (print): ________________________________ Date: __________________
Signature: ________________________________ Date: __________________

Name of person obtaining consent: __________________ Date: __________
Signature of person obtaining consent: __________ Date: __________

By signing below you agree to following:

1. Audio recording during interviews and focus group sessions.
2. Videotaping during focus groups and instructional workshop.
3. Photographs of notes, documents and artifacts created during the instructional workshop.

Name (print): ________________________________ Date: __________________
Signature: ________________________________ Date: __________________
APPENDIX F

LETTER OF INFORMED CONSENT (CURRICULUM DIRECTORS/INSTRUCTIONAL COACHES)
Dear Participant:

As some of you may know from our collaborative work within the UA MS Engineering 101 program, I am a doctoral student at Arizona State University in the Leadership & Innovation program through the Mary Lou Fulton Teachers College. The purpose of my action research dissertation involves an innovation utilizing instructional strategies complementing the engineering design process used within the UA MS 101 Arizona Ice House Challenge unit. As an instructional/curriculum leader of the UA MS Engineering 101 program, I am inviting you to participate in my action research study and be a collaborator on utilizing instructional strategies to create authentic learning modules so that students achieve real world STEM experiences as active participants. I have received approval from UA to contact the teachers who participate in the UA MS Engineering 101 program.

Should you choose to participate in this research study, the communication and commitment will be as follows during the months of October/November 2015:

- One individual interview approximately 60 minutes – face-to-face or phone

Your participation in this study is completely voluntary. You may choose to leave the study at any point in time without penalty. Pseudonyms will be used to maintain confidentiality. All materials will be de-identified. All audio recording will be for the purpose of data analysis within my dissertation. Results from this study will be published in this dissertation and has the potential to make an impact with middle school STEM based learning in schools across the state. All data acquired from this study will be electronically stored securely through ASU server system, which is password protected. There are no known risks associated with this study. Although I cannot promise benefits
to you, however possible benefits are greater understanding of pedagogy skills through the use of instructional strategies. Since I recognize that your time is valuable and greatly appreciated during this study, you will receive the following compensation for your participation in a $10 Visa/general gift card. If you have any questions concerning this study, please contact Donna Jagielski at djagiels@asu.edu. You may also contact J. Jill Rogers (College of Engineering Academic Affairs office) at: jjillrogers@email.arizona.edu. You may also contact my chair, Dr. Scott Marley at scott.marley@asu.edu. If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the Chair of Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance at 480-965-6788.

Donna Jagielski  
Mary Lou Fulton Teachers College  
Arizona State University  
847-204-8079
Informed Consent Signature Page

Your signature documents your permission to take part in this research:

Name (print): ________________________________  Date: ________________
Signature: ________________________________  Date: ________________
Name of person obtaining consent: ____________________  Date: __________
Signature of person obtaining consent: ____________________  Date: _________

By signing below you agree to following:

1. Audio recording during individual interviews.

Name (print): ________________________________  Date: ________________
Signature: ________________________________  Date: ________________
APPENDIX G

INSTRUCTIONAL STRATEGIES QUESTIONNAIRE
Directions:
Please answer each question below regarding the following collaborative strategies.

1. How familiar are you with the Six Thinking Hats?
   1. not at all familiar
   2. 3. 4. 5. 6. extremely familiar

2. How familiar are you with Think-Pair-Share?
   1. not at all familiar
   2. 3. 4. 5. 6. extremely familiar

3. How familiar are you with Jigsaw?
   1. not at all familiar
   2. 3. 4. 5. 6. extremely familiar

4. How familiar are you with The Five Whys and the Five Hows?
   1. not at all familiar
   2. 3. 4. 5. 6. extremely familiar

5. How familiar are you with The Nine Windows?
   1. not at all familiar
   2. 3. 4. 5. 6. extremely familiar

6. For each strategy with which you have familiarity, describe how you became familiar with that strategy?

7. Which strategies have you used in your instruction? (Please check all that apply)
   The Six Thinking Hats
   Think-Pair-Share
   Jigsaw
   The Five Whys and the Five Hows
   The Nine Windows
8. For each strategy you have used, describe how you have used that strategy?

9. What is your gender?
   Male  Female

10. How many years have you been teaching?

11. What is your highest degree?
   B.A.  M.A./M.S.  Ed.D./Ph.D.  Other (please specify):

12. What teaching certifications/endorsements do you currently hold?

13. How many years have you been teaching in your current district?

14. How many years have you been teaching at your current school?

15. What grade levels do you currently teach?

16. Are the classes you currently teach considered to be electives?
   Yes  No
APPENDIX H

INSTRUCTIONAL WORKSHOP
Participants will be using the UA MS engineering 101 The Ice House Solar Challenge lesson as the basis of the developing real world experiences. The Ice House Challenge is a unit based on energy efficiency where by students will follow the engineering design process of: Ask, Explore, Plan, Create, Test, Improve and Production/Reflection. The entire Ice House Challenge unit lasts approximately four weeks in duration, using all the elements of the design process. The duration of the authentic learning modules will be about two weeks. Using the principles of the design process, students will construct a house from basic materials to properly insulate the house so that when an ice cube in placed inside of the house, it will not melt.

The two-hour instructional workshop with a quick review of how the Great Ice House Challenge utilizes the engineering design process. The engineering design process is an iterative process consisting of steps by which engineers follow as a guide in solving problems. The first three steps of the engineering design process (ask, explore and plan) will then be used to identify and propose solutions of energy efficiency issues the students find in their individual schools. Using these first three steps of the engineering design process will provide a foundation for teachers to create the authentic learning modules where the teachers will then be able to implement cooperative strategies so that students can gain a greater understanding of abstract concepts involved in their authentic learning experience.

For each of the three stages, I will introduce teachers to several different instructional strategies, which will foster the development of an authentic learning experience. During the first stage of ‘ask’, students will be transitioning their abstract learning of the energy efficiency lesson to the concrete by seeking to identify the energy
efficiency issues in their school. During this stage, the teachers and I will engage in the strategy of think-pair share. Teachers can then use this strategy to include other members of the school community with their students to discuss the school energy issues. During the second stage of ‘explore’, students will be changing the classroom culture as they will now progress in becoming experts in particular areas needing to be addressed in undertaking the energy efficiency issue in their school. During this stage, the teachers and I will engage in the strategy of jigsaw. Teachers can then use this strategy to develop a classroom culture similar to that of an engineering firm, where there are groups of leading experts within different departments.

Lastly, during the third stage of ‘plan’, students will be collaborating to establish a proposed solution to the energy issue within their school. During this stage, the teachers and I will engage in DeBono’s Six Thinking Hats. Teachers can then use this strategy to invite a professional engineer into the classroom either in person or virtually, so that students, teacher and engineer can each wear varying hats representing the different perspectives in attempting to brainstorm a solution to their school energy efficiency issue. The conclusion of the workshop will include discussion by teacher participants to engage, explore, and collaborate in other instructional strategies, which they believe are appropriate in developing the authentic learning experiences within these three stages.

Activities:
Silent Discussion using poster board and color markers for exploration of the Six Thinking Hats and The Nine Windows.
Shades of Six Thinking Hats using paper paint samples. Activity also include components of Think-Pair-Share and Jigsaw.
Exploration of using Todays Meet and Edmodo (technology based) for discussion while using Jigsaw, Think-Pair-Share of any of the strategies.

**Handouts:**

Descriptions of all strategies with examples of uses.

DOK levels including sample question prompts.

**Books:**

Triz for Engineers – Enabling Inventive Problem Solving by Karen Gadd

The Innovator’s Toolkit by David Silverstein, Phillip Samuel and Neil DeCarlo

<table>
<thead>
<tr>
<th>Engineering Design Process Stage</th>
<th>Ask</th>
<th>Explore</th>
<th>Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Identify the Problem</td>
<td>What others have done</td>
<td>Brainstorm Decide on a plan</td>
</tr>
<tr>
<td>Ice House Lesson Components</td>
<td>Examining model home.</td>
<td>Researching materials of similar structures.</td>
<td>Assign task roles to each member of student team to brainstorm solutions.</td>
</tr>
<tr>
<td>Authentic-learning components</td>
<td>Identify an area in the school, which might be having an issue with energy efficiency.</td>
<td>Research what others have done in solving the school energy issue. Determine what materials have been used in this particular area of the school.</td>
<td>Collaborate with others within or outside of the school in determining alternatives solutions feasible to solve this particular energy issue within your school.</td>
</tr>
<tr>
<td>Strategies to implement authentic learning modules</td>
<td>Think-Pair-Share</td>
<td>Jigsaw</td>
<td>DeBono’s Six Thinking Hats</td>
</tr>
</tbody>
</table>
APPENDIX I

GENERAL OBSERVATIONAL PROTOCOL
1. Observations will be scheduled in conjunction with participant schedule, approximately one-week prior.

2. Observation will last 30 minutes in duration.

3. Observation will consist of handwritten notes, which will be time stamped in five minute intervals.

4. Observations and notes will be taken on verbal behaviors and interactions of individuals (who is speaking, length of time, initiation of dialogue and tone of voice).

5. Observations and notes will be taken on classroom traffic (people who enter and exit room, standing up, sitting down, walking around the room, number of individuals in groups, length of time teacher interacts with each group/individual).

6. Observations and notes will be taken on physical interactions (individuals receiving a great deal of attention, ones receiving little or no attention).

7. Observations and notes will be taken on interaction with environment (use of technology, use of notebooks, use of hand-outs/worksheets, use of classroom materials, projector/Smartboard technology).

8. Notes will include a drawing of the configuration of the room (physical environment of room), which will include seating arrangements and where I am sitting in relationship to the space.
Observation Protocol of Instructional Strategies within Authentic Learning Modules

Number: __________  Class number: __________  School number: ______
Start Time: ______  End Time: ______

<table>
<thead>
<tr>
<th>My question prompt</th>
<th>Descriptive</th>
<th>Interpretation</th>
<th>Concept/Themes/Musings</th>
</tr>
</thead>
<tbody>
<tr>
<td>What type of instructional strategy is being used within instruction?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the teacher encourage students to modify the instructional strategy? If so, how?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To what degree does the teacher encourage students to interact with different peers when using the strategy?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What types of questioning does the teacher use when engaging students in the strategy used?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How does the teacher modify the instructional strategy based on the needs of students?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How does the way the teacher implemented the strategy promote dialogue on problem-solving between students with their teacher? The students with their peers?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX J

PROTOCOLS FOR INTERVIEWS
1. I will be sharing interview questions with participants ahead of time.

2. Participants who will be recorded over the phone, Cogi will be used to record the interview (and for transcription).

3. A back up device of a digital recorder will be used in addition, since the phone call will be placed on speakerphone.

4. Digital/virtual interviews will be recorded through a digital recorder.

5. Face to face interviews will be recorded using a digital recorder.

6. I will place the call from a secure, interruption free environment in order to maintain the confidentiality of the interview.

7. All interview transcripts will be transcribed using Cogi.

8. Face to face interviews will take place in an interruption free environment.

9. At the onset of all interviews, I will record the introduction, which will review the protocols and obtain verbal consent of participants by participants stating their full name.

10. I will send the digital audio file out to Cogi within 24 hours of interview.

11. All transcriptions will be initially be transcribed by Cogi and then I will be refining transcription to include pauses, laughter, length of silence and intonation.

12. All transcripts will be transcribed verbatim.

13. All transcripts will be stored as an audio file on password protected personal home computer.
14. Notes will be taken during each of the interviews and shared with participants during that time.

15. For phone interviews, I will disclose to the participant that I will be taking notes. I will share notes with participants via screen during digital face-to-face interviews. For in-person interviews, I will have notes displayed between the participant and myself.

16. Participants will receive transcript of first interview one week prior to the second interview for review.

17. After the interview has concluded, I will make notes in my researcher memo about the interview.
APPENDIX K

QUESTIONS FOR TEACHER INTERVIEWS 1
1. Which authentic learning modules have you used during your instruction of the Ice House Challenge?

2. Which strategies have you used to address those authentic learning modules?

3. Why and how did you decide to select the strategies you used?

4. Were there any strategies used that either you or students came up with?

5. If so, what were they?

6. In what ways can you describe how using the strategies you selected provided authentic real world experiences for your students?

7. What, if anything has surprised you in using these strategies?

8. What changes, if any, do you see within your practice as a result of using these strategies?

9. What successes have you experienced so far?

10. What challenges have you experienced so far?

11. What recommendations for improvement and/or changes would you suggest?

   Why?
APPENDIX L

QUESTIONS FOR TEACHER INTERVIEW 2
1. Have you used additional authentic learning modules within your instruction of the Ice House Challenge, since our previous interview?

2. If so, which additional modules have you addressed within your instruction of the Ice House Challenge since the last interview?

3. If you have utilized additional authentic learning modules since our previous interview, which strategies have you used to address those authentic learning modules?

4. Were there any strategies used that either you or students came up with?

5. If so, what were they?

6. Why and how did you decide to select the strategies you used?

7. In what ways can you describe how using the strategies you selected provided active participation opportunities for your students?

8. What, if anything has surprised you in using these strategies?

9. What changes, if any, do you see within your practice as a result of using these strategies?

10. What successes have you experienced so far?

11. What challenges have you experienced so far?

12. What recommendations for improvements and/or changes would you suggest? Why?

Participants will receive transcript of previous interview to review one week prior to second interview.
Questions regarding data analysis and member checking from Interview #1

1. When looking at the codes from the previous interview (#1) how might you recapitulate what I have described in the analysis?

2. What codes or parts of the analysis stand out to you?

3. How would you describe some of the patterns you see within the analysis?

- Understanding that researcher is free to interject at any point in time to redirect, clarify norms.

- Participants are encouraged to ask to have questions reframed, rephrased or repeated for clarity.

- Participants do not have to raise their hand.

- Different processes for answering each question will be facilitated by researcher, during the session, including months of birthdates, popsicle sticks, and various other methods.

- Group dynamics will be reviewed in terms of respecting others differences regarding cultural backgrounds, use of slangs, urban dictionary, acronyms, sarcastic humor and anything else, which may offend anyone in the group.
APPENDIX M

QUESTIONS FOR CURRICULUM DIRECTORS/INSTRUCTIONAL COACHES
1. What types of instructional strategies do you use with teachers to foster real world experiences within classroom instruction?

2. What types of collaborative strategies do you use with teachers to foster real world experiences for students within classroom instruction?

3. What types of instructional strategies do you use with teachers to foster active participation within classroom instruction?

4. What types of collaborative strategies do you use with teachers to foster active participation within classroom instruction?

5. Are there any particular instructional strategies you have used specifically with the UA MS 101 teachers? If so, what were they and what was the outcome?

6. What challenges do you face in fostering best practices instructional strategies in conjunction with the UA MS engineering program?

7. What successes have you had in fostering best practices instructional strategies in conjunction with the UA MS engineering program?

8. How do you provide support to teachers who wish to foster the use of technology in the UA MS 101 program?

9. How do you provide support to teachers who wish to foster reflective practices in the UA MS 101 program?

10. How do you provide support to teachers who wish to collaborate with one another within this UA MS 101 program?
APPENDIX N

PROTOCOLS FOR FOCUS GROUP SESSIONS
1. Face to face focus groups will take place in a private conference room either on the UA campus in Tucson or an affiliated space.

2. Room will be equipped with workstation needs including projector capabilities, marker board, markers, paper and pencils/pens.

3. Breakfast will be provided for both focus group sessions.

4. Participants will sign in upon arrival.

5. Participants will receive questions for focus group in advance.

6. I will be sharing data analysis with participants during this session.

7. Audio recording will take place from the official start until the official end of the session.

8. I will also set a timer for the session where it will be visible to all participants.

9. I will also serve as the note taker during the focus group and notes will be made visible to the participants.

10. Participants will be asked to turn sounds off of cell phones. Lights and vibrating will be permitted and if necessary, accepting and placing calls must be conducted outside of the focus group conference room.

11. There will be no texting and/or other communications using the phone or iPad (or any other digital device) in the focus group room during the session.

12. One official 5-minute stretch/bathroom break will be provided at the half way-point (one hour mark).

13. Participants are encouraged to excuse themselves to use the bathroom at any point in time during the session.
14. I will take notes within researcher memo later that day. I will also send out the recording to Cogi for transcription within 24 hours.

15. All transcriptions will be initially transcribed by Cogi and then a refining of transcription including pauses, laughter, length of silence and intonation will be included in the 2nd transcription, which I will conduct.

16. All transcripts will be transcribed verbatim.

17. All transcripts will be stored as an audio file on password protected personal home computer.

18. Participants will receive transcript of first focus group one week prior to second focus group for review.

19. Additional protocols for the focus groups will include:

- Allowing others to finish their statements.
- Refraining from monopolizing the dialogue/discussion.
- Understanding that researcher is free to interject at any point in time to redirect, clarify norms.
- Participants are encouraged to ask to have questions reframed, rephrased or repeated for clarity.
- Participants do not have to raise their hand.
- Different processes for answering each question will be facilitated by researcher, during the session, including months of birthdates, popsicle sticks, and various other methods.
- Group dynamics will be reviewed in terms of respecting others differences regarding cultural backgrounds, use of slangs, urban dictionary, acronyms, sarcastic humor and anything else, which may offend anyone in the group.
APPENDIX O

QUESTIONS FOR FOCUS GROUP SESSION 1
1. Describe what your experiences have been in using the authentic learning modules during the instruction of the Ice House Challenge?

2. Describe what your experiences have been in using the strategies within the authentic learning modules?

3. Describe some of the events, which took place during the implementation of the authentic learning modules?

4. Describe how your events unfolded.

5. What would you do differently in the future in using the authentic learning modules?

6. What would you do differently in the future in using the strategies with the authentic learning modules?

7. Has your school adopted, accepted or otherwise responded to any of the recommendations made by the students?
APPENDIX P

QUESTIONS FOR FOCUS GROUP 2
1. What codes or parts of the analysis stand out to you?

2. What patterns do you see within the analysis of establishing these codes for the components of this data representation report?

3. How do you feel this visual data representation model captures the final data analysis of this study?
APPENDIX Q

RESEARCHER REFLECTION QUESTIONS
Addressing the following both pre and post study in researcher journal.

Compose a narrative snapshot of the following:

1. Section I: My practice/research
   - How do I describe myself as an educational practitioner?
   - How do I describe myself as a researcher?
   - How do I describe how I work with teachers?
   - How do I describe instructional strategies?

2. Section II: Reification of conceptual components of study
   - What is STEM?
   - How do teachers use strategies within their instruction?
   - How are student authentic, real world experiences described?
   - How do students achieve authentic, real world experiences?
   - How do I describe authentic learning experiences?
   - How do I describe communities of practice (CoPs)?
   - How are CoPs developed in a classroom setting?
APPENDIX R

CODE BOOK/CODE SHEET DESCRIPTORS
Code Book for Semi-Structured Interviews

01. Facilitating Instruction
01. FAC-HOT.01 = Higher Order Thinking Skills (HOTS)
01. FAC-CCC.02 = Cross Curricular Connections
01. FAC-SDM.03 = Shared Decision Making (FAC: SDM)

02. Sharing
02. SHA-COL.01 = With colleagues
02. SHA-COI.02 = Common Interests

03. Fostering Independence
03. FOS-TAO.01 = Taking Ownership
03. FOS-STI.02 = Student Initiative
03. FOS-NON.03 = Non – Judgment

04. Changes
04. CHA-PAC.01 = Participant Confidence

05. Challenges
05. CHL-TIC.01 = Time Constraints
05. CHL-AVT.02 = Availability of Technology
05. CHL-DAS.03 = Degree of Administrative Support

06. Questioning Strategies
06. QUS-GLT.01 = Global Thinking
06. QUS-PRS.02 = Problem Solving

07. Communication
07. COM-TEP.01 = Teacher Prompts
07. COM-UNF.02 = Understanding Failure
07. COM-VSI.03 = Valuing Student Input

08. Student Engagement
08. STE-CHO.01 = Student Choice
08. STE-TEU.02 = Technology Use

09. Instructional Supports
09. INS-CLE.01 = Classroom Environment
09. INS-PRT.02 = Processing Time
Code Book for Focus Groups

01. Facilitating Instruction
01. FAC-HOT.01 = Higher Order Thinking Skills (HOTS)
01. FAC-CCC.02 = Cross Curricular Connections
01. FAC-SDM.03 = Shared Decision Making (FAC: SDM)

02. Sharing
02. SHA-COL.01 = With colleagues
02. SHA-COI.02 = Common Interests

03. Teacher Reflections
03. TRS-QUU.01 = Question Use

04. Changes
04. CHA-PAC.01 = Participant Confidence

05. Challenges
05. CHL-TIC.01 = Time Constraints
05. CHL-AVT.02 = Availability of Technology
05. CHL-DAS.03 = Degree of Administrative Support

06. Teacher Reflective Practice
06. TRP-AFE.01 = Accepting Failed Expectations

Code Book for Workshop

01. Facilitating Instruction
01. FAC-HOT.01 = Higher Order Thinking Skills (HOTS)
01. FAC-CCC.02 = Cross Curricular Connections

02. Sharing
02. SHA-COL.01 = With colleagues

03. Goals for Student Exploration
03. GOA-GEN.01 = General

Code Book for Observations

01. Facilitating Instruction
01. FAC-HOT.01 = Higher Order Thinking Skills (HOTS)
01. FAC-CCC.02 = Cross Curricular Connections
Participants depicted facilitating instruction by selecting particular instructional approaches to support the collaborative strategies. In seeking to establish how and in what ways teachers used the collaborative strategies, teachers cited examples and it was observed, where teachers demonstrated the use of prompting students to dialogue, ask questions and engage in analysis, evaluation and the synthesis of information thus coded as “Higher Order Thinking Skills – HOTS”. An example of this code is “getting students to see the difference between ‘accurate’ answers like the one asked for on the test and how there can be a answer different than the correct one on the test based on using different viewpoints, a synthesis of perspectives and grey area”. Participants expressed how they initiated students in utilizing higher order thinking skills by asking probing questions as a scaffold prior to classroom discussions using strategies such as the Six
Thinking Hats. For example, “In their engineering notebooks, they’ll create associations and relationship to think. I’ll ask ‘why did you draw Mickey Mouse?’

Continuing to facilitate instruction, drawing upon using HOTS as an impetus, participants drew upon bringing attention to cross-curricular connections. Participants facilitated discussions to encourage students to analyze how cross-curricular connections were established. I created the code of “Cross Curricular Connections” and examples of this code are “I have my kids read Isaac Asimov and others and then write their own futurism stories and it helps them to see all those connections and be able to develop broader and deeper perspectives” or “everyone automatically marries science with math but there should be a lot more reading paired up with science”.

Finally, as a capstone in facilitating instruction, participants encouraged students to share in the decision-making process once students established cross-curricular connections using higher order thinking skills. Examples of the code “Shared Decision-Making” are “I ask them (students) have you reached a conclusion?”, “are you agreeing to disagree?” and “everyone needs to discuss and decide”.

02. Sharing
02. SHA-COL.01 = With colleagues
02. SHA-COI.02 = Common Interests

Participants depicted sharing as the ability to share ideas about instruction and the collaborative strategies with fellow colleagues, both within the study and outside of the study. This study also provided participants the platform to further develop the common interests shared amongst the participants and researcher. Participants provided a number of comments referring to how and what experiences they shared amongst each other. The code “with Colleagues” represented comments, which were used to describe how participants pooled ideas and communicated with one another. Examples of this code are “elective teachers offer ideas to the science teachers and vice versa” and “a lot of science is found in social studies so the social studies teacher and I talk about that”.

Comments such as “there’s something in this for everyone “ as demonstrated in the code of “Common Interests” described how participants expressed the idea of possessing commonalities within their instruction and educational interests rather than being isolated by content area. Examples of this code are “doesn’t matter if it is science or elective or music, there are a lot of mutual ideas between all of us” and “many of us have a universal perspective which draws us together”.

03. Fostering Independence
03. FOS-DAO.01 = Taking Ownership
03. FOS-STI.02 = Student Initiative
03. FOS-NON.03 = Non – Judgment
Participants depicted how they provided students support to gain independence during instruction, particularly when using the collaborative strategies. The code “Taking Ownership” was used to demonstrate examples of how participants encouraged students stand behind the ideas they suggested. Examples of this code are “describe your thoughts, however you want” and “this has to make sense to you, not to me”.

As part of the ownership process, participants described how they had encouraged students to be self-starters. The code of “Student Initiative” depicts how participants described how they supported students in introducing ideas and viewpoints to other members of their group and classmates in general. Examples of this code are “if I see things working for them, I let them go and encourage them to keep going” and “students tend to stick to the deadlines better when they come from their peers”.

Finally, participants continued to encourage students to gain independence by creating an environment free of judgment, so students would be comfortable to initiate and take ownership of their own ideas and viewpoints. The code of “Non-judgment” refers to how teachers refrained from placing judgment on the ideas students brought forth and how teachers encouraged the peers of students to refrain from judgment as well. Examples of this code are “my (teacher) opinion doesn’t matter” and “as long as it conveys what you (student) want, that’s fine”. As participants encouraged the same type of non-judgmental support from students, examples include “listen to everything they have to say” and “try to see it through their eyes at least for a short time”.

04. Changes
04. CHA-PAC.01 = Participant Confidence
Participants described changes within their confidence level during the course of the study. Such changes within the dynamics of their confidence level influenced their classroom instruction as well as their interactions with the public. The code “participant confidence” was selected to describe the vibrant variations, which took place regarding participants’ levels of assurance. Examples of this code are “wow, it worked with this dynamics of students” and “this really made an impact on my SPED students, it made me feel really great”.

05. Challenges
05. CHL-TIC.01 = Time Constraints
05. CHL-AVT.02 = Availability of Technology
05. CHL-DAS.03 = Degree of Administrative Support

Participants depicted the numerous challenges they faced while taking part in the study. A number of the challenges participants faced directly impacted the directions they sought during the course of the study. The code of “Time Constraints” was used to describe how participants expressed the anxiety of being pulled in a number of directions as a teacher professional. Examples of this code are “wondering how am I going to fit everything in” and “I have so much on my plate”.

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Additionally, participants faced the challenge of different levels of support when it came to using technology in their classroom instruction. The code of “Availability of Technology” was used to describe how participants expressed what technologies were available at their school, lack of technological support and technology infrastructure. Examples of this code are “much of what I have is outdated” and “we have to look at creative ways to get technology in the classroom since there isn’t enough”.

Finally, participants described how the administrative structure of their schools posed challenges at times due to a lack of understanding or interest in what they were aiming to achieve. This was coded as “Degree of Administrative Support”. The range of administrative support varied since participants were at different schools within different districts. Yet nevertheless, all participants faced the challenge as related to administrative support. Examples of this code are “no matter what content area I would be teaching I think life would be tough. We all get handed something…” and “they (elementary and high school teachers and admin) said they don’t have the time (to meet and plan vertical articulation of program) and I said you have to make the time”.

06. Questioning Strategies
06. QUS-GLT.01 = Global Thinking
06. QUS-PRS.02 = Problem Solving

Participants denoted the use of questing strategies within their instruction particularly as related to using the collaborative strategies. The code of “Global Thinking” was used to describe particular questioning strategies participants used when encouraging students to examine a multitude of dimensions of an issue. Examples of this code are “you might think the problem is only about water, but now because of your proposed solution do you think it could trigger a budget issue and a potential health risk” and “thinking about transportation, what are some of the further issues with school bus routes? Maybe gas, traffic congestion, jobs for drivers, time constraints?”

Participants also depicted their questioning strategies to elicit students’ ability to strategize. Coded as “Problem Solving”, this represented questioning strategies used by participants during instruction which stimulated students’ thinking to solve problems creatively. Examples of this code are “what’s the best way you think of doing this?” and “what might be the most outrageous possible solutions you can think of?”

07. Communication
07. COM-TEP.01 = Teacher Prompts
07. COM-UNF.02 = Understanding Failure
07. COM-VSI.03 = Valuing Student Input

Participants depicted communication as means of suggesting and conveying key concepts for students to gain an understanding while being immersed in using the collaborative strategies.
As participants continued to guide students during instruction, they relied upon providing students with suggestions. Using the code “Teacher Prompts” describes how teachers coached students in working out issues for themselves or initiating further dialogue. Examples of this code are “how do you think a creative person views the world” or “how can you emphasize your perspective even more”.

Participants depicted how there was a great emphasis placed on discussing the concept of failure in a variety of circumstances during the study. In particular, participants expressed how students began to acquire greater learning experiences from the numerous fruitful discussions about failure. The code “Understanding Failure” represented comments, participants that described how they believed students’ benefited from obtaining a deeper understanding of failure. Examples of this code are “don’t be afraid to fail, and if you do, embrace it and write it down because failure leads to success” and “I want them to express everything that works and what doesn’t work”.

Participants also placed a great importance on the opinions students expressed during the study. This depiction was coded as “Valuing Student Input”. Examples of this code are “I would ask ‘is this fair to you guys’” and “go ahead and tell me if you think this is a bad idea and why”.

08. Student Engagement
08. STE-CHO.01 = Student Choice
08. STE-TEU.02 = Technology Use

Participants depicted student engagement as the active involvement students demonstrated during instruction. Participants expressed that the greatest amount of student involvement took place when students worked in an unrestricted environment which many times utilized aspects of technology. The code “Student Choice” represents comments participants made about witnessing the active involvement of students when provided an array of choices in how to utilize the strategies provided. Examples of this code are “I let them kind of just explore the materials, roles and perspectives and how they were going to use things and explore viewpoints” and “students chose to explore Six Thinking Hats in a silent discussion format because they said the discussion in silence is less likely to turn into an argument”. Further comments included “by providing students with the freedom to explore these (strategies) anyway they want, everybody is doing something all the time and it is productive”.

Participants’ access and usage of technology also provided students with the ability to make additional choices to expand their engagement. The code of “Technology Use” was created to describe how participants expressed how students selected technology to support their involvement and engagement during instruction. Examples of this code are “what ideas can you get from looking at those apps” and “examine the types of resources you find online, primary and secondary, have someone in your group with a critical eye really examine them”.

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Participants depicted how they provided a variety of instructional supports within the classroom setting to establish an atmosphere that was conducive for students to be actively involved in class. The code “Classroom Environment” represents how participants described how and what they did to prepare the learning space. Examples of this code are “everyone has something to contribute, no matter what level you are at” and “students know who isn’t on the same academic level as they are and that is ok, you find ways of working with them, even if it just to listen to them and pay respect their ideas and thoughts”.

Participants also expressed the importance of providing students ample time to reflect and process information before rendering decisions. Examples of the code “processing time” included “they (students) need to be given time to think”, “slow down, give it some thought” and “I have to build in think time”.

Code Sheet Descriptors for Focus Groups

01. Facilitating Instruction
01. FAC-HOT.01 = Higher Order Thinking Skills (HOTS)
01. FAC-CCC.02 = Cross Curricular Connections
01. FAC-SDM.03 = Shared Decision Making (FAC: SDM)

Participants depicted facilitating instruction by selecting particular instructional approaches to support the collaborative strategies. In seeking to establish how and in what ways teachers used the collaborative strategies, teachers cited examples and it was observed, where the teachers demonstrated the use of prompting students to dialogue, ask questions and engage in analysis, evaluation and the synthesis of information thus coded as “Higher Order Thinking Skills – HOTS”. An example of this code are “if you walk out of my class and can solve a problem by using different viewpoints and thinking, I’ve done my job” and “once they get used to becoming an expert or establishing viewpoints, they can recognize those same attributes in others and begin to analyze and critique them. That’s when the real discussions really begin.”

Participants cited the importance of utilizing higher order thinking skills through additional comments such as “real life work situations are made up of ill structured problems so I try to cite examples so that it gets them thinking on deeper levels”.

Continuing to facilitate instruction, drawing upon using HOTS as an impetus, participants drew upon bringing attention to cross-curricular connections. Participants facilitated discussions to encourage students to analyze how cross-curricular connections were established. I created the code of “Cross Curricular Connections” and examples are “when we look at things from a lot of different angles is dismisses the old question of
‘what does this have to do with that’ – they answer their own question” and “you get those ah-ha moments of students saying ‘oh yeah now I understand why solar costs so much’.”

Finally, as a capstone in facilitating instruction, participants encouraged student to share in the decision-making process once students established cross-curricular connections using higher order thinking skills. Examples of the code “Shared Decision-Making” are “establish some protocols so you can come to a decision so you don’t just discuss all day” and “maybe leave it up to the project manager in charge of this phase to get you guys to the decision stage”.

02. Sharing
02. SHA-COL.01 = With colleagues
02. SHA-COI.02 = Common Interests

Participants depicted sharing as the ability to share ideas about instruction and the collaborative strategies with fellow colleagues, both within the study and outside of the study. The study also provided participants the platform to further develop the common interests shared amongst the participants and researcher.

Participants provided a number of comments referring to how and what experiences they shared amongst each other. The code “with Colleagues” represented comments, which were used to describe how participants pooled ideas and communicated with one another. The code also described how participants shared ideas will fellow colleagues within their own workplace/schools. Examples of this code are “after (other participant) told me some of his ideas, I talked more with the science teacher in the classroom next to me because she does a lot of STEM stuff with aviation” and “this entire program and everything is great because everyone can extract what they need from it, math teachers and I can talk about trajectory and social studies we can talk about the economic impact”.

Comments such as “there’s so much we can all bring to the table“ is demonstrated in the code of “Common Interests” where expressed participants expressed the idea of possessing commonalities within their instruction and outside educational interests rather than being isolated by content area. Examples of this code are “stuff like 3D printing can bring in areas like art” and “since receiving admin permission for students to use their cell phones in class for research a lot of other teachers have started talking to me asking me how my classroom made that happen”.

03. Teacher Reflections
03. TRS-QUU.01 = Question Use

Participants depicted their reflections about how they used questioning strategies and techniques within their instruction. Participants reflected on how they delivered a blend of open ended and higher order thinking based questions to students. During the reflective process, participants also questioned their own practice in how they could
improve such questioning they posed in the classroom. The code “Question Use” represented comments participants expressed about question delivery in the classroom and how they critiqued their own questions. Examples of this code are “I wondered if they (students) would have had stronger opinions if we introduced a technology format or platform into the discussion” and “sometimes I wonder if I need to provide more examples about how they can evaluate a situation or if that would be too much leading direct type of instruction?”

04. Changes
04. CHA-PAC.01 = Participant Confidence

Participants described changes within their confidence level during the course of the study. Such changes within the dynamics of their confidence level influenced their classroom instruction as well as their interactions with the public. The code “participant confidence” was selected to describe the vibrant variations, which took place regarding participants’ levels of assurance. Examples of this code are “I was impressed with the fact that using these strategies they way I have, has reached both my high achieving students and struggling ones just as much” and “last year’s test scores indicated that this group I have this year is falling far below, yet they get this, they see the connections, it makes me feel really good and proud to see them accomplish so much.”

05. Challenges
05. CHL-TIC.01 = Time Constraints
05. CHL-AVT.02 = Availability of Technology
05. CHL-DAS.03 = Degree of Administrative Support

Participants depicted the numerous challenges they faced while taking part in the study. A number of the challenges participants faced directly impacted the directions they sought during the course of the study. The code of “Time Constraints” was used to describe how participants expressed the anxiety of being pulled in a number of directions as a teacher professional. Examples of this code are “since I am on the go all day, many times including lunch time, I have very little time to reflect and revise” and “I kind of overloaded things and put too much in my lessons”.

Additionally, participants faced the challenge of different levels of support when it came to using technology in their classroom instruction. The code of “Availability of Technology” was used to describe how participants expressed what technologies were available at their school, lack of technological support and technology infrastructure. Examples of this code are “the high school has much more technology than we do at the middle school, so how can we really prepare the kids to meet all the demands in high school without the technology we need” and “about 103 of my 115 kids have cell phones and smartphones at that, it just makes sense for them to be able to use their phones since we don’t have enough COW (computers on wheels)”. 
Finally, participants described how the administrative structure of their schools posed challenges at times due to a lack of understanding or interest in what they were aiming to achieve. This was coded as “Degree of Administrative Support”. The range of administrative support varied since participants were at different schools within different districts. Yet nevertheless, all participants faced the challenge as related to administrative support. Examples of this code are “I had to educate my assistant principal prior to my observation and evaluation that I was using my cell phone with the app for the Plickers that I use for the kids reflective question at the end of the hour, can’t use my district iPad because it’s outdated” and “I’m on my own, they (administration) don’t really understand what I do, so they leave me alone, which is fine, but it would be nice if they got it”.

06. Teacher Reflective Practice
06. TRP-AFE.01 = Accepting Failed Expectations

Participants depicted an aspect of their reflective practice during the study to include discussions based upon how they personally viewed the concept of failure and how they coped with failure within their professional practice. The code “Accepting Failed Expectations” describes how participants expressed coping with their own perceived failures during the study. Examples of this code are “sometimes you just have to say to students ‘hey, this is new, even I don’t know how it’s going to work out or if it doesn’t go so well you say ‘ok, let’s try another direction’” and “sometimes something that works great one day just bombs the next and you have no idea and it’s ok, everything can’t go perfect all the time, you just have to plan and keep trying, it’s all a gamble”.

Code Sheet Descriptors for Workshop

01. Facilitating Instruction
01. FAC-HOT.01 = Higher Order Thinking Skills (HOTS)
01. FAC-CCC.02 = Cross Curricular Connections

Participants depicted facilitating instruction by selecting particular instructional approaches to support the collaborative strategies. In seeking to establish how and in what ways teachers used the collaborative strategies, teachers cited examples and it was observed, where the teachers demonstrated the use of prompting students to dialogue, ask questions and engage in analysis, evaluation and the synthesis of information thus coded as “Higher Order Thinking Skills – HOTS”. Examples of this code are “using these strategies will complement my metacognition questions I use and building on developing that deeper knowledge and inquiry”, “it might start off with something superficial or basic but then it will be easier to guide them in deeper thought” and “all these strategies promote the type of thinking that isn’t answered with yes or no or a quick and correct answer. One response can lead to another question.”

Continuing to facilitate instruction, drawing upon using HOTS as an impetus, participants drew upon bringing attention to cross-curricular connections. Participants facilitated
discussions to encourage students to analyze how cross-curricular connections were established. I created the code of “Cross Curricular Connections” and examples are “it’ll be interesting to see what other areas we end up talking about” and “this could get them debating like candidates in an election, trying to convince others with their point of view, public speaking, articulation, convincing and conviction”.

02. Sharing
02. SHA-COL.01 = With colleagues

Participants depicted sharing as the ability to share ideas about instruction and the collaborative strategies with fellow colleagues, both within the study and outside of the study. The study also provided participants the platform to further develop the common interests shared amongst the participants and researcher.

Participants provided a number of comments referring to how and what experiences they shared amongst each other. The code “with Colleagues” represented comments, which were used to describe how participants pooled ideas and communicated with one another. The code also describes how participants shared ideas will fellow colleagues within their own workplace/schools. Examples of this code are “I’ll send you the readings I give my kids”, “I’m gonna steal that idea from you”, “I love these books you have here, I want to get these” and “let’s start an email group”.

03. Goals for Student Exploration
03. GOA-GEN.01 = General

Participants depicted goals for student exploration, as being a variety of ways students would be exploring the collaborative strategies. Participants discussed a number of targeted goals they had for how students could potentially explore such strategies. The code “General” describes the various ways participants discussed how students could explore such strategies. Examples of the code are “it’s good for the quiet and introverted students” and “it could enhance students’ ability to debate and speaking skills”.

Code Sheet Descriptors for Observations

01. Facilitating Instruction
01. FAC-HOT.01 = Higher Order Thinking Skills (HOTS)
01. FAC-CCC.02 = Cross Curricular Connections
01. FAC-SDM.03 = Shared Decision Making (FAC: SDM)

Participants depicted facilitating instruction by selecting particular instructional approaches to support the collaborative strategies. In seeking to establish how and in what ways teachers used the collaborative strategies, teachers cited examples and it was observed, where the teachers demonstrated the use of prompting students to dialogue, ask
questions and engage in analysis, evaluation and the synthesis of information thus coded as “Higher Order Thinking Skills – HOTS”. Examples of this code are “if you are the expert on something, you better be prepared to answer a lot of complex questions about what you know” and “issues in life are complex”.

Continuing to facilitate instruction, drawing upon using HOTS as an impetus, participants drew upon bringing attention to cross-curricular connections. Participants facilitated discussions to encourage students to analyze how cross-curricular connections were established. I created the code of “Cross Curricular Connections” and examples of this code are “what else does this remind you of”, “where else have you seen or heard of this” and “how are these issues described on the news or in social media”.

Finally, as a capstone in facilitating instruction, participants encouraged student to share in the decision-making process once students established cross-curricular connections using higher order thinking skills. Examples of the code “Shared Decision-Making” are “As a starting point, find one place, point of the issue you can all come to a conscious on” and “work on developing a decision on the most key and prominent aspects of the issue first”.

02. Sharing
02. SHA-COL.01 = With colleagues
02. SHA-COI.02 = Common Interests

Participants depicted sharing as the ability to share ideas about instruction and the collaborative strategies with fellow colleagues, both within the study and outside of the study. The study also provided participants the platform to further develop the common interests shared amongst the participants and researcher.

Participants provided a number of comments referring to how and what experiences they shared amongst each other. The code “with Colleagues” represented comments, which were used to describe how participants pooled ideas and communicated with one another. Examples of this code are “she’s the teacher next door and we’ve been talking about all this” and “I got the idea from A1 (other participant)”.

Comments such as “there are a lot more similarities in what we teach than I realized “ as demonstrated in the code of “Common Interests” expressed how participants expressed the idea of possessing commonalities within their instruction rather than being isolated by content area. Examples of this code are “we complement each other really well” and “even diametrically opposing content areas share commonalities”.

03. Fostering Independence
03. FOS-DAO.01 = Taking Ownership

Participants depicted how they provided students support to gain independence during instruction, particularly when using the collaborative strategies. The code “Taking
Ownership” was used to demonstrate examples of how participants encouraged students
stand behind the ideas they suggested. Examples of this code are “demonstrate that you
are the expert in your group” and “determine for yourself what you think it means.

Code Sheet Descriptors for Researcher Memos

01. Obstacles
01. OBS-ACC.01 = Accountability

Participants and researcher depicted obstacles as the challenges, which could not be altered. Such responsibilities within the profession remained obstacles because they could not be changes. The code “Accountability” represented comments, which were used to describe events and activities participants were required to attend and partake in. Examples of this code are “there are PLC’s” and “many of us teachers sub during our prep hour and so we loose that”.

02. Sharing
02. SHA-COL.01 = With colleagues
02. SHA-COI.02 = Common Interests

Participants and researcher depicted sharing as the ability to share ideas about instruction and the collaborative strategies with fellow colleagues, both within and outside of the study. This study also provided participants the platform to further develop the common interests shared amongst the participants and researcher.

Participants and researcher provided a number of comments referring to how and what experiences they shared amongst each other. The code “with Colleagues” represented comments, which were used to describe how participants pooled ideas and communicated with one another. Examples of this code are “building ideas off of one another, such as laminating the paper paint samples so students can write on them for the Six Thinking Hats” and “I would like to experiment with Todays Meet to see if you could color code the responses to coordinate to the hats (Six Thinking Hats)”.

Comments such as “there’s something in this for everyone “ as demonstrated in the code of “Common Interests” expressed how participants expressed the idea of possessing commonalities within their instruction rather than being isolated by content area. Examples of this code are “how about we both participate in the Barnes and Noble event and maybe the others would like to join too” and “Facebook is a great place to connect and exchange ideas, grant info etc”.

03. Frustration
03. FRU-CIR.01 = Circumstances

Researcher depicted frustrations based upon of circumstances, which took place during the course of the study. The code “Circumstances” represented comments, which
expressed, an irritation over being hindered the uncontrolled conditions and situational events, which took place during the course of the study. Examples of this code are “scheduling the focus group poses great difficulty since everyone is in such different geographic locations” and “keeping track of all these different personal schedules and school schedules makes coordinating very tricky.”

04. Changes
04. CHA-PAC.01 = Participant Confidence
04. CHA-SEP.02 = Self Perception

Participants and researcher described changes within their confidence level during the course of the study. Such changes within the dynamics of participant confidence level influenced their classroom instruction as well as their interactions with the public. The code “participant confidence” was selected to describe the vibrant variations, which took place regarding participants’ levels of assurance. Examples of this code are “we reached and interacted with so many people, such a great event” and “it feels good to help others out and be recognized”.

Researcher described changes within own perception of self as related to being a researcher and instructional specialist practitioner. Such changes occurred within positionality and the overall relationships with participants. The code “Self-Perception” was selected to describe the variations, which took place within the identity of the researcher. Examples of this code are “they (participants) consider me to be the expert and say things like ‘you know best’ and he doesn’t really consider or see me as being a guest at his school.”