Leading a Culture of Making: Investigating Leadership Capacities That Impact Learning Agency *by* Design Project, Pittsburgh

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The organic nature of maker-centered learning has built a strong base of artists, teachers, and makers at the foundation, and top-level funding and governmental supports at the top, resulting in local administration lost in the middle. This problem space prompts the question, *How do school principals and program directors identify and advocate for implementing maker-centered learning opportunities that enact curriculum, affect student achievement, and increase collaboration equally among all learners?* As teachers struggle to identify the instructional strategies and maker techniques required to impact student achievement, school principals are presented with unique adaptive and technical challenges to lead a culture of making.

This study identifies the specific leadership capacities that shift, support, and grow a culture of maker-centered learning. Working together with the members of Pittsburgh's Agency *by* Design (A*b*D) Learning Community, I surveyed A*b*D members to determine who, how, and the extent to which educators are supported in enacting maker-centered learning in their places of practice. Through an online survey, participants identified the person (or persons) who most supports their practice as well as the types of supports that are most valued. Participants considered supports such as: general leadership, financial support, curricular support, networking, professional development opportunities, collaboration with colleagues, and time for implementation and ranked them according to needs.

The results of the study reveal that leadership supports are important for educators to enact maker-centered learning practices. Results also indicate that leading a culture of making is a complex endeavor that requires both operational (scheduling, budget, curriculum) and empowering supports (advocacy, trust, shared leadership opportunities) for educators. An unexpected finding in the research revealed that participants were overwhelmingly appreciative of administrative supports. The subtle nuances associated with administrative cooperation, encouragement, and trust motivate educators to enact maker-centered learning in formal and informal learning spaces across the Pittsburgh region. It is this collective understanding that supports spaces for creativity, innovation, thinking, and learning. It is also a place where, with supportive leadership, a culture of making can emerge.

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Acknowledgements

In the poem, ***The Road Not Taken*****,** by Robert Frost, a traveler chooses to take a path less traveled. This path, the one that is grassy and wanted wear, made a significant impact and difference in the traveler's life. When I recently reread this poem, I couldn't help but compare it to my recent dissertation journey. Taking this path, although difficult, challenging, and not frequently traveled, has made a significant difference in my life. I'm forever grateful for the journey, and thankful that I took the path less traveled.

Although often a lonely journey, I certainly was not alone. This dissertation is the result of the guidance of my advisor and committee members, support from by husband and family, help from my Quaker Valley colleagues, and encouragement from my friends. Without each of you, my journey would not have been possible.

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1.0 Introduction

"Creativity and innovation is the product of intentional leadership."

(Catmull, 2014)

As school administrators navigate the complex world of meaningful maker-centered learning opportunities within the context of standards and high stakes testing, finding clear understanding and perspective can be challenging. Some school principals lack the experiential knowledge, cultural understanding, and leadership techniques of maker-centered learning practices. While the idea of "leading a culture of making" may seem vague, unrealistic, or too undefined, the learning outcomes in this culture are formative and important for school administrators to consider. Although the literature identifies the purposes, pedagogy, tools, and outcomes of maker-centered learning, there is very little research on how school principals impact or support maker-centered learning environments (Gierdowski & Reis, 2015; Peppler & Bender, 2013; Sheridan, Halverson, Litts, Brahms, Jacobs-Priebe, & Owens, 2013; Slatter & Howard, 2013).

Those unfamiliar with maker-centered learning, including some school principals, may think that making is simply "crafting" or "doing projects." This simplistic interpretation overlooks an important understanding of maker-centered learning. Bronwyn Bevan (2017), the University of Washington's senior research scientist, defines maker-centered learning as a

> *rapidly emerging form of educational practice that involves the design, construction, testing, and revision of a wide variety of objects, using high and low technologies, and integrating a range of disciplines including art, science, engineering, and mathematics. Making expands on traditions associated with Technology Education Design-Based*

> *Learning, but differs in ways that can potentially broaden participation in science and STEM learning to include learners from communities historically underrepresented in STEM fields* (p.1).

This definition associates making as a valuable practice for all students, indicating the inherent equality in maker-centered learning. It also clearly identifies the interdisciplinary nature and historical pedagogy of this type of learning. Most importantly, this definition considers maker-centered learning as an "educational practice" with potential for strong leadership to support opportunities for deeper learning.

1.1 Purpose of the Study

The organic nature of maker-centered learning has built a strong base of artists, teachers, and makers at the foundation, and top-level funding and governmental supports at the top, resulting in local administration lost in the middle. This problem space prompts the question, *How do school principals and program directors identify and advocate for implementing maker-centered learning opportunities that enact curriculum, affect student achievement, and increase collaboration equally among all learners?* As teachers struggle to identify the capacities and instructional strategies required to impact student achievement, school principals are presented with unique adaptive and technical challenges to embrace a culture of making.

The goal of my research is to identify specific leadership capacities that shift, support, and grow a maker-centered learning environment that deepens students' thinking and increases students' achievement. It is often said that "change is difficult." The difficult nature of this change requires purposeful, visionary, goal-orientated leadership with the outcome of improving school

culture and supporting teachers. To address this complex leadership challenge, I surveyed members of Pittsburgh's Agency *by* Design (A*b*D) Learning Community to identify specific leadership supports associated with leading maker-centered learning. The inquiry questions will focus on leadership supports within the following contexts as identified in the literature:

- Historical/Pedagogical Context (Dewey, 1900; Papert, 1991; Piaget, 1950)
- Clear Maker-Centered Vision for Learning (Martin, 2015; Ritchhart, 2015)
- Embedded Professional Development (Martin, et al., 2014; Wardrip & Brahms, 2014)
- Connections to Curriculum/Standards (Bevan, 2017; Halverson & Sheridan, 2014; Martin, 2015 Clapp, Ross, Ryan, & Tishman, 2017)
- Identified Instructional Practices & "Look For's" (Digital Promise, 2017)
- Student Learning Outcomes & Assessment (Bevan, 2017; Brahms & Crowley, 2014; Clapp, Ross, Ryan, & Tishman, 2017; Sheridan & Halverson, 2014)

1.2 Definitions of Terms

The following definitions provide explanations for terms specific to this study.

1. Agency *by* Design (A*b*D): A*b*D is an active research project founded in 2012 as an extension of Harvard Graduate School of Education's Project Zero. Backed by the Abundance Foundation, A*b*D researchers seek to gain an understanding of the benefits of maker-centered learning and the pedagogies and practices that support it. A*b*D participatory research first started in Oakland, California, and is now a nationally recognized learning community consisting of individuals representing maker-centered learning environments throughout the United States (Clapp, Ross, Ryan, & Tishman, 2017).

2. A*b*D Administrator: A*b*D administrators are categorized as middle-level managers in an educational system, typically schools. While most A*b*D administrators hold the title of school principals, there are a few administrators who hold titles such as director, coach, mentor, guide, and facilitator. Most A*b*D administrators have building-level (or system-level) supervisory responsibilities and are supervised by a superintendent, CEO, manager, or director. A*b*D administrators have some level of authority, power, and influence in their place of practice and typically supervise A*b*D Educators.
3. A*b*D Educator: An A*b*D educator is a teacher, educator, museum docent, tutor, mentor, or informal educator who is a member of the A*b*D network. Most A*b*D educators are supervised by an A*b*D administrator. A*b*D educators participate in face-to-face and virtual A*b*D networking sessions and share a common value for maker-centered learning.
4. Maker-Centered Learning: Maker-centered learning "is a rapidly emerging form of educational practice that involves the design, construction, testing, and revision of a wide variety of objects, using high and low technologies, and integrating a range of disciplines including art, science, engineering, and mathematics. Making expands on traditions associated with Technology Education Design-Based Learning, but differs in ways that can potentially broaden participation in science and STEM learning to include learners from communities historically underrepresented in STEM fields" (Bevan, 2017, p.1).
5. Pittsburgh Agency *by* Design (A*b*D) Learning Community: Founded in 2015 by Dr. Jeff Evancho and Dr. Peter Wardrip, Pgh A*b*D is a network of Western Pennsylvania educators committed to exploring the promises, practices, and pedagogies of maker-centered learning. Specifically, the Pittsburgh A*b*D Community values the development of

documentation and assessment strategies as the next frontier of research and practice for maker-centered learning (Evancho & Wardrip, 2018).

6. Qualtrics: A web-based services that allows for the creation of surveys, the collection and secure storage of data, the analysis of responses, and the presentation of results via professional-quality graphs (Qualtrics Survey Service, 2016).

1.3 Research Questions

This study seeks to gather information from Pittsburgh A*b*D Learning Community educators regarding their perceived value of leadership supports of maker-centered teaching and learning practices. Educators from the A*b*D Learning Community were surveyed in order to better understand their individual perceptions and level to which they value (if any) maker-centered leadership supports. The specific research questions include:

Q1: From whom and in what ways do A*b*D educators perceive that they receive support from their administration to enact maker-based learning experiences?

Q2: Related to enacting maker-centered learning, what kinds of administrative supports do educators value and why?

Q3: In what additional ways do educators claim that their administration could provide support to enact maker-based learning experiences?

1.4 Significance of the Study

This study seeks to identify and examine the leadership supports needed for educators who are enacting maker-centered learning as an instructional practice. This study is important because the identification of helpful leadership supports (as reported by educators directly working with students) may provide opportunity to influence and improve leadership practices of those in a position of authority or who have influence on programmatic and financial decisions. The results of this inquiry have the potential to align and implement research-based best practices in schools, museums, and informal learning spaces to improve the frequency and quality of maker-centered teaching and learning. Specifically, in the Western Pennsylvania Region, there is enormous potential to share the results of this study across all A*b*D networks including schools, museums, and informal learning spaces.

1.5 Summary

The aim of this study is to identify and explore leadership supports for maker-centered learning in greater depth. However, the titles of "leader" and "administrator" are used interchangeably. In the case of changing school culture, the terms cannot be interchanged. The administrative challenge presented with implementing maker-centered learning practices requires purposeful leadership. As maker-centered learning pedagogy becomes more common practice in classrooms and learning spaces, educators need specific, concrete supports from administration. This study specifically focuses on a sample group of educators in Pittsburgh's Agency *by* Design Learning Community and identifies and examines their perceived value of maker-centered

learning support. Understanding the value placed on leadership supports by educators, as well as the ways in which those supports are helpful in enacting maker-centered learning, informs the practice of administrators. Ultimately, the hope is that administrators will use the knowledge gleaned from this research to improve supports and lead a culture of making in their place of practice.

2.0 Review of Literature

This literature review explores the history of maker-centered learning and the challenges associated with implementing maker-centered learning in educational settings.

The review begins by defining maker-centered learning and provides background on the history and context of the current problem of practice. Particular attention is given to the leadership implications for administrators who support faculty in both schools and informal learning spaces.

The second portion of the review focuses on key leadership strategies and capacities found in the literature and is categorized into five general leadership supports including: 1) a clear maker-centered vision for learning, 2) embedded teacher professional development, 3) connections to curriculum and standards, 4) identified instructional practices and "look for's," and 5) developed student learning outcomes and assessment.

2.1 What is Making?

The Maker Movement "represents a growing movement of hobbyists, tinkerers, engineers, hackers, and artists committed to creatively designing and building material objects for both playful and useful ends" (Martin, 2015, p. 30). This movement is responsible for creating an international "maker culture" generating makerspaces, Maker Faires, and fabrication (or fab) labs across a range of instructional environments, including K-12 schools, museums, libraries, after-school clubs, institutions of higher education, and non-profit and for-profit organizations (Halverson & Sheridan, 2014; Resnik & Rosenblum, 2013). Historically, the act of making traces

back to crafts such as wood working, sewing, and electronics (Martin, 2015); however, the rise in do-it-yourself activities including textile crafting, robotics, cooking, electronics, digital fabrication, and mechanical repairs has revolutionized the act of making for the twenty-first century (Peppler & Bender, 2013).

Twenty-first century global economy demands have increased the need for a "maker workforce." To thrive in a global economy, people are required to demonstrate high levels of imagination, creativity, and innovative thinking to continually invent and manage new and better services and products (Trilling & Fadel, 2009). This global need set the stage for the Maker Movement to gain momentum, energy, and popularity. In alignment with Papert's (1991) learning theory of constructionism, the Maker Movement embodies the notion that individuals learn best when they are constructing for public consumption (Papert & Harel, 1991). Chris Anderson (2012), former editor-in-chief of *Wired* magazine, defines the movement as "a new industrial revolution," while Mark Hatch (2014), CEO of TechShop Makerspace, authors a "Maker Movement Manifesto." Both Hatch and Anderson highlight the importance of the construction of physical objects as a feature of the international Maker Movement.

Some maker-centered learning literature focuses on the tools, technologies, and spaces that are transformed by the Maker Movement; however, Dougherty (2012) defines the Maker Movement more generally by asserting that making is universal and core to human identity. He defines the Movement more in terms of the people who associate with the ethos of making than in terms of how or where making happens. In his view, the movement evolves to encompass the identities and practices of those who align with it (Dougherty, 2012). Dougherty's humanistic definition of the Maker Movement is aligned with other recent studies linking making to people. Honey and Kanter (2013) and Sheridan et al. (2013) define the interest-driven engagement and

creative production of making as a "culturally recognized social movement." Others agree that making has emerged as a socially engaging entry point for STEM education (Making Meaning Report, 2013; Peppler & Bender, 2013), workforce development (Executive Office of the President, 2014), and development of entrepreneurial skills (Benton, Mullins, Shelley, & Dempsey, 2013). I wholeheartedly endorse Dougherty's fundamental idea that the foundation of the Maker Movement belongs to the people who invest in it.

2.2 Historical and Pedagogical Context

Although some educators describe maker-centered learning as a twenty-first century phenomenon, the roots of making are evident as early as the 1900s. In 1902, John Dewey evoked maker-centered learning when he spoke of children's need to create:

> The instinct of making – the constructive impulse. The child's impulse to do finds expression first in play, in movement, gesture, and make-believe, becomes more definite, and seeks outlet in shaping materials into tangible forms and permanent embodiment. The child has not much interest for abstract inquiry…. There is no distinction between experimental science for little children and the work done in the carpenter shop. (p.4)

He articulated that the act of making is innately human, especially for children. Moreover, Dewey (1900) advocated for schools to leverage children's innate impulses specifically to make, converse, inquire, and artistically express meaningful learning experiences. In 1912, Maria Montessori argued that children learn by playing and building with interesting tools and materials. Decades later, Piaget's idea of students "testing theories out in the world," a process called "conceptual disequilibrium," became a widely accepted educational practice (Piaget, 1950).

A fundamental point in the historical context of maker-centered learning is captured in the theoretical foundation of Seymour Papert's work. Many consider Papert the "Father of the Maker Movement" (Martinez & Stager, 2014, p.21). Papert's (1991) theories build on Piaget's (1980) theory of constructivism. Piaget proposed that individuals construct knowledge through experiences and that those experiences are then sorted into cognitive schemes (Driver, et al. 1994). Expanding on Piaget's work, Papert argues that people learn best when they are constructing an entity for public consumption, "whether it's a sandcastle on the beach or a theory of the universe" (Papert & Harel, 1991, p.1). In essence, Papert theorizes that people learn best when they are making something of personal value with the goal of sharing that product with the world.

Around the turn of the century, a grassroots global collection of makers, tinkerers, crafters, and hackers joined to formalize *The Maker Movement*. Gaining rapid momentum, The Movement grew in capacity and popularity. In 2005, Maker Media published the first issue of *Make Magazine* and the following year sponsored the world's first Maker Faire, held in San Mateo, California (Bevan, 2017). Maker experts agree that this event marked a rebirth of excitement in "making things" as opposed to "consuming things" (Clapp, Ross, Ryan, & Tishman, 2017). The trend continued and even gained the attention of the federal government. In 2014, the White House hosted its first ever Maker Faire and established June 18 as a "National Day of Making." In his speech to the makers gathered for this unprecedented event, President Obama remarked:

> This is a country that imagined a railroad connecting a continent, imagined electricity powering our cities and towns, imagined skyscrapers reaching into the heaves, and an Internet that brings us closer together. So we imagined these things, then we did them. And that's in our DNA. That's who we are. We're not done yet. And I hope every company, every college, every community, every citizen joins us as we lift up makers and

builders and doers across the country (The White House, Office of the Press Secretary, 2014).

President Obama's comments opened a sea of advocacy for the Maker Movement. Voices from media, government, industry, and education joined in support of the Maker Movement. In his book, *Makers: The New Industrial Revolution*, Chris Anderson (2012), predicted that the next wave of global manufacturing and entrepreneurship would be born of the talents and shared ideas developed by makers.

Recently, there have been increasing attempts to integrate maker-centered learning into informal learning environments, such as museums and science centers (Bennet & Monahan, 2013; Brahms & Werner, 2013; Petrich, Wilkinson, & Bevan, 2013), after-school clubs (Vossoughi, Escude, Kong, & Hooper, 2013), summer camps and workshops (Buechley & Eisenberg, 2008; Buchholz, Sively, Peppler & Wohlwend, 2014; McDowell, 2015), specialty events (Finn, 2012; Zosh, Fisher, Golinkoff, & Hirsh-Pasek, 2013), libraries (Bowler, 2014; Moorefield-Lang, 2015; Resnik, 2014; Slatter & Howard, 2013), and institutions of higher learning (Forest et al., 2014; Olson, Schweik, & Brewer, 2015). Most of the research on making in education has focused on these informal learning environments and is just beginning to focus attention on making in formal PK-12 learning environments (Sefton-Green, 2013; Vossoughi & Bevan, 2014). Additionally, because maker learning in formal PK-12 school settings is a new field of scholarship, researchers are still identifying the important questions for investigation. Many studies have focused on how learners engage in maker-centered learning (Martin, 2015; Martinez & Stager, 2013; Peppler & Bender, 2013; Rees, Olson, Schweik & Brewer, 2015; Sheridan et al., 2014); however, very few identify how administrators lead a culture of making (Fleming, 2015; Ritchhart, 2015). The remainder of this literature review provides a discussion of the research that has been conducted

to investigate specific leadership capacities and technical challenges associated with leading a culture of making. It is organized, specifically for administrators/director level managers, into the following subsections: a clear maker-centered vision for learning, embedded teacher professional development, connections to curriculum and standards, identified instructional practices and "look for's," and student learning outcomes and assessment.

2.3 Leadership Strategies and Capacities

2.3.1 Clear Vision for Maker-Centered Learning

A common theme across both formal and informal maker-centered learning spaces is that the most successful school transformations, implementations, and changes have been supported by a champion in a position of authority (e.g., a principal, director, or superintendent) (Moorefield-Lang, 2015; Sheridan et al., 2014). In one reflection, a school librarian remarks that "the key to success of my makerspace was that my administrator actively nurtured a culture in my school that allowed for creativity and innovation to occur" (Fleming, 2015, p. 59). Maker-centered learning in schools can only be successful with the help of school leaders who model twenty-first century collaborative practices and recognize that teachers need flexibility and encouragement to inspire innovation. As the prominent educational writer Ken Robinson (2011) puts it, "Creating a culture of innovation will only work fully and effectively if the initiative is able to claim real and ongoing commitment from the top of the organization" (p. 219). Despite the organic progression of maker-centered learning, I suggest that visionary leadership will influence the next generation of maker-centered learning growth in formal school settings.

When it comes to the idea of changing culture, most would readily agree that leadership is critical to any change initiative. In discussions of maker-centered learning, this argument usually ends, however, with a discussion of the benefits of top-down versus bottom-up leadership frameworks. Whereas some researchers are convinced that maker-centered learning will continue to grow in formal school settings organically (Clapp, Ross, Ryan, & Tishman, 2014), others suggest that purposeful leadership is critical. Leadership experts Heifetz, Grashow, and Linsky (2009) maintain that a defined direction and clear vision, created together with stakeholders, is necessary to inspire an adaptive shift towards maker-centered learning. They define adaptive leadership as "the practice of mobilizing people to tackle tough challenges and thrive" (Heifetz et al., 2009). Therefore, adaptive leadership techniques (a blend of top-down and bottom-up) have potential to transform a traditional school atmosphere into a place that prioritizes making as a way of learning.

Harvard researcher Ron Ritchhart (2015) describes a culture of thinking as one that "produces the feelings, energy, and even joy that can propel learning forward and motivate us to do what at times can be hard and challenging mental work" (p. 5). This definition provides a template for vision and action needed to make an adaptive change. Lee Martin's (2015) research further supports the critical need for vision, advising that stakeholders "profess common beliefs and discuss critical attributes that embody the learning that will occur" in a maker-centered culture (p. 35). Although he describes four specific beliefs about learning (that it should be playful, asset- and growth-oriented, failure-positive, and collaborative), he is adamant that school leaders should "construct their own version of the maker mindset appropriate to the local context" (Martin, 2015, pp. 35-36). As stakeholders start to believe in the vision of maker-centered learning, there is a powerful potential to break down equity barriers evident in traditional learning spaces. When

educators believe that all children have the inherent right to learn via "making," the culture can honor the spirit of inclusivity transcending social, racial, and gender bias (Fleming, 2015). These beliefs start with a clear vision for maker-centered learning.

2.3.2 Embedded Professional Development

The science of teaching involves finding new ways to support the ever-changing needs of students. Numerous studies have shown the importance of administrators and teachers engaging in professional development together in order to prepare for changing educational trends (OECD, 2005). In many high-performing education systems, teachers do not only have a central role to play in implementing educational initiatives but are also at the center of the efforts themselves (OECD, 2011). In a maker-centered classroom, a teacher's role as facilitator, responder, planner, and designer is unique from a traditional classroom. School administrators are challenged with providing professional development that bridges the gap between the ideal maker-centered learning environment and day-to-day practices and requirements. The international Organization for Economic Co-operation and Development (OECD) recommends that professional development should be ongoing; include training, practice, and feedback; and provide adequate time and follow-up support from administrators. Furthermore, successful professional development programs involve teachers in learning activities that are similar to those they will use with their students (OECD, 2011).

Little research has focused attention on professional development for maker-centered classrooms in the traditional school system. Martin et al. (2014) conducted a professional development session for 30 middle and high school teachers that focused on design-based learning and creating with technology; in particular, teachers gained experience with Arduinos and 3D

printers. Following the training, pre- and post-surveys, as well as a STEM content assessment, were administered to the teachers. Results indicated that teachers were proud of their creations but struggled with the use of technology and programming that was required. Teachers showed a slight increase on scores for the content assessment, but the sample size was too small to gain statistically significant results. Additionally, researchers did not report on the teachers participating in subsequent use of these design-based projects with their own students. These findings have important implications for the broader domain of professional development because they highlight the need for administrative support and on-going training for professional development to change culture or improve teaching.

Conversely, Wardrip and Brahms (2014) describe their experiences with a mobile makerspace associated with MAKESHOP at the Children's Museum of Pittsburgh. In an effort to share making with the local community, MAKESHOP teamed with two suburban elementary schools to integrate making into the curriculum. Educators at both schools attended a summer "boot camp" and participated in ongoing instructional training from museum facilitators. The preliminary findings suggest that differences in school implementation greatly influenced how the teachers did (or did not) incorporate making into their classrooms. The following factors were identified as particularly influential: 1) how school leadership selected participating teachers, 2) the space available for making, and 3) how making was (or was not) connected to learning already occurring in their classroom. Successful teachers wanted to incorporate making into their classrooms, found creative ways to connect making to other content areas, and did better when there was a designated space for making (as opposed to a mobile cart) (Wardrip &Brahms, 2014).

The complexity of maker-centered learning requires a two-tiered approach to professional development. In addition to the technical and practical trainings required to understand the tools,

technologies, and structure of maker-centered learning (Martin et al., 2014; Wardrip & Brahms, 2014), teachers need a transformed mindset to a new pedagogy that embraces the enthusiasm and attitude of the Maker Movement (Martinez & Stager, 2014). These attitudes, otherwise defined as capacities for learning, focus on the social, shared learning experiences created by the learners themselves. Risk taking, creativity, and innovative thinking are nurtured in learning environments that foster questioning, patience, openness to fresh ideas, high levels of trust, and learning from mistakes and failures (Trilling & Fadel, 2009). The mindset that once assumed that teachers are the sole authority of knowledge in a classroom is being challenged by researchers who believe that knowledge can be accessed from many sources, including the students themselves (Clapp, Ross, Ryan, & Tishman, 2017). Ultimately, creating a culture of making requires embedded, on-going, and collaborative professional development for teachers and administrators.

Thomas Guskey (2016), an expert in evaluation design and educational reform, suggests that effective professional development extends beyond collaborative engagement and should include statistical evaluation data to measure effectiveness. Furthermore, he argues that administrators should consider backwards planning as a professional development strategy, considering student learning outcomes first and then determining the instructional practices and policies that will most effectively produce those outcomes. Therefore, if we want students to develop maker-empowered dispositions for learning (Clapp, Ross, Ryan, & Tishman, 2017), administrators and educators need to engage in defining the sources of data that that best reflect those outcomes and work backwards to design meaningful teacher professional development. The essence of Guskey's (2016) research is that "professional learning that increases educator effectiveness and results for all students uses a variety of sources and types of student, educator, and system data to plan, assess, and evaluate professional learning" (p. 36). Although I agree with

Guskey's argument supporting the need of data to evaluate professional development, I think educators are still in the infancy stages of identifying data points and assessments that accurately reflect maker centered learning dispositions.

2.3.3 Connections to Curriculum and Standards

In 2010, the National Governors Association adopted the Common Core State Standards, the first nationalized curriculum in the history of the United States. Officially, the purpose of the standards was to prepare students to enter a global workforce (Spring, 2014). By March of 2014, Pennsylvania had amended, reviewed, and adopted the CCSS Standards under Chapter 4, renaming them PA Core Standards (Pennsylvania Department of Education, 2010). Although not identical, the CCSS and PA Core Standards similarly "define the knowledge and skills students should have within their K-12 education careers so that they will graduate high school and be able to succeed in entry-level, credit-bearing academic college courses or in workforce training programs" (CCSS, 2013, p. 3). PA Core Standards represent the current academic standards of performance in all public schools.

Despite the claim that PA Core Standards are "evidence based," there is no research supporting the assumption that standards will lead to student success in the global workforce (Spring, 2014). Furthermore, there is a wide gap between what is written in the document and how those standards are addressed. Decisions on how to teach the standards (i.e. the curriculum, tools, textbooks, and materials to be used) are left to local school board decision-makers. It is expected that school districts update their textbooks, teaching methods, curriculum activities, and instructional materials to align with PA Core Standards (PASPB, 2014). As PA Core Standards increase in academic rigor, new methods of teaching are required that lead students to become

critical thinkers and problem solvers with higher levels of mastery. It is important to note that local decisions regarding teaching and learning significantly impact opportunities for maker-centered learning in PA schools because of the grass-roots nature of the movement.

Given educators' broad autonomy with teaching techniques, coupled with the positive rhetoric of maker-centered learning, one would think that there would be evidence, research, and literature aligning standards with maker teaching strategies. However, this could not be further from the case. The reality is that both PA Common Core Standards and effective maker practices are relatively new to the field of research. making it difficult to find quantitative, definitive, or actionable studies linking the two. Many maker-centered experts (Bevan, 2017; Clapp, Ross, Ryan, & Tishman, 2017; Halverson & Sheridan, 2014; Martin, 2015) agree that longitudinal research is needed to fully understand the influence and opportunity maker-centered learning strategies have on curriculum and standards. Maker space designer Laura Fleming (2015) believes that instructional changes begin at the classroom level and hopes that:

> in developing my makerspace, it would serve as a catalyst for future changes in the curriculum and in my school community, some of which, gratifyingly, I have already seen happen. I have seen classroom teachers begin to adjust their curricula and their teaching practice in order to reflect many of the principles related to making. (pp. 56-57)

From a leadership perspective, I am of two minds when it comes to this claim. On the one hand, I agree that individual teachers have potential to be catalysts for change. On the other hand, I am not sure that maker-centered teaching practices can grow with the consistency, purpose, and accuracy necessary to impact student achievement in a bottom-up framework for change. Heifetz, Grashow, and Linsky (2009) define this adaptive leadership challenge as a "competing commitment" (p. 81). Furthermore, they argue that the resolution to a challenge such as this

requires a strong organizational leader to make an informed, strategic decision considering that there may be a loss as a result of that decision.

Next Generation Learning Challenges (NGLC), a national initiative closely related to the innovative side of maker-centered learning, is conducting field-based experiments in next generation learning. A group of educators, researchers, and entrepreneurs at both K-12 and postsecondary levels are exploring, addressing, and refining the idea of the current "student learning experience" (Calkins & Vogt, 2013). Through this work, the NGLC hopes to establish a framework that assembles and organizes the teaching strategies involved in designing, implementing, and enabling "next generation" learners. This research study is the closest example of a wide-scale approach to creating curriculum and identifying student outcomes related to the National Common Core Standards (Calkins & Vogt, 2013). However, it is worth considering that these concepts only have the potential to impact learning when they are operationalized in curricula, assessments, and practice.

2.3.4 Identified Instructional Practices and "Look For's"

Globally, there are 14 times more established makerspaces than there were in 2006. With 1,400 active spaces reported worldwide, unprecedented growth is expected to continue (Lou & Peek, 2016). A growing number of classrooms, libraries, and common spaces are being transformed into makerspaces, and educators are leveraging maker activities to engage learners in creative, higher-order problem-solving through design, construction, and iteration (Bannon, 2016). Reportedly, makerspaces are also exposing students to technical disciplines and entrepreneurial thinking, and producing innovative solutions (Herold, 2011). Teachers are incorporating making into the curriculum and experimenting with design thinking approaches. As momentum for maker-

centered learning sweeps the field of education, scholarly research has just begun. With limited research in this area, superintendents, principals, and supervisors have few resources for identifying best practices and teaching techniques that build a culture of making.

Researchers in Denmark examined how makerspaces at the International School of Billund (ISB) contribute to primary students' skill development through exploration and play. ISB has a Creator Space that equips teachers with the skills to support students in maker-centered learning. A conclusion drawn from this study is that merely assigning an open space is not enough; the environment must be configured in a manner that nurtures creativity and collaboration while promoting both self-directed and peer-to-peer learning (Ferguson, 2016). Recent studies such as this one shed new light on the instructional priorities of maker-centered learning, which previous studies had not addressed.

Other organizations, such as Digital Promise, are working with educational leaders, researchers, and technology developers to design frameworks and "look for" handbooks to guide school leaders who supervise teaching and learning. Recently, Digital Promise published a *Project Design Guide* (2017) as a tool to better understand a maker project that is currently in progress or to aid in designing a new project. The guide is grounded in three core values: agency, authenticity, and audience, and it engages both the teacher and the student in reflection questions. Teaching in a maker environment requires attention to a broad set of factors in addition to the teacher's direct interaction with students. Therefore, the guide attends to multiple dimensions of student engagement (e.g., materials, social interactions, and personal refection) and teacher facilitation (including qualities such as safe, responsive, intentional, and empowering).

Some research seeks to answer the question "What does learning look like in a maker-centered classroom?" Since 2012, researchers from the Agency *by* Design Project (A*b*D) have

completed a series of site visits to a variety of maker-centered learning environments, pairing interviews with educators with observations of classrooms. To answer this complex question, A*b*D researchers respond: "You are likely to see lots of examples of distributed teaching and learning – students teaching students, students teaching teachers, teachers and students learning alongside one another, and students knowledge-sourcing form one another and online" (Clapp, Ross, Ryan, & Tishman, 2017, pp. 73-74). In the maker-centered classroom, one may also see community members working with students in the classrooms, as well as groups of multi-age students working collaboratively on projects. They also argue that the essence of maker-centered learning in action is students "figuring things out for themselves" (Clapp, Ross, Ryan, & Tishman, 2017, p. 74).

In the Commonwealth of Pennsylvania, school principals and supervisors observe and evaluate teachers through processes outlined in ACT 82. ACT 82, otherwise known as the Educator Effectiveness Act, was passed into law in 2012 with the goal of developing "educator effectiveness models that will reform the way we evaluate school professionals as well as the critical components of training and professional growth" (Act 82, 2012). Under Act 82 requirements, teacher observations and evaluations are based on Charlotte Danielson's (2007) teaching framework and assigned the following categories: planning and preparation, classroom environment, instruction, and professional responsibilities. These specific categories frame teacher observations, differentiated supervision options, and the PA yearly formal evaluation mandated by the state. The organic, malleable nature of maker-centered learning provides challenges for administrators who are required to complete specific, rigid classroom observations and walkthroughs as outlined in Act 82.

2.3.5 Student Learning Outcomes and Assessment

One current area of research with maker-centered learning focuses on how to measure and assess student learning outcomes in formal classroom environments. Halverson and Sheridan (2014) observe that "in these spaces, learning happens as a consequence of individuals beginning as legitimate peripheral participants and moving towards becoming full participants. But learning is not guaranteed; nor is it regulated…As a result, the unit of analysis is not necessarily individual learners over time, but, rather, what happens in the space" (p.8). While some (Litts, 2014) contend that the physical artifact produced is enough evidence of learning, others question how to measure and assess the learning that occurs through making (Bevan, 2017; Brahms & Crowley, 2014; Clapp, Ross, Ryan, & Tishman, 2017; Sheridan & Halverson, 2014). These questions, asked by multiple researchers, add weight to the argument that neither teachers nor supervisors have a clear understanding of how to assess maker-centered learning in traditional classroom structures.

Petrich, Wilkinson, and Bevan (2013) identify four tentative indicators of learning by observing visitors at the Exploratorium's Tinkering Studio: 1) engagement (duration, frequency, and emotional expressions), 2) intentionality (personalization of projects, self-direction, and varied paths), 3) innovation (repurposing ideas/tools, complexification, and redirecting efforts), and 4) solidarity (borrowing/adapting/sharing tools and ideas, and contributing to the work of others) (p.66). Furthermore, they posit that if "learning is conceptualized as more than the ability to reproduce facts and skills in decontextualized settings, if it is understood as engaging in practices that draw on facts and skills to advance valued and purposeful activity, and if learning activities are designed within a STEM-rich context...then, yes, they are learning" (Petrich, Wilkinson, & Bevan, 2013, p. 69).

In 2014, Brahms and Crowley identified seven core learning practices associated with maker-centered learning by analyzing a series of Maker practices: explore and question, tinker/test and iterate, hack and repurpose, combine and complexify, seek out resources, and customize. These learning practices, also called indicators of learning, provide guidelines for educators as to what students should do in a maker-centered classroom. Furthermore, these indicators are in alignment with the spirit of the Maker Movement, ensuring that formalizing making in school settings will not "quash the emergence, creativity, innovation, and entrepreneurial skills that are the hallmarks of the maker revolution" (Sheridan & Halverson, 2015, p. 500).

Another prominent study, conducted by Wardrip and Brahms (2015), identifies learning practices of museum visitors at MAKESHOP, a makerspace at the Children's Museum of Pittsburgh. Building from Brahms and Crowley's (2014) research, this study articulates how indicators resonate as a framework for learning in context. MAKESHOP researchers observed museum visitors over time in order to identify learning practices, which were refined through "critical discussions" and "reflective conversations." The identified practices included: inquire, tinker, seek and share resources, hack and repurpose, express intention, develop fluency, and simplify to complexity. Although recent studies (Brahms & Crowley, 2014; Petrich, Wilkinson & Bevan, 2013; Wardrip & Brahms, 2015) have clearly identified student learning indicators and outcomes, the literature fails to address how maker-centered learning is formally assessed.

While maker-centered learning holds the transformative potential to deepen students learning experiences, there is an inherent problem with assessing this type of student learning. In 2010, Pennsylvania adopted National Core Standards, which ultimately directed local district curriculum. Each spring, beginning in third grade, elementary students across the Commonwealth take mandated standardized tests (PSSAs) to measure their knowledge and understanding of these

rigorous standards. As expectations rise, elementary teachers prioritize math, reading, and science instructional time to cover the standards with the hopes of increasing student achievement (Gewertz, 2015). With pressure to prepare students for high-stakes testing, non-traditional assessments that measure maker-centered learning outcomes (such as portfolios, self-assessments, and rubrics) may have less emphasis. This problem space leaves educators struggling to see evidence of maker learning because required assessments are not aligned with instructional practices and do not necessarily measure deep thinking.

2.3.6 Leadership Supports: General, Operational, and Empowering

Although there is little scholarly evidence regarding specific leadership supports for implementing maker learning, there is research that informs general leadership supports for educators. Zavala and Valenta (2017) have done significant research on how elementary school principals support teachers' professional capacity, specifically through the era of high-stakes testing and increased state and national accountability. They contend that effective leaders support teachers by: building capacity in teachers, serving as instructional facilitators, entrusting teachers to implement equitable pedagogy, expecting teachers to practice differentiated instructional strategies, and engaging in varied levels of collaboration (e.g., professional learning communities) (Zavala & Valenta, 2017). The essence of this study connects research-based supports with effective leadership. Other researchers agree and further assert that the "leadership ability and values of the principal determine in large measure what transpires in a school, and what transpires in a school either promotes and nourishes or impedes and diminishes student academic achievement" (Ovando & Cavazos, 2004, p. 101).

In another recent study, investigators determined that principal support is one of the two most influential factors related directly to teacher job satisfaction and school climate (Olsen & Huang, 2019). Using the restricted *2011-2012 Schools and Staffing Survey*, Olsen and Huang determined that "principal support" is a statistically significant variable in predicting overall job satisfaction in schools. The findings, aligned with Spiro's (2013) work, maintain that principals support teachers by being competent leaders who "recognize the strengths and weaknesses of faculty and staff, know how to make data driven decisions, and are open to learning new techniques and skills (p. 20). Research from multiple disciplines support the theory that supervisors have the potential to influence and support their employees (Grissom & Keiser, 2011; Nicholson-Crotty & Keiser, 2012; Trottier, Van Wart, & Wang, 2008).

Some researchers categorize general leadership supports into two categories. The first category includes the managerial types of support an administrator may provide for educators. This category may also be called "operational" supports and can sometimes be considered bureaucratic. Often times, these supports come as a result of the daily urgencies and logistical issues that occur in educational settings. The University of Washington Center for the Study of Teaching and Policy describes these supports on a continuum of responsibilities from the "management of personnel, supply orders, procurement of vendor services, and maintenance of the school facility, and on the other end, the management of crises, staff conflict, delicate student placement issues, or interactions with irate parents" (Knapp, Copland, Honig, Plecki & Portin, 2010, pp. 22-23). There are significant risks for crisis or operational failures without leadership support systems for these types of managerial and operational needs.

A second category of general leadership supports falls into the category of empowerment supports. The idea of empowerment leadership has emerged as a category as organizations become

"flatter," with more reliance on teamwork, work complexity, and increased interest in leadership from practitioners (Arnold, Arad, Rhoades, & Drasgow, 2000; Seibert, Silver, & Randolph, 2004). Empowering leadership is defined as "leader supports directed at individuals or entire teams and consisting of delegating authority to employees, promoting their self-directed and autonomous decision making, coaching, sharing information, and asking for input" (Kirkman & Rosen, 1999). Leadership practices that can be considered empowerment supports include: collaborative teaming focused on problem solving, creation of an environment that supports trying new ideas, modeling risk taking, creation of structures for collective decision making, and recognition of teacher expertise (Short, 1998). Empowerment leadership also extends beyond the organization to build networks within the community to support school programs and initiatives. Finally, additional research links empowerment leadership to creativity (Harris et al., 2014; Zahng & Zhou, 2014), a fundamental pillar in the world of maker-centered learning practices.

The need for general leadership supports for educational initiatives is apparent throughout the literature. Petzko (2004) established that principals who create supportive environments that foster recognition and appreciation have more satisfied teachers, and Brown and Wynn (2009) find that principals who actively support their teachers are more committed to personal growth and retain teachers at higher rates compared to their peers. While it is doubtful that anyone would disagree with the overwhelming need for leadership supports in education settings, one may wonder if those supports are the same supports educators may need to enact maker learning and teaching practices.

2.4 Summary

Undoubtedly, there is great enthusiasm around incorporating maker-centered practices into formal and informal educational spaces. Educational literature, blogs, books, *YouTube* videos, and social media reflect this excitement and point educators towards resources, projects, and do-it-yourself tutorials for just about any type of task. While there is no lack of ideas in the field of maker-centered learning, the field is missing visionary leadership that shifts, supports, and grows cultures of making across educational settings. If, as expressed in the literature, maker-centered learning practices have the potential to enrich learning, then educators need direct and indirect administrative supports to transform learning spaces and improve instructional strategies. George Couros (2015), popular author and motivational speaker, acknowledges that "creating a culture of innovation requires a series of small steps taken toward a great vision" (p. 88). Furthermore, he suggests that empowering educators through purposeful modeling is the best way to achieve this vision. But, what are those strategic steps, and how do administrators meaningfully support educators in enacting maker-centered learning? These questions point to the gap in current educational literature that this research seeks to fill.

3.0 Methods

This chapter discusses the methodology utilized in this research study. The chapter begins with a statement of the inquiry problem, which is then followed by a discussion of three critical research questions. The research design and survey instrument are also described. Next, I provide a discussion of the proposed data analysis procedures and identify the study stakeholders. Lastly, I examine the study limitations.

3.1 Statement of the Problem

The purpose of this study is to identify and examine the supports that administrators provide educators regarding implementing maker-centered learning practices and pedagogies in both formal and informal learning spaces. As administrators are the stakeholder group most likely responsible for supporting educators in this maker endeavor, they are the ones most likely to benefit from this inquiry. The goal of the literature review was to provide a foundation for this study by addressing the following question: How do administrators identify and advocate for implementing maker-centered learning opportunities that enact curriculum, affect student achievement, and increase collaboration equally among learners? Throughout the literature, several themes of administrative supports emerge, including: clear vision for maker-centered learning, embedded professional development, connection to curriculum and standards, clearly identified instructional practices/best practices, student learning outcomes, and assessment. The gaps that remain, found among the general themes, is the problem space that led to the formulation

of the research questions this study examined. These research questions also guided the research design, instrument, setting, stakeholder group, sampling time frame and procedures, and processes for analyzing data and reporting findings.

3.2 Research Questions

Following are the specific research questions that drove this inquiry:

Q1: From whom and in what ways do A*b*D educators perceive that they receive support from their administration to enact maker-based learning experiences?

Q2: Related to enacting maker-centered learning, what kinds of administrative supports do educators value and why?

Q3: In what additional ways do educators claim that their administration could provide support to enact maker-based learning experiences?

3.2.1 Inquiry Question One Discussion

From whom and in what ways do AbD educators perceive that they receive support from their administration to enact maker-based learning experiences?

In a variety of different contexts, maker-centered learning transforms educational practice. This new pedagogy encourages community, collaboration, distributed teaching and learning, boundary crossing, and responsive and flexible teacher practices (Clapp, Ross, Ryan, & Tishman, 2017). As maker-centered learning practices spread into schools, museums, libraries, and community spaces, it is important to identify <u>who</u> (in administration/management) and <u>how</u> those

individuals support this educational shift. Specifically, school principals and director level supervisors need to know what effect (if any) their roles have on this educational practice.

3.2.2 Inquiry Question Two Discussion

Related to enacting maker-centered learning, what kinds of administrative supports do educators value and why?

A common theme across both formal and informal maker-centered learning spaces is that the most successful school transformations, implementations, and changes have been supported by a champion (e.g., a principal, director, or superintendent) in a position of authority (Moorefield-Lang, 2015; Sheridan et al., 2014). Question two sought to specifically identify the types of supports or leadership techniques A*b*D principals/directors employ to shift, grow, and/or build a maker-centered culture in their places of practice. Subsequently, the supports were ranked to determine the most beneficial influences on an educator's practice. Once the supports were identified, they could have the potential of being replicated in practice.

3.2.3 Inquiry Question Three Discussion

In what additional ways do educators claim that their administration could provide support to enact maker-based learning experiences?

School principals and directors of informal learning spaces are responsible for supervising teaching and learning in their places of practice. Most organizations utilize a prescribed supervisory or leadership framework to explain these evaluative conversations. For example, public schools in Pennsylvania utilize Charlotte Danielson's Framework for Teaching (FFT) to

define and evaluate distinguished instructional practices (Danielson Group, 2013). Question three of this study sought to illuminate educators' perspectives about what is missing from the prescribed leadership or supervisory frameworks that may have greater impact on maker-centered teaching and learning. How can school principals and directors better support maker educators, and how does this support fit into prescribed supervisory frameworks such as the FFT?

3.3 Research Design

The purpose of this inquiry was to identify effective supports provided by A*b*D administrators in a maker-centered learning environment. This mixed methods research, informed by a constructivist paradigm, assumed that knowledge is socially constructed by those active in the research process and that researchers should attempt to understand the complex world of lived experiences from the point of view of those who live it (Schwandt, 2000). The inquiry was designed as a needs assessment with roots in improvement science. As this research represented a complex educational problem, both quantitative and qualitative data were collected (Teddlie & Tashakkori, 2009).

According to Babbie (2010), "Quantitative methods emphasize the objective measurements and the statistical analysis of data collected through surveys. Quantitative research focuses on generalizing the data across groups of people to explain a particular phenomenon" (p. 254). In addition to collecting quantifiable data, this study also sought to represent the voices of the study participants through the collection and coding of responses to open-ended survey questions. Qualitative methods "allow for the inclusion of participants' differences in beliefs, values, intentions, and meanings as well as social, cultural, and physical contextual factors that

affect relationships" (Maxwell, 2012, p. 655). Both Hesse-Biber (2013) and White (2013) argue that mixed methods research design can enhance research because a mixed-methods approach incorporates techniques from both quantitative and qualitative research traditions. Furthermore, a mixed methods approach enhanced the ability of the researcher to draw conclusions about leadership supports for maker-centered learning in a way that would not have been possible using either quantitative or qualitative methods exclusively.

Additionally, this methodology focuses on the "concept of a case, the particular example or instance from a class or group of events, issues, or programs, and how people interact with components of these phenomena" (Moore, Lapan, & Quartaroli, 2012, pp. 243-244). Specifically, this case study investigated how A*b*D Administrators support educators as they engage with maker-centered learning. Included in this study are the results of a simple descriptive survey of A*b*D Educators. The data analysis focused on central themes and commonalities that are perceived by A*b*D educators and found in the literature.

3.4 Research Setting and Participants

3.4.1 Research Setting

The research setting for this inquiry included public, private, charter, and informal learning spaces throughout the Pittsburgh region. The spaces, mostly schools, represented a wide variety of socioeconomic statuses from various types of locations, including rural, suburban, and urban areas. Schools included in the research are in districts that participate in the Pittsburgh Agency *by* Design Cohort, a multi-year research initiative at Project Zero, a research center at the Harvard

Graduate School of Education (Clapp, Ross, Ryan, & Tishman, 2017). The purpose of the A*b*D group is to investigate the promises, practices, and pedagogies of maker-centered learning experiences with a specific cohort focus on developing documentation and assessment strategies as the next frontier of research for maker-centered learning (Evancho & Wardrip, 2017).

Since 2015, Pittsburgh Agency *by* Design fellows have been meeting in formal and informal locations throughout the Pittsburgh region on a monthly basis. Meeting locations include Quaker Valley School District, The Pittsburgh Children's Museum, Sto-Rox School District, South Fayette School District, Slippery Rock School District, and the Falk Laboratory School, to name a few. During the monthly workshop/study groups, A*b*D educators are welcomed by the school principal, tour the school, complete classroom observations, and participate in a maker-activity or design challenge with students. Each month, participants pilot web-based applications, rubrics, and checklist assessments to assess maker-centered learning in their own teaching/learning space. A*b*D participants also look for "learning in the wild" by observing and documenting learning values in classroom settings. The A*b*D cohort has become a mini-incubator of ideas, thoughts, research, and technology integration.

3.4.2 Participants

Each year, 30 to 40 educators participate in the A*b*D Pittsburgh Cohort. The group's variety of educational experiences was helpful to my inquiry. Most of the participants are supervised by a building-level principal or director and have direct experiences with both the positive and problematic nature of their supervisors. Of the 35 participants from 2016-2017, 9 percent teach language arts or humanities, 43 percent teach in STEM, 33 percent teach in the arts, and 15 percent are informal educators. About one-third of the group has been teaching for one to

five years, another third has been teaching for five to 15 years, and another third has been in the profession for over 15 years. Group members are also disaggregated by the age levels of the students with whom they work. Fourteen percent work with preschool students, 33 percent with elementary students, 21 percent with middle-level students, 30 percent in high schools, and 2 percent in post-secondary learning institutions. Participants come together collaboratively with a common passion for growing maker-centered learning in the Pittsburgh region. The demographic participant data for the 2018-2019 cohort is discussed in Chapter 4.

In this study, it was important to identify the backgrounds, characteristics, and levels of experience of individuals associated with A*b*D. A*b*D educators may demonstrate higher levels of maker-centered proficiency compared to colleagues in other learning spaces due to their passion, experiences, and willingness to participate in the research project. In addition, the participants' administrators may inherently provide greater levels of support, in part due to the permission, funding, and encouragement for their faculty to participate in the project. This demographic information could have added bias to the data collection or to the outcome of the study.

3.4.3 Researcher as Participant

It is important to note my 10 years of experience as an educational leader and my two years of participation in the A*b*D Learning Community. During my tenure as an administrator, I have been engaged with maker educators regionally, nationally, and internationally. During the summer of 2016, I attended Harvard's School of Education Project Zero Summer Institute and have presented at subsequent Project Zero Perspectives Conferences. Project Zero, founded by Nelson Goodman in 1967, focuses on understanding learning in and through the arts. Through my work and training with Project Zero, I have become especially interested in one of Harvard's sister

research projects; Agency *by* Design. The first A*b*D Learning community started in 2012 at the Harvard Graduate School of Education in order to investigate the promises, practices, and pedagogies of maker-centered learning. Since that time, the research project branched first into Oakland, California; since 2015, a regional chapter has evolved in the Pittsburgh region.

Since 2016, I have been a participant in the A*b*D Pittsburgh Learning Community. It is important to acknowledge the relationships that have been established between the researcher and the educators in A*b*D Pittsburgh. As a newer participant in the Learning Community, I take purposeful steps to foster positive relationships with educators and engage in the Learning Community culture. During monthly meetings, I collaborate with various educators, provide reflective lesson feedback, and share learning through the group's established social media outlet. Despite being the principal investigator in this research study, I also consider myself to be a participant in the sense that I will use the findings of the study to directly inform my practice as a maker leader and to foster a culture of making in the research setting and in my place of practice.

3.5 Research Instrument

A Qualtrics-based electronic survey instrument was the method of data collection to address the inquiry questions in this research study. The use of a survey for this particular study was chosen because it could provide reliable direction for informing the practices of maker leaders. In addition, surveys can be given to sample groups with a quick turnaround time (Creswell, 2014). As Babbie (2010) explains:

> Survey research is probably the best method available to the social researcher who is interested in collecting original data for describing a population too large to observe

directly. Careful probability sampling provides a group of respondents whose characteristics may be taken to reflect those of the larger population, and carefully constructed standardized questionnaires provide data in the same form from all respondents. (p. 254)

The survey instrument was anonymous, which was important because educators shared sensitive information and perceptions about their direct supervisors. Prior to administering the survey, it was reviewed and vetted by Dr. Jeff Evancho and Dr. Peter Wardrip, co-facilitators of the A*b*D Pittsburgh Learning Community. Both Evancho, Assistant to the Superintendent at South Fayette School District, and Wardrip, the Assistant Professor of STEAM Education of the University of Wisconsin-Madison, have extensive knowledge of and experience with educational research and maker-centered learning. The survey was also piloted by five educators who are not members of the A*b*D Learning Community but have experience with maker-centered learning and are supervised by an administrator in the Pittsburgh region.

The feedback garnered through the vetting and piloting process was used to refine the inventory prior to its distribution. All grammatical, numerical, and content issues were reviewed and addressed. During the winter of 2019, A*b*D participants were directed to the Qualtrics Survey System. Qualtrics is a privately held company founded in 2002 and is provided to students completing electronic surveys for research at the University of Pittsburgh. Qualtrics allows for electronic survey distribution, response, collection, and data analysis in a confidential and secure environment.

The survey instrument was designed by the researcher and informed by the reviewed literature. The survey included both closed and open-ended response items. (See Appendix A for a copy of the full instrument.) The survey included a block of demographic questions (Q1 – Q9)

in section one, which allowed the researcher to analyze data based on patterns correlated with particular demographic characteristics. Demographic differences or similarities may have statistical relevance to the inquiry questions. A summary of demographic questions includes questions describing the participant (e.g., educational or teaching assignment, practice context, time in education, role in the A*b*D Learning Community, and degrees earned) and questions about each participant's place of practice (e.g., socioeconomic description, geographic description, and type of learning setting).

For *Research Question One* (a. and b.), survey items Q10-Q20 were used to identify whom educators perceive to support their practice and what supports are provided. Questions included multiple choice, open response, and side-by-side questions. Specifically, Q12, Q17, and Q20 sought to delineate the difference between each participant's supervisor and the person who is most supportive of his or her ability to enact maker-centered learning. Once this role was established, Q13-Q16, Q18, and Q19 required participants to compare and contrast the knowledge and values of their supervisors and greatest supporters. Survey question 21 sought to determine the degree to which supports, as identified in the literature, were provided (or received) in their place of practice.

Regarding *Research Question Two*, items Q22-Q29 were used to determine which leadership supports are most valued by maker educators. These questions included rank ordering and open-ended responses. Specifically, Q22 required participants to view a series of research-based leadership practices and rank them from the most important support to the least important support. As a follow-up to Q22, participants were asked to describe how the support that they ranked as number one in Q22 most influences a participant's ability to enact maker learning. In collecting both quantitative and qualitative data in parallel for research question two, the researcher

hoped to obtain both a quick snapshot of the most important leadership support and also a deeper investigation into why the participant might value one identified support over another.

For *Research Question Three*, respondents were asked to respond to two questions. For the first question (Q 31), participants responded "yes" or "no" as to whether there were leadership supports missing from their places of practice. If they answered yes, they were directed to Q32 to respond to an open-ended question to collect qualitative data. In Q32, participants listed or explained missing supports and could explain why they perceived the supports to be lacking. This question gave the participants an opportunity to share or give open feedback in their own words regarding leadership supports that they believed to be useful for this study (Mertens, 2015).

The final question of the survey instrument (Q35) was optional and invited participants to respond to the question, "What else would you like to share with your direct supervisor about leadership supports for maker-centered learning and teaching?" This question was specifically designed to be more personal and to prompt the participant to elaborate on the strengths and needs of the leadership supports in their places of practice. Conceivably, some educators could discuss supports that have already been identified in the literature. Other educators could identify completely new supports not previously identified in the literature. Either result provided useful information to the researcher because it confirms that support for making is important and provides the possibility for new supports to emerge that are not currently explained in the literature.

3.6 Data Analysis

After A*b*D Educators completed the survey, the process of analyzing the data surrounding their perceptions of maker-centered leadership supports began. Table 3.1 illustrates the process of data analysis and is organized according to research question. In order to begin the analysis, I exported the survey data from Qualtrics into Microsoft Excel. I maintained a master file of the raw data using an Excel Spreadsheet, which allowed for maintaining and sorting the data as well as creating tables and graphs to illustrate findings.

The process of organizing the data, also called data cleansing, ensured that data was correct, consistent, and usable (Das & Johnson, 2003). First, I identified any errors, irregularities, or corruptions in the data. Specifically, I visually inspected the data for outliers that fell far outside the normal distribution. Examples included variables, non-responders, or duplicate cases. Unusable data was deleted, corrected, or removed from the data set. In addition, all identifying information from the data, including names, email addresses, and IP addresses were deleted. Removing personal information assured that participant information was kept confidential. The next step in the cleaning process was to create variables and examine frequencies of that data. This examination and correction included review of participant numbers, variable coding, invalid values, inconsistent values, and missing data.

During analysis of the quantitative data, I reviewed the construct scores available in Qualtrics in order to organize data and to draw conclusions related to the research topics. The analytics produced from Qualtrics presented different views of the data by considering averages, minimums, maximums, and basic standard deviations. It also produced several different charts, tables, and graphs. I reviewed all of the options before selecting a visual representation that best fit the data conclusions. As the survey included a combination of multiple choice and closed-

ended question formats, I anticipated that the survey data would result in a list of administrators who provide supports to A*b*D educators and a ranked list of supports provided. The supports were identified along a continuum of most helpful to least helpful using scale question formatting.

Survey questions on the perceived values of administrative supports were derived (in part) from the Teacher Attitudes and Assessment Survey (TAAS). TAAS is a Likert-type instrument designed to ascertain educators' feelings regarding effective teaching practices and changes in student and teacher roles from engaging in maker-centered learning (Waxman, Wang, & Lindvall, 1983). Survey analysis included looking for trends and patterns in the data. When possible, I did cross-tabulations for subgroup analysis (e.g., survey responses from urban educators compared to survey responses from rural educators). The survey data are displayed using tables and graphs in Chapter 4.

To analyze the open-ended qualitative data, I engaged in the process of coding the participants' responses. Coding is a widely recognized approach, and arguably the most critical step, in analyzing qualitative data (De-Curi-Gunby, Marshall, & McCulloch, 2011). The coding method used in this research project is considered "data-driven" because the codes emerged from the raw participant survey responses (Ryan & Bernard, 2003). This type of coding is an iterative process requiring the researcher to repeatedly examine the raw data. Using De-Curi-Gunby, Marshall, and McCulloch's (2011) coding strategy, I created a codebook consisting of three main components: code name/label, full definition, and an example participant response. The codebooks for this research can be found in Appendix D.

During the process of coding the qualitative data, I assigned codes (previously defined in the codebook) to each participant's open-ended responses. As I assigned codes, I began to make connections between ideas and concepts. During this stage of analysis, researchers engage in data

"reduction, simplification, expansion (making new connections between concepts), transformation (converting data into meaningful units), and reconceptualization (rethinking theoretical associations between ideas and concepts" (Coffey & Atkinson, 1996). By applying codes to the participants' responses, I began to examine how data supports maker-centered leadership practices or reveals contradictions to these expected results. During this process, I revisited the participant responses, the code book, and the codes as I drew conclusions about the data. Formally, Corbin and Strauss (2008) define this process as open coding, or "breaking data apart and delineating concepts to stand for blocks of raw data" (p. 195).

Survey data was also sorted by the categories of supports. This approach is based on the theoretical leadership construct described in Paletta's (2015) study of the relationships between improving school context and principal leadership. She categorizes leadership supports into five categories, including strategic direction, organization, self-assessment, professional resources, and professional networking. She then identifies scales for each category that represent the level at which "the principal effectively does and the teachers' perception of the leadership action" (p. 99). Paletta's approach was utilized to code, categorize, and rank the data in rank-order survey questions.

Table 3.1. Method Design and Analysis

Inquiry Questions	Method	Evidence/ Components	Analysis/ Interpretation
Demographic Information	Qualtrics inventory questions Q2, Q3, Q7, Q8, Q9	Data contains demographic information about the participant	Qualtrics analytics – number of and frequency of rankings described via written analytic statements
	Qualtrics inventory questions Q4, Q5, Q6, Q10, Q11	Data contains demographic information about the participant's place of practice	

Table 3.1 continued

Question 1(a): **From whom do educators perceive that they receive support from their administration to enact maker-based learning experiences?** Question 1(b): **In what ways do educators perceive that they receive support from their administration to enact maker-based learning experiences?**	Qualtrics inventory questions Q12-Q20 Q21	Educators perceived identification or definition of individual providing support Establish a difference between a supervisor and a person providing the most support Description of the value and knowledge both the supervisor and the person providing the most support have for maker-centered learning practices	Qualtrics analytics – number of and frequency of rankings described via written analytic statements Open-ended data results read and emerging themes coded.
Question 2: **Related to enacting maker-centered learning, what kinds of administrative supports do educators value and why?**	Qualtrics inventory questions: Q22 Q23 – Q29	Specific identifiable supports provided to educators enacting maker-centered learning. Ranking of the differential value of the perceived educator supports (i.e. most important support through the least important support Description of the most important leadership support	Descriptive analysis – number of and frequency of rankings described via written analytic statements. Open-ended data results read and emerging themes coded.
Question 3: **In what additional ways do educators claim that their administration could provide support to enact maker-based learning experiences?**	Qualtrics inventory questions Q31 Q32	Identifiable leadership supports missing from practice Explanation of the missing supports (i.e. causes, barriers, problems, outcomes) Evidence demonstrating impact of leadership support on educators in maker-centered learning environments.	Descriptive analysis – number of and frequency of rankings described via written analytic statements. Open-ended data results read and emerging themes coded.

3.7 Effects of the Study on Stakeholders

Administrators are the target stakeholders for this research study. For this study, administrators are categorized as middle-level managers in an educational system. Most administrators hold the title of school principal; a few administrators hold titles such as director, coach, mentor, guide, and/or facilitator. Most stakeholders in this study have building-level (or system-level) supervisory responsibilities and are supervised by a superintendent, CEO, manager, or director. Administrators have some level of authority, power, and influence in their place of practice and typically supervise teachers, educators, museum docents, tutors, mentors, or informal educators.

It is difficult to identify the number of stakeholders who may be indirectly influenced by this research inquiry. However, the minimum goal is for all administrators of A*b*D educators to be aware of, and possibly impacted by, the outcomes of this research. A*b*D administrators have the advantage of receiving all A*b*D communication. The A*b*D communication network includes direct communication, social media alerts, and formal/informal conversations between A*b*D educators. All A*b*D communication networking outlets are used to showcase and engage stakeholders in a discussion of the results of the research investigation.

3.8 Limitations of the Study

According to Saunders et al. (2009), research methodology serves as the backbone of a research study. Quantitative research's main purpose is the quantification of data, which allows the researcher to generalize results by measuring the responses of a sample population. However,

in this study, there were a few limitations beyond the researcher's control. First, most quantitative research requires a large sample size (Science, 2001). In this study, the sample size of the survey was dependent upon the number of participants in the A*b*D Learning Community. This sample population only represented a small number of educators in the Western Pennsylvania region. Hence, the results of the survey cannot be generalized in context to this larger population, but rather, be suggested.

The second limitation of this study involves the issue of accuracy in participant responses. Since the researcher is also a local school administrator who directly supervises some of the participants, there could have been participant hesitation to be completely honest in their responses. As the researcher, I assured each participant that honest feedback would help me to better support teachers and would help other educators receive helpful supports from administrators. When the survey was introduced, participants were provided with a detailed verbal explanation of the purpose of the study (Appendix B) and written assurance of participant anonymity (Appendix C). In addition, the researcher introduced the study well in advance of the survey instrument distribution during the October, November, and December A*b*D monthly meetings, by previewing the research request.

4.0 Results

The findings associated with the three research questions that frame this study are discussed throughout Chapter 4. This discussion includes both quantitative and qualitative analysis. To ensure that the analysis captures the voice of survey participants, direct quotes from the participants have been italicized in Chapter 4. Following a discussion of descriptive statistics, Chapter 4 is organized according to the following research questions:

Q1: From whom and in what ways do A*b*D educators perceive that they receive support from their administration to enact maker-based learning experiences?

Q2: Related to enacting maker-centered learning, what kinds of administrative supports do educators value and why?

Q3: In what additional ways do educators claim that their administration could provide support to enact maker-based learning experiences?

This survey was shared with all 34 participants who attended the January 23, 2019 Agency *by* Design learning community meeting at Edgeworth Elementary School. Thirty-four participants took the survey (100 percent response rate). Of those responses, three individuals did not provide enough demographic or descriptive information for their responses to be evaluated. The remaining 31 respondents completed all the questions. The sample size of this survey is $n=31$.

4.1 Descriptive Statistics

Of all survey participants, 29 percent self-identified as mentor educators and 71 percent as participant educators. At the time of the study, mentor educators had been in the learning community for two or more years and were actively practicing A*b*D routines and protocols in their places of practice. Conversely, participant educators had been in the learning community for about four months and were currently developing understandings of A*b*D theories. Most survey participants were master degree level educators, a few were bachelor degree educators, and there were no doctorate level educators. A majority of respondents indicated that they worked at elementary levels, although middle, secondary, and post-secondary educators were also represented. Participant demographic information is highlighted in Table 4.1.

Table 4.1. Participant Demographic Information (n=31)

Variable	N (%)
Category	
Mentor Educator	9 (29.03)
Participant Educator	22 (70.97)
Credentials	
Master's Degree	25 (80.65)
Bachelor's Degree	6 (19.35)
Type of School (could select multiple options)	
Early Childhood (pre-k)	3 (6.25)
Primary Level (K-2)	12 (25.00)
Intermediate Level (3-5)	13 (27.08)
Middle Level (6-8)	9 (18.75)
Secondary (9-12)	10 (20.83)
Post-Secondary	1 (2.08)

Regarding participants' places of practice, most were working in the public-school system and only a few reported being employed in the private sector at charter schools, laboratory schools,

private schools, or informal learning environments. Most of these schools are considered suburban, with a few urban and a few rural. There was a fairly even distribution of socioeconomic statuses among these educational settings ranging from high (fewer than 20 percent of students qualify for free/reduced lunch), average (around 20 to 50 percent of students qualify for free/reduced lunch), to low (50 percent or more students qualify for free/reduced lunch). Contextual demographic data is highlighted in Table 4.2.

Table 4.2. Contextual Demographic Information (n=31)

Variable	N (%)
Place of Practice	
Public School	23 (74.19)
Other	8 (25.81)
Classification	
Suburban	18 (58.06)
Urban	10 (32.26)
Rural	3 (9.68)
Socioeconomic Status	
High	9 (29.03)
Average	7 (22.58)
Low	12 (38.71)
Not Applicable	3 (9.68)

A*b*D survey participants were asked to describe their current positions at their places of practice. Participants could select multiple descriptors, choosing all responses that apply. Interestingly, of the 64 descriptors, the descriptor chosen most often was "making." Figure 4.1 identifies the descriptors from which participants could select, including STEM, STEAM, Arts, Design, Making, Humanities, Computer/Drafting, Mathematics, Science, Library, All Elementary Subjects, Academic Coaching, and Other.

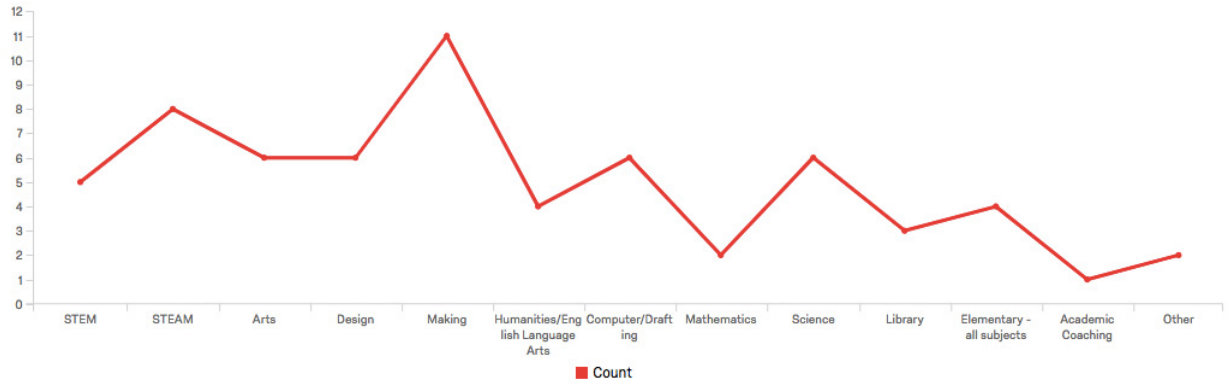

Figure 4.1. Distribution of current position description

Inventory question 10 revealed that an overwhelming majority of participants (90 percent) agreed that practices in their current educational setting support a culture of making (Figure 4.2). As a follow-up for those who agreed, question 10 asked respondents to share examples and evidence of the supports currently in place in their educational settings. Those responses were analyzed and coded, and include the following categories as shown in Figure 4.3: space (25 percent), time (19 percent), leadership (15 percent), materials (13 percent), professional development (10 percent), collaboration (8 percent), community partnerships (6 percent) and financial support (4 percent). While 21 of the 48 responses indicated that space (*maker spaces, fab labs, wonder lab space, STEAM Studio, Science Lab, Recording Studio, Mobile Maker Lab*) and time (*weekly classes, frequency to make, weekly planning periods, schedule making centered classes*) were in place, only seven respondents shared examples or evidence of leadership practices. Of those seven responses, one participant wrote:

> *In our setting, our administrators allow freedom and allow opportunity for us to try new things. They support new ideas and innovation in the classroom. For example, if we want to try second chance learning we are allowed to.*

Another participant wrote:

We have a makerspace and plenty of materials to support the teachers. We also have a principal and admin who seem to be open to letting us try new ways of teaching and see how it works for our students.

A third participant wrote:

Having a dedicated maker space with a teacher that is available to collaborate with. encouragement from administrators to continue making and experimenting within the classroom. Professional development with a maker-centered focus.

The other four participant responses were very similar in nature to the three reported here. For the purposes of this study, it is interesting to note that only seven examples of current leadership practices were shared from a group who frequently identified *making, STEAM, STEM, and Design* (Figure 4.1) as their current positions.

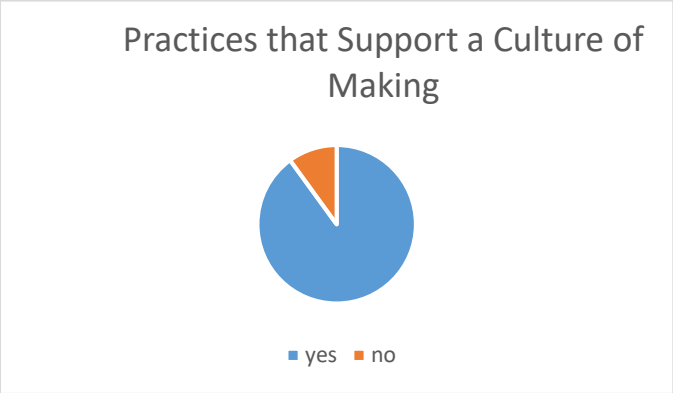

Figure 4.2. Current practices that support a culture of making

Figure 4.3. Categories of evidence currently in place that support a culture of making

4.2 Inquiry Question One: From Whom and in What Ways Do A*b*D Educators Perceive That They Receive Support From Their Administration to Enact Maker-Based Learning Experiences?

Inquiry question one is organized into two main sections. Section one includes inventory questions 12 through 20 and primarily describes the data collected to identify who most supports A*b*D educators in enacting maker-based teaching and learning experiences in their places of practice. Section two contains data and analysis from inventory question 21 focusing on how A*b*D educators are supported in enacting maker-based teaching and learning experiences in their places of practice. Both quantitative and qualitative evidence are discussed.

4.2.1 Who Supports A*b*D Educators?

Inventory questions 12 through 20 prompted participants to consider who most supports their ability to enact maker-based learning experiences in their places of practice. Each of these questions built upon the previous question, which required participants to specifically identify the maker-based values and knowledge of those in leadership roles in their organizations. First, participants reflected on their immediate supervisors and then reflected on the person who most supports their maker-based work before distinguishing between the two. The purpose of these inventory questions was for participants to identify the primary supporters of their practice and to gain participants' perspectives on how those supporters understand and value maker-centered learning.

Over 87 percent of A*b*D participants are supervised by a building principal or assistant principal. Of the remaining 13 percent, four are supervised by a director or manager. Conversely, when asked to identify the most supportive person, only 48 percent of A*b*D participants identified a building principal or assistant principal as being the most supportive, and 52 percent identified other individuals as being the most supportive. The other individuals identified included director or manager (10 percent), district office administrator (13 percent), teachers/colleagues (19 percent), and unidentified individuals (10 percent). The comparison between inventory question 12, the direct supervisor, and inventory question 17, the most supportive person, is illustrated in Figure 4.4.

It is worth noting three significant findings from Figure 4.4. First, as most of the A*b*D participants work in school settings, it is surprising that around 50 percent of A*b*D teachers do not feel most supported by their building administrators as traditional school hierarchy may suggest. Instead, A*b*D participants list others, in more non-traditional administrative roles, as the most

supportive. A second finding from this analysis shows that A*b*D supporters are spread across many different district roles ranging from directors, to superintendents, to curriculum directors, and to other non-identified administrators. The second most frequently identified support role is fellow teacher. Almost 20 percent of participants list mentor teacher, colleague, teacher colleague, STEAM teacher, team teacher, and other teacher as the ones who are most supportive of maker practices. This is especially interesting as one could assume that individuals in these roles are not in traditional administrative roles. Finally, it is noteworthy that none of the A*b*D participants listed "coach" as a supporter of maker-centered teaching and learning practices. Many school districts in the Southwestern Pennsylvania Region have coaching positions that are designed to support teachers' instructional practices; however, this role was not identified as a supporter by A*b*D participants.

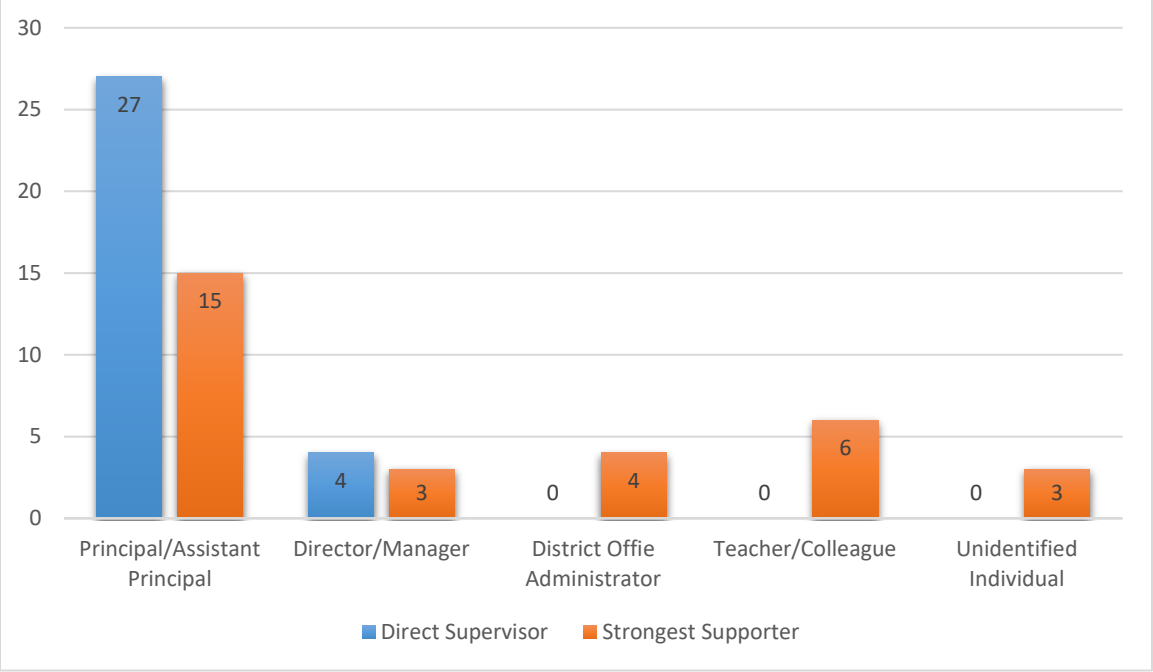

Figure 4.4. Identified supervisors and supporters

In response to inventory question 20, about half of A*b*D participants identified their immediate supervisors as the same person they identified as the one most supportive of their ability

to enact maker learning practices. The other half of A*b*D participants named a person other than an immediate supervisor as the most supportive of their practice. Further analysis of inventory questions 13 and 18 revealed that participants overwhelmingly perceive (77 percent) that the person identified as most supportive values maker-centered learning a great deal. However, only 57 percent of participants felt that their direct supervisors value maker-centered learning a great deal. Inventory questions 15 and 19 revealed that over half of participants (77 percent) perceive that the person identified as the most supportive is extremely knowledgeable about maker-centered learning practices, while only 30 percent perceive that their direct supervisors have this same type of content knowledge. Results of this comparison are highlighted in Figure 4.5.

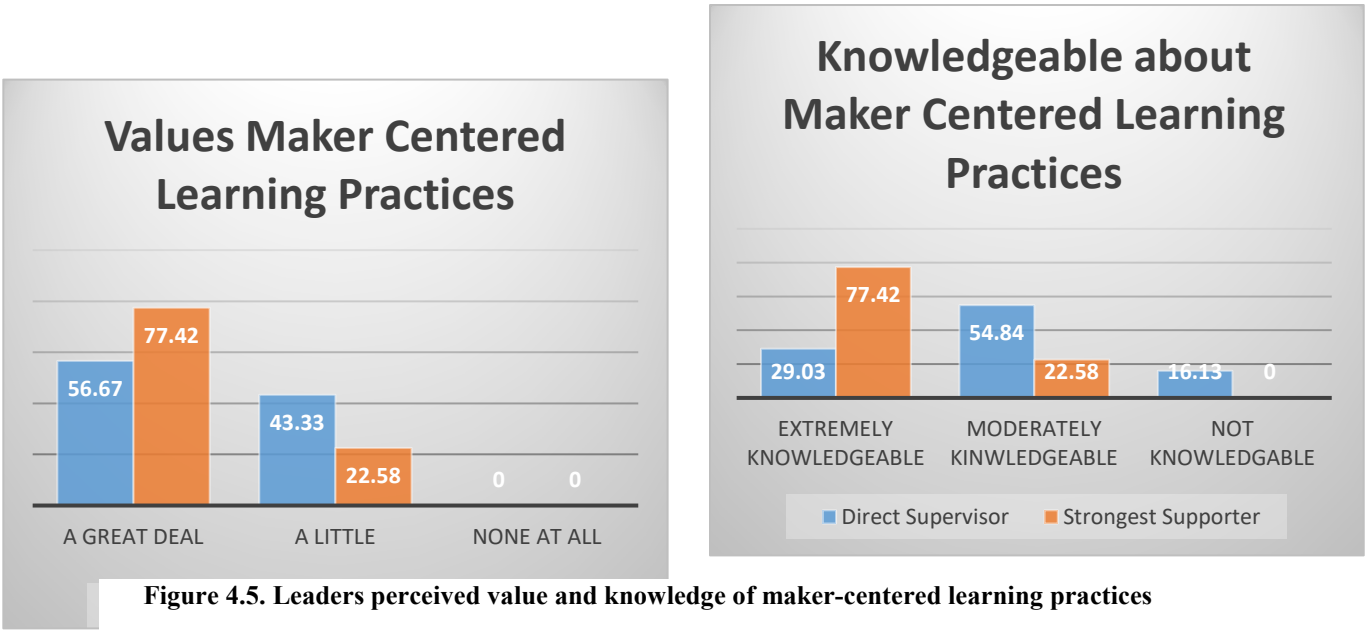

Figure 4.5. Leaders perceived value and knowledge of maker-centered learning practices

Twenty-two participants responded to survey question 16 of the inventory, which invited participants to provide evidence as to why their supervisors may lack knowledge related to supporting maker-centered learning practices. Analysis and coding of this question resulted in six themes regarding the supervisor, including the following: does not value making as a priority, lacks ability to implement maker spaces or maker culture, has other managerial priorities, is more

focused on data, does not have a maker background, and lacks interest. These themes are presented in Table 4.3.

Table 4.3. Frequency of Themes Reported About Supervisor's Lack of Knowledge

	Themes	Frequency
My supervisor…	*does not value making as a priority*	8
	lacks ability to implement maker spaces or maker culture	5
	has other managerial priorities	3
	is more focused on data	3
	does not have a maker background	3
	lacks interest	2

A*b*D participants most frequently mentioned the lack of priority for maker-centered learning as the reason why supervisors may lack knowledge of maker practices. Respondents who mentioned this lack of priority clarified that they did not feel that the individual administrator was necessarily lacking knowledge of maker-centered learning. Sample responses in this category include:

- *Not necessarily a lack of knowledge, just directed towards other matters.*
- *I truly feel it is not because he does not see the need or value. Nor is a lack of interest. I believe our school is finally beginning to look down the path of innovation in education. We, as a district, are starting to have conversations about how to improve our students' experiences. I think as the idea of innovation*

and maker-centered learning begin to move up the ranks and become more of a priority he will be open to gaining knowledge and supporting teachers' voices.

- *I think he knows about maker learning and considers it valuable but holds traditional method (testing, notes, essays etc.) as the priority practice and assessment.*

The second most frequent reference to question 16 was coded "*lacks ability to implement maker spaces or maker culture.*" Five participants noted that they felt that their supervisors had not fully developed maker cultures in their educational settings. One participant noted:

Our maker spaces are brand new this year. My administration is supportive, but it seems that we are not clear on exactly how to implement the spaces into each classroom just yet. We are working to develop these spaces.

This participant made an interesting reference to the collective nature of building a maker culture by saying "our" and "we." It can be inferred from this response that culture is important but that leadership and vision are a prerequisite to physical spaces. In a similar response, another participant noted that the administrator had some knowledge of maker research but did not understand how to grow a culture of maker learning:

In our district the idea of maker-centered learning is a new topic. She has researched the idea of maker-centered learning but has not helped to develop a culture of maker-centered learning. She is in the process of helping to create an area for maker-centered learning, but it appears to be taking a back seat to other day to day activities.

In a third participant's place of practice, the administrator seemed to understand the value of maker-centered learning but was not personally invested in the practice:

I think my principal puts a lot of trust in my ability to create quality STEAM activities, but she does not necessarily take an active role in learning about STEAM practices. She knows enough to see the value of maker-centered learning, and provides me the resources to implement it, but does not know the details.

In this response, it is clear that the administrator may have seen value in this participant's practice but did not fully understand the pedagogy or methodology involved in maker learning. Another conclusion that could be drawn from this response is that the administrator may not understand the collective nature inherent in a culture of making because he/she only seemed to trust this particular educator and not necessarily the entire staff. As the premise of making is inclusive, embracing a culture of making requires collective trust as opposed to investing in one or two individuals in the organization.

The other four response categories for question 16 include other managerial priorities, more focus on data than making, supervisor does not have a maker background, and the supervisor lacks interest. A general theme that permeated these response categories is the feeling that A*b*D administrators are spread thin across their organizations and are responsible for political and economic factors facing educational organizations across the Commonwealth. Either directly or indirectly, these responses illustrate the administrative challenges associated with educational leadership. Examples of each response by category follow:

- Other managerial priorities:

  She is supportive of my efforts to create a maker environment. She is just overwhelmed with other issues that I do not feel she has been able to spend the time to learn best practices for the maker space.

- More focus on data than making:

My principal's first focus is on data. Showing student growth in tested subject areas is a priority in my district.

- Supervisor doesn't have a maker background:

  They have a lot of interest in making-related thinking and creating, but not a lot of personal experience. They support individual teachers' choices, but they cannot explain in depth why those choices were made and why. There is a lot of trust in each teacher's expertise.

- Supervisor lacks personal interest:

  Not part of his job description, interest or what he observes.

One of the most important conclusions that can be drawn from this particular data can be observed when comparing the graphs in Figure 4.5. These graphs depict important information regarding how supervisors and other supporters value and understand maker-centered learning practices. The most notable statistic is that 100 percent of participants report that their supervisors or other supporters value (on some level) maker-centered learning practices. Despite the fact that they may not necessarily understand the practices, they do value making practices. This designation is important to establish prior to examining the remaining inventory results.

4.2.2 Ways A*b*D Educators Receive Supports

In the next section of the survey, participants were asked to consider various common leadership supports from the perspective of enacting maker-centered learning practices. Specifically, inventory question 21 asked participants to categorize 16 different leadership supports into categories including "Supports Received," "Support Not Received," and "Support Not Received and Not Needed." (See Table 4.3.)

A very high percentage of participants (90.3 percent) reported that they receive support to engage in maker thinking and are encouraged to take responsible risks. Most participants (87.1 percent) also reported receiving support to participate in national/regional partnerships and networking opportunities as well as receiving personal encouragement and trust to engage in maker-centered learning and teaching. Another two-thirds of participants (67.7 percent-77.4 percent) indicated they receive an ample budget for materials and supplies as well as professional development with maker approaches and hands-on opportunities. Only about half of A*b*D participants (46.7 percent-58.1 percent) reported receiving assistance to write grants; engage in flexible assessment opportunities; having purposeful time for innovating, creating, making and doing; and having designated before and after school opportunities for making. (See Table 4.4.) Of the 16 supports, those reported the least frequently included extended time for learners to engage in maker-centered learning (40 percent), clear expectations and vision for maker learning (38.7 percent), time for organizational collaboration (38.7 percent), and curricular documents aligned to maker-learning outcomes (33.3 percent). A closer look at this data reveals that although some supports are not received, they are also not needed. For example, 13 participants reported that they do not receive curriculum alignment supports for maker-centered learning. Another seven participants reported that while they do not receive curriculum alignment support, they also do not need this support. Therefore, we can conclude that only 11 participants consider this support "not received." (See Table 4.4.)

Conversely, one can assume that other supports identified as "not received" are needed because a high number of participants did not say that these supports are "not needed." Supports that most frequently fell into this category include extended time for learners engaging in maker-centered learning (16 participants), time for organizational collaboration (15 participants), and

purposeful time for innovating, creating, making and doing (12 participants). These supports are the ones least likely to be received by A*b*D participants and could also be considered the supports most needed. It is interesting to note that "time" (for organizational collaboration; for innovating, creating, making and doing; and for learners to engage in maker-centered learning) is a common theme in each of the three supports identified as not received by A*b*D Educators. (See items in red in Table 4.4.)

Table 4.4. Classification of Leadership Supports (n=31)

Leadership Supports	Support Received		Support Not Received		Support Not Received and Not Needed	
	(n=31)	%	(n=31)	%	(n=31)	%
Ample budget for materials and supplies	21	67.7%	9	29.0%	1	3.2%
Assistance writing grants	17	54.8%	9	29.0%	5	16.1%
Participation in national/regional partnerships	27	90.0%	3	10.0%	0	0.0%
Clear expectations/vision for maker learning	12	38.7%	15	48.4%	4	12.9%
Supports maker thinking	28	90.3%	3	9.7%	0	0.0%
Personal encouragement and trust	27	87.1%	3	9.7%	1	3.2%
Encourages responsible risk taking	28	90.3%	3	9.7%	0	0.0%
Aligned curricular documents	10	33.3%	13	43.3%	7	23.3%
Flexible assessment opportunities	18	58.1%	8	25.8%	5	16.1%
Networking opportunities	27	87.1%	4	12.9%	0	0.0%
Professional development with maker-centered approaches	23	74.2%	7	22.6%	1	3.2%
	24	77.4%	7	22.6%	0	0.0%

Table 4.4 continued

Professional development with hands-on opportunities						
Time for organizational collaboration	12	38.7%	17	54.8%	2	6.5%
Purposeful time for innovating, creating, making & doing	14	46.7%	14	46.7%	2	6.7%
Extended time for learners engaging in maker-centered learning	12	40.0%	17	56.7%	1	3.3%
Before/after school opportunities for making	17	54.8%	11	35.5%	3	9.7%

4.3 Inquiry Question Two: Related to Enacting Maker-Centered, What Kinds of Administrative Supports Do Educators Value and Why?

Inquiry question two provided participants a forum to identify the leadership support they most value with regard to enacting maker-centered learning. Participants responded first by ranking the supports from most important to least important. Next, they described why they chose a particular support as being the most important. The responses to inventory questions 22 and 23 provided insight into how teachers perceive and value leadership supports. These inventory questions asked participants to share specific examples and speak to the impact of those supports on their practice.

4.3.1 Most Important Leadership Supports

Thirty-one participants ranked seven general leadership supports from most important to least important on inventory question 21. Overall, the majority of the sample chose "time for

implementation" (58.1 percent) or "general leadership" (42 percent) as either the first- or second-most important support for implementing maker-centered learning practices (Table 4.5). Participants ranked "collaboration with colleagues" (38.7 percent) as the next most important leadership support. The remaining four supports ("financial support," "curricular support," "networking," and "professional development opportunities") were ranked the least important for A*b*D educators.

Table 4.5. Frequency (%) and Number of Participants Selecting a Support as Most Important (n=31)

	1	2	3	4	5	6	7
General Leadership	32.3% **(10)**	9.7% **(3)**	9.7% **(3)**	22.6% **(7)**	3.2% **(1)**	3.2% **(1)**	19.4% **(6)**
Financial Support	16.1% **(5)**	9.7% **(3)**	29.0% **(9)**	16.1% **(5)**	6.5% **(2)**	3.2% **(1)**	19.4% **(6)**
Curricular Support	6.5% **(2)**	16.1% **(5)**	9.7% **(3)**	19.4% **(6)**	16.1% **(5)**	16.1% **(5)**	16.1% **(5)**
Networking	0.0% **(0)**	3.2% **(1)**	0.0% **(0)**	12.9% **(4)**	16.1% **(5)**	32.3% **(10)**	35.5% **(11)**
PD Opportunities	9.7% **(3)**	0.0% **(0)**	16.1% **(5)**	12.9% **(4)**	29.0% **(9)**	29.0% **(9)**	3.2% **(1)**
Collaboration with Colleagues	12.9% **(4)**	25.8% **(8)**	12.9% **(4)**	12.9% **(4)**	19.4% **(6)**	12.9% **(4)**	3.2% **(1)**

Table 4.5 continued

Time for Implementation	22.6% **(7)**	35.5% **(11)**	22.6% **(7)**	3.2% **(1)**	9.7% **(3)**	3.2% **(1)**	3.2% **(1)**

4.3.2 Supporting Evidence: Time for Implementation

Eighteen A*b*D participants ranked "time for implementation" as the support that most influences their ability to enact maker learning. Of those participants, six provided detailed examples of how time impacts their ability to enact maker learning. The six responses were coded and categorized. Two distinct themes emerged during this process:

1. time for lesson planning and preparation
2. scheduled time to engage students in maker-centered learning

Two participants' responses focused on time for lesson planning and preparation. These responses designated the time before instruction and learning as significant for them to effectively enact maker-centered learning practices. Focusing on collaborative planning and instructional materials, respondent number one said:

Time allows me to collaborate with other teachers and allows me to prepare projects, materials, and equipment for classes to use.

In this first response, the participant's focus was broad in nature, speaking generally about planning for his/her "classes." Similarly, a second participant's response focused on instructional planning; however, this participant focused more on the importance of planning for individual student learning outcomes:

It takes a lot of time to design lessons for students. Without the planning time my lessons wouldn't properly serve the students

What makes these two examples significant is that they both designate "time" for planning and preparation for learning as important for enacting maker-centered learning.

Conversely, the other four participants' responses focused on "time" for students to engage in maker-centered learning practices. One respondent clearly delineated the difference between planning time and instructional time:

> *Time is not a factor during the planning & development phase. It does become an issue when working around the students' schedules. Certain times and subjects are untouchable. With lots of creative planning we can usually find a time that works.*

Establishing time in a schedule for enacting maker learning was a common theme among the other three participant responses. These three respondents mentioned how the lack of "time" is problematic to their practice:

- *There is no time in our schedule for students to engage in cross curricular maker-centered learning.*
- *In our schedule, there are strict times for classes to be focused on certain learning objectives. This makes it difficult to squeeze in maker projects. There are things we HAVE to teach and sometimes the creative learning is getting lost.*
- *Having control of time in the classroom and order of academics makes it possible to implement more making opportunities in classroom.*

It is significant that three participants noted barriers to scheduling as an important factor that may prevent maker-centered learning opportunities because, typically, scheduling is an administrative responsibility. In most places of practice, educators have very little control or input into a building schedule. These participants spoke directly to the need for operational supports, or in this particular case, operational challenges.

4.3.3 Supporting Evidence: General Leadership

Inventory question 21 defines general leadership support as the personal encouragement or support that influences an educator's ability to enact maker-centered learning. Thirteen participants chose this support and provided supporting evidence as to why general leadership was most important to them. The first theme that emerged from these responses was that general leadership inspired risk taking and new projects. One participant who values this support wrote:

> *Our building administration and Superintendent encourage trying new things and taking risks. There is a great deal of support for all maker-related activities.*

Another said:

> *Both of my principals (and past principals in the same district) have been supportive of projects/initiatives in which I've shown interest. Their support and "green light," so to speak, is the first and crucial step in planning to engage in a project.*

Another participant provided the following example for making a connection with positive risk taking and collaboration with other teachers:

> *It allows me to experiment and develop student-centered curricula, both through research and with other teachers in my school.*

A second common theme coded under the category of general leadership involves validation. A*b*D educators remarked that positive leadership is both validating and valuable to their practice. Put very simply, one participant wrote:

> *It shows this type of learning is valued, and the risks associated with it are recognized and accepted.*

Open, honest, and frequent communication is another example of how a teacher may feel validated to continue in the work of maker-centered learning and teaching practices. One participant remarked:

> *Support from my building principal as well as the other administration is vital to the success of a maker space learning center. Currently I am able to communicate my ideas and desires to establish a maker space with my administration and feel as though my thoughts and ideas are validated. They agree that we need to expand our current space and supplies as well as incorporate more teachers into a maker mindset in our building. There are a few teachers who embrace the maker idea; however, many teachers are uncertain of what maker learning actually looks like. It is seen as just playing instead of being a valuable learning tool. Having the support from leadership encourages me to continue on in the way I present material to my students as well as encourages me to share the ideas of making with other teachers.*

General validation can also promote maker learning across disciplines and help others to perceive making as a valuable practice. One participant expressed this idea and suggested that maker learning is an essential part of core learning:

> *As an Art Teacher and consistent "maker," I am fully supportive of this way of learning. At times, though, I find myself sitting second to some of the other core class educators. Most likely due to the stigma of "it's just art class", many core teachers view making as a free time activity. It is important for our leaders to show our educators that it is not only for a past time or between lesson project or used as an "elective", but an experience for itself. Without the support of our leaders, us "maker obsessed" struggle with being taken seriously.*

The final sub-category coded under general leadership is a general feeling of encouragement provided to an educator. This heartfelt response is similar to the others who felt general encouragement from someone in their place of practice:

> *Had I not ended up teaching at a school with a vision for maker learning, I may not have realized its importance! The encouragement that I received actually caused me to change my style of teaching!*

Through this particular comment, one can infer that personal, positive encouragement significantly impacted this educator's career as well as his/her ability to enact maker-centered learning practices. This piece of data is important to recognize and highlight and could be shared as a positive outcome to maker leadership.

4.3.4 Supporting Evidence: Collaboration with Colleagues

Twelve participants chose "collaboration with colleagues" as either the number one or number two most important leadership support for enacting maker-centered learning. Four of those participants described why collaboration with colleagues is important to their practice. Two of the participants described how sharing ideas with others teachers and educators significantly improved the lessons and activities they planned for students. One explained:

> *I think having several brains working on maker-centered learning is so important! The more ideas that can be shared the more enriching the activity will become.*

Another participant responded:

> *I find that when I have discussion with my colleagues about things that they are trying in the classroom, it allows me to generate lesson ideas for my classroom. Hearing what worked, what didn't and how the students responded provides a catalyst for deeper thought.*

> *Even if what they share is not an example of maker learning, I find myself thinking about how they could have tweaked the lesson to make it more student centered or how I would make a similar lesson in my classroom student centered.*

The other two participants explained how the benefits associated with collaborating with others increases maker learning opportunities both vertically and horizontally in their organizations. As one participant put it:

> *I realize that although in our school there is a makerspace - I do not need to be physically in the space in order to be involved in maker-centered learning. Examples of what I already have done in class are examples of making only through a different lens and having the ability to collaborate with colleagues and peers across all levels affords for the opportunity to enact maker learning in a genuine, thoughtful and purposeful way.*

A second participant, coming from a more specialized perspective, shared:

> *I work in the library and must collaborate with my colleagues to develop effective maker opportunities*

Considering the inherent interdisciplinary nature of maker-centered learning, it is not surprising that many participants ranked collaboration with colleagues as being important. What is surprising about this data is that only one A*b*D participant (or 3.2 percent of all participants) ranked "networking" in the top three most important supports (Table 4.5). Because "collaborating with colleagues" is similar to "networking," one could expect statistically similar survey results. Contrary to the expectation, participants statistically value collaborating with colleagues in their place of practice over regional or national networking opportunities.

4.4 Inquiry Question Three: In What Additional Ways Do Educators Claim That Their Administration Could Provide Support to Enact Maker-Based Learning Experiences?

The final questions of the survey instrument provided participants an opportunity to discuss additional ways that their administrations could provide support to help them better enact maker-based learning experiences. Beginning with question 31, participants were asked if there are leadership supports missing in their places of practice. Slightly more than half (16 participants) felt that leadership supports are missing (Figure 4.6).

Figure 4.6. Percentage of participants who perceived lack of leadership supports n=31

As a follow-up to question 31, the 16 participants who reported missing leadership supports were invited to list or explain the specific supports they felt were missing in their places of practice. Those 16 responses were analyzed, coded, and categorized into eight categories of support, including opportunities to plan/collaborate with colleagues (seven references), financial supports (four references), general encouragement/trust (four references), maker-related in-service training for teachers (three references), time to implement maker practices (two references), competing

priorities (two references), curricular alignment (two references), and teacher leaders (two references). These themes are identified in Table 4.6.

Table 4.6. Frequency of Supports Missing from Place of Practice

	Identified Supports	Frequency
Supports missing in my place of practice….	*opportunity to collaborate/plan with colleagues*	7
	financial supports	4
	general encouragement/trust	4
	Maker-related in-service training for teachers	3
	time to implement maker practices	2
	balancing priorities	2
	curricular alignment	2
	teacher leaders	2

Participant responses to this question were especially thoughtful and thorough. Most participants discussed several different supports in each individual response. The most frequently mentioned missing support was the opportunity to plan or collaborate with colleagues. The participants who reported this support as missing typically mentioned it in a list of other missing supports. However, one participant elaborated on the need for this particular support:

> *Funding and collaborative opportunities are the two supports that come to mind first and foremost. I feel like it could be so beneficial if we had more time to collaborate (with some guidance) to create more relevant learning experiences for our students.*

This response is noteworthy because the participant connected the need for leadership supports (financial and time for collaboration) to student learning outcomes. The participant was directly

stating that the benefit of time to collaborate with colleagues is directly related to creating learning experiences for students.

This second most frequently mentioned need for support included the need for general leadership and financial supports. It is not surprising that general leadership was a common theme in this response because this is also a support identified as one that is most needed in Q21 (Table 4.4). It is surprising, however, how frequently participants used the word "encouragement" when describing the need for general support. One participant explained:

We are not discouraged from trying innovative practices, but we are not encouraged either.

Another said:

I do think many of the necessary supports are in place. However, I think having more general encouragement would be beneficial.

These comments pointed to the needs associated with empowering supports (visionary, collaborative leadership) more than operational supports (managerial, administrative leadership). It is important to note the difference indicated here as an implication for leadership in a culture of making.

It was surprising to find "finances" referenced as a missing support because it was not identified as a support most needed in Q21 (Table 4.4). In reviewing responses coded in this category, only one participant elaborated on this particular need by saying:

Funds. Money is always a hurdle. Innovation can take place within the financial constraint, but moving forward and truly making changes takes funding.

The essence of this participant's argument is that finances are a barrier to the systematic cultural changes needed to enact maker-centered learning. While in the short term, innovation is a

possibility, the bigger concern for the future is the more global idea of financing maker innovations.

Although the other five categories of missing supports were not mentioned as frequently, they do have potential to inform maker supports for teaching and learning. Participant responses from each category include:

- Maker-related in-service training for teachers

  I feel there could be more embedded support (in-service time) for staff to learn about maker-centered principles and begin to plan / collaborate.

- Time to implement maker practices

  Time for implementation - The rigid schedule doesn't leave a ton of extra time for creative teaching and implementation of new activities or ideas.

- Balancing priorities

  Most focus is placed on core content areas, and they are encouraged to follow the curriculum aligned to the Keystone tests. We are lacking leadership support that will in turn lead to teacher support for maker-centered learning. We are also lacking the staff that could support classes designed for maker-centered learning. For electives, students can only choose Art, Music, or Spanish, and we don't have enough staff to offer more variety than that. Core content teachers are asked to teach electives to fix holes in the schedule, but they must focus on test prep or basic technology classes.

- Curricular alignment

  Because my school is relatively new and is constantly in the process of generating its own curriculum (the teachers create the curriculum), students sometimes miss

the larger picture of their learning and feel as though they aren't learning much through projects. Many of our students say that they would prefer a more traditional approach (lectures and tests) to project based learning and that they feel unprepared for higher education. I feel that most of this comes from a lack of organization and communication of learning goals from our staff as a whole.

- Teacher Leaders

  Opportunities for me to lead/involve my colleagues and introduce them to maker learning in a regular classroom to enhance curriculum time

The category "teacher leaders" is noteworthy because this is the first time that this category theme emerged in the survey data. It was also not a category previously identified by the researcher as a common leadership support for enacting maker learning and teaching.

5.0 Conclusions, Recommendations, Reflection

Changing school culture requires purposeful, visionary, goal-oriented leadership supports for teachers and educators. This refrain, supported in the literature (e.g., Robinson, 2011), was the motivation for conducting this study. If purposeful leadership is important to establishing a culture of making, then administrators should know and understand how to support the educators who are responsible for enacting maker-centered teaching and learning in classrooms across various educational settings. It is also reasonable to assume that with the identification of supports, leadership can be influenced, improved, and targeted to meet the needs of educators to improve student achievement and increase collaboration equally among all learners. This study sought to discover which leadership supports are most helpful in enacting maker learning, and to determine the leadership capacities that shift, support, and grow a maker-centered learning environment.

Members of the Pittsburgh Agency *by* Design Learning Community, a group of educators committed to enacting maker-based learning in their classrooms, were the focus group for this study. The setting of the study was the Southwestern Region of Pennsylvania including Beaver, Butler, and Allegheny counties. This is the area where I practice as a school administrator and where the focus group sample was available.

My research suggests that the field of maker research now has data that begins to address important questions regarding leading a culture of making, questions such as: *From whom and in what ways do AbD educators receive leadership supports? What kinds of administrative supports do educators value and why? In what areas are additional supports needed?* My hope is that this this research contribution advocates for the needs of educators, validates leadership practices, and inspires additional leadership supports for maker-centered learning and teaching.

Chapter 5 is organized into three main sections: conclusions, recommendations, and reflections. Throughout this chapter, the survey data is synthesized into a discussion that addresses the question above, points out general themes and understandings discovered in the data, and offers suggestions for future studies that would further the practices and pedagogies reflective of a maker-centered learning environment. The chapter ends with my personal reflection as a practicing administrator in the field.

5.1 Leadership Supports Are Important for Educators to Enact Maker-Centered Learning Practices

Data suggests that regardless of who is providing supports, participants need, value, and crave leadership for enacting maker-centered learning practices. The findings also show that the supports for maker-based learning are not very different from the supports needed to implement other educational initiatives. The survey data corelates with the general leadership themes found in the literature (Grissom & Keiser, 2011; Nicholson-Crotty & Keiser, 2012; Olsen & Huang, 2019; Ovando & Cavazos, 2004; Savala & Valenta, 2017; Trottier, Van Wart, & Wang, 2008) and are similar to the ones needed in other educational reform efforts. More importantly, the qualitative responses that were collected as part of the open-ended survey questions provided insight into the types of leadership supports that are most important for enacting maker-centered learning. The data that was collected, coded, and analyzed in this study reveal that participants value the following qualities: time for implementation, personal encouragement/general leadership, and opportunities to collaborate with colleagues. These specific leadership behaviors mirrored those found in the literature and cited in this study (Clapp, Ross, Ryan, & Tishman, 2014;

Fleming, 2015; Guskey, 2016; Martin, 2015; Moorefield-Lang, 2015; Robinson, 2011; Sheridan et al., 2014; Wardrip & Brahms, 2014; Zavala & Valenta, 2017). Each of these supports was identified in both the quantitative measures (Q21) and in open-ended responses (Q32).

5.2 Current Leadership Supports Are Quite Varied

Results from the study suggest that there is not one predominant leadership support specifically needed for enacting maker-centered learning. Instead, it appears that educators require a variety of leadership supports. As Table 4.3 indicates, the variety of "supports received" is quite extensive. Educators report that all of the supports (n=16) are identified in at least 38 percent of places of practice and many supports (n=8) are identified in over 50 percent of places of practice. Some (n=5) of the identified supports are in place in 87 percent or more of places of practice and include: participation in national or regional partnerships, leadership that supports a maker mindset, administration who encourages responsible risk-taking, personal encouragement and trust, and opportunities for networking.

Identified leadership supports also vary significantly according to the needs of each educator. As noted in the survey data, one educator may value and need personal encouragement to enact maker-based teaching and learning while another educator may value and need time to collaborate with colleagues and align curriculum to instructional making practices. Educator needs also vary based on their places of practice, the socioeconomic status of their community, and unique personal needs of the individual teacher.

The varied and personalized style of leadership supports present a challenge for educational leaders. Without a "one-size-fits-all" approach, educational leaders need a diverse tool kit of

leadership strategies to grow a culture of making. As a school principal, I have heard teachers discuss the challenges associated with finding new ways to support the ever-changing needs of their students. Similarly, one could argue that the challenges of administration involve finding new ways to support the ever-changing needs of teachers. Both the survey data in this research (Table 4.3) and current educational literature (Clapp, Ross, Ryan, & Tishman, 2017; Martin et al., 2014; Martines & Stager, 2014; OECD, 2015; Trilling & Fadel, 2009; Wardrip & Brahms, 2014; Zavala & Valenta, 2018) validate the need for varied leadership supports for educators who are enacting maker-centered learning and teaching practices.

5.3 Leading a Culture of Making Is a Complex Endeavor

An important finding, both in the literature and in the results of this study, is that leading a culture of making is a complex endeavor (Ritchhart, 2015). As emphasized at the beginning of this study, the terms "leader" and "administrator" are not synonymous. The results of this survey reinforce this notion and begin to identify administrative challenges associated with leading a culture of making. An intriguing analysis occurred in comparing the data from Table 4.5, "*Frequency of Supports Missing From Place of Practice,"* with two types of leadership supports found in the literature: operational supports and empowering supports (Zavala & Valenta, 2018). The missing supports (Q32) were further analyzed and coded as either "operational" or "empowering." The results, highlighted in Table 5.1, are fascinating.

Table 5.1. Missing Supports Categorized by Type

	Identified Supports	Frequency	Type
Supports missing in my place of practice….	*opportunity to collaborate/plan with colleagues*	7	*Empowering*
	financial supports	4	*Operational*
	general encouragement/trust	4	*Empowering*
	Maker-related in-service training for teachers	3	*Empowering*
	time to implement maker practices	2	*Operational*
	competing priorities	2	*Empowering*
	curricular alignment	2	*Operational*
	teacher leaders	2	*Empowering*

In considering supports in relation to operational supports and empowering supports, participants referenced the need for empowering supports more than twice as often (18 references) than operational supports (eight references). Although operational and empowering supports are often interconnected, it is the responsibility of an administrator to provide the most appropriate support for a given circumstance or for a particular educator or faculty. The fundamental leadership complexity here involves finding the right balance of operational and empowerment supports to support a culture of making.

5.3.1 Operational Supports

Operational supports are closely identified with administrative duties involving policies, resources, protocols, behaviors, procedures, and data. The operational supports identified in this study include financial supports, time for implementing maker practices, and opportunities to align

curriculum to making practices. Often times, administrators provide operational supports through the budget revision process, careful creation of a master schedule, faculty meeting updates, and curriculum design meeting opportunities. One could argue that these are the very basics of administrative supports and are necessary for an organization to run smoothly (Robbins & Alvy, 1995). However, an important conclusion we can draw from this data is that while operational supports are needed, they are insufficient in isolation. Operational supports provide a foundation and structure for effective leadership. Absent this fundamental core, there are limited opportunities to empower growth or inspire change in an educational system.

5.3.2 Empowering Supports

Empowering supports are closely related to leadership practices. As cited in the literature (Arnold, Arad, Rhoades, & Drasgow, 2000; Chen, Lam, & Zhong, 2007; Kirkman & Rosen, 1999; Konczak, Stelley, & Trsty, 2000; Seibert, Silver, & Randolph, 2004) and identified in this research, empowerment supports are the highly interpersonal, visionary types of supports necessary to shift, grow, or support culture in an organization. Examples of empowerment supports identified in this study include opportunities for collaboration, trust and encouragement, advocacy for maker-based professional learning opportunities, balancing priorities, and sharing leadership responsibilities with teacher leaders (Table 5.1). Empowering supports have positive effects on teams as well as individuals. A key understanding for educational administrators is that although empowering supports are complex, they are also needed to support innovative programs and services. Data from this survey support this claim; the need for empowerment supports are referenced much more frequently than operational supports (Table 5.1). Once could speculate that participants need

empowerment supports more than operational supports because creating a culture of making is a complex leadership endeavor.

5.4 Educators Are Appreciative of Maker Leadership

Roughly 81 percent of the survey respondents (n=27/31) chose to respond to the final open-ended survey question that asked if they would like to share anything with their direct supervisors about leadership supports for maker-centered learning and teaching that were not otherwise addressed in the survey. This high response rate for this type of open-ended response may be due to the respondents' personal desire to contribute meaningfully to the study. A review of the responses revealed similar data already collected in the survey, including themes of needing professional development, financial supports, and general leadership around maker-centered learning practices.

An unexpected, noteworthy theme that emerged is the idea of "encouragement." This theme falls outside the focus of the three inquiry questions but is important to share with the educational community. Many participants expressed their appreciation and thankfulness for the support they are currently receiving. One participant wrote:

> *I feel thankful to be encouraged to use maker-centered learning and teaching in my classroom. Even more thankful to be able to collaborate with and learn from individuals as part of the AbD group that provide inspiration and applicable ideas to bring back to my students and school.*

Another wrote:

> *I appreciate all the opportunities for professional development that my leader provides.*

Several other participants wrote a note to encourage their direct supervisor to continue providing supports to them. One participant said:

> *Keep up the good work! Your encouragement and positive comments keep me pushing forward and always looking for ways to improve.*

Another participant emphasized the importance of not only continuing the support but also deepening the support to a full-school maker-mindset initiative:

> *Continue to support it in the school as a full student body initiative. All kids should be progressing as makers from kindergarten through 8th grade. Developing skills and mindsets that will help them in other subjects and in life.*

The conclusions that can be drawn from these responses are especially noteworthy because the positive feelings educators described were volunteered. If participants didn't need/want leadership supports, they might not have expressed this level of appreciation or desire for the supports to continue. Although outside the scope of this study, I argue that the positive commentary regarding maker leadership is an important theme worthy of sharing with regional administrators.

A school culture is reflective of its organizational members (Robbins & Alvy, 1995). In my experience as an elementary school administrator, I have experienced first-hand the benefits of establishing reciprocal trust between educators and administrators. I know how it feels when a faculty member shares a set of unspoken values, how it sounds when teachers are motivating students to do their best, how it looks when faculty share a common purpose, and how the sweet first-day-of-school aroma lingers on for weeks in a school with positive school culture. These subtle nuances are the results of faculty and administrative cooperation, encouragement, and trust. By acknowledging and encouraging one another (themes identified in the survey) everyone is motivated to do their best for the benefit of the students. It is this collective understanding that

supports spaces for creativity, innovation, thinking, and learning. It is also a place where, with supportive leadership, a culture of making can emerge.

5.5 Recommendations for Future Studies

To continue to explore the nature of leadership supports as related to maker-centered learning, additional research is necessary. The overarching question for this extended research is, "How do supervisors and principals receive maker-based training and professional learning"? It seems clear from both this study as well as the literature that leadership support is needed to enact maker-based teaching and learning. If we accept this claim, we need to explore the ways in which pre-service administrators are trained and how they continue professional learning about leadership into their tenure. Are there opportunities for observation, collaboration, and professional reading on maker-based learning and teaching? Are administrators trained to know the most effective maker practices, what to look for in maker classrooms, and how to support maker educators? Based on my own experiences with professional preparation and professional learning, I can speculate that principals feel ill-equipped for the complex leadership challenges associated with supporting teachers and implementing educational initiatives such as maker-centered learning practices.

As this study was a baseline inquiry focusing mainly on identifying leadership supports, it would be interesting to explore the complexities of those supports on a deeper level. For example, a study on the sequence of leadership supports could be beneficial to administrators new to maker-centered teaching and learning practices. Knowing which supports are needed in the program development stage as compared to the supports needed to sustain a program require potentially

very different leadership strategies. Another exploration could focus on the best balance of leadership supports. Considering the varying needs of educators, how are supports individualized to help all educators across various age levels and interest levels? Further, how do administrators balance support of maker learning with the other leadership demands they juggle?

The field of education has been impacted by the Maker Movement, and the support of maker educators has become a priority in Southwestern Pennsylvania. It would be interesting to determine if leadership supports are also important in other regions of the country and how survey data in other regions may compare to the data in this survey. Therefore, another suggestion for future research is to replicate this study in a different demographic area to compare the results.

Presently, the Southwestern Region of Pennsylvania is known for its advocacy and willingness to embrace the practices and pedagogies of maker learning. With strong historical roots in the manufacturing industry; significant funding opportunities from Grable, Benedum, and Buhl Foundations; established national museums; and recent educational partnerships with Remake Learning, Digital Promise, and KidsBurgh; one could argue that Southwest Pennsylvania is a maker region (Remake Learning, 2015). As all members of A*b*D are part of this maker region, their data results reflect this particular demographic area. In contrast, how would that data compare in other areas, perhaps ones without such historical roots, or without funding opportunities, or absent community partnerships, or not as familiar with maker research? How would data from rural areas compare to data in urban settings? How would the results differ in Oakland, California, a hot-bed for maker research? What are the leadership implications if similar conditions do exist across the country and what if they are very different? Fully understanding the leadership supports across different regions might be very informative and lead to advances in maker discourse and advocacy.

5.6 Reflection

Each year, hundreds of people from around the world attend the Disney Institute leadership training. They learn from the company's success and expertise as inspired by Walt Disney's vision (Disney Institute, n.d.). The institute promotes leadership and is built around the idea that leaders are able to effect positive change and sustain it. The institute also teaches that "creativity and innovation is the product of intentional leadership." The leadership ideals taught at the Disney Institute parallel my research in that creating a culture of making in schools can only be successful with the support of leaders who not only encourage valuable innovation in and by students but also recognize that educators need support to be creative and innovative. Immersing myself in this maker inquiry and situating my study within the context of the Pittsburgh Agency *by* Design Learning Community has solidified my belief that with the right supports, educators can enact maker-centered teaching and learning in their places of practice. I believe that by intentionally and actively nurturing a culture that allows for creativity and innovation to occur, the practices and pedagogies associated with the Maker Movement can shift our educational spaces to be more learning-centered.

This inquiry project has forever changed me as a leader, as a learner, and as a maker. As a leader, I am acutely aware of the complex responsibilities I have for supporting maker educators in my school and school district. I know the benefits, barriers, and the risks involved in changing the culture of a system and feel empowered to actively nurture an environment that embraces a culture of making. As a learner, I acknowledge that I am not the authority on maker-centered learning. I recognize the breadth of talent and knowledge that my colleagues contribute to the movement and vow to learn from their experiences and trust them to take responsible risks. As a maker, I embrace failure as a means to learning. A common mantra among Makers is "fail fast,

fail often," because inherent in failure is the cyclical idea of design thinking. As a true maker, I will constantly be iterative, improving, fixing, and failing as a means to grow, learn, and push the boundaries of my own thinking and that of others in my circle of influence.

This research study has had a significant impact on my practice as public school principal. It has been an exercise in patience, perseverance, active listening, deep thinking, and personal reflection. I am more knowledgeable about the operational supports teachers need to enact maker-centered learning and am inspired to identify the unique leadership supports that teachers require in order to further cultivate, grow, and transform our schools into places that value innovation and maker-centered learning practices. Most importantly, the work of this study has sparked a confidence in me that I have never had before. I feel very comfortable engaging in pedagogical, practical, and complex leadership discussions about supporting ambitious teaching and learning. I am constantly questioning and considering multiple perspectives before forming conclusions. There is both depth and discovery in my cognitive processes for decision making.

This research study has also afforded me an opportunity to learn from the educators and facilitators of A*b*D Pittsburgh. I am humbled by the passion and energy of the group and am forever grateful for their willingness to participate in my survey. I learned so much from the open-ended qualitative survey responses and feel that I have represented "the voices of the educators" in my descriptive analysis. My hope is that the needs they have expressed, and the data they have informed, will be recognized by administrators across our region and that this study will enable those administrators to support cultures of making in their places of practice. I feel that John Dewey would admire the work of this study, as it is situated in the greater Maker Movement, as an attempt to promote and support learning-through-doing. I think he would celebrate the idea of children participating in their own learning and the teacher being a guide in that process.

The inquiry process I have used in this study is one that I will continue to engage in as a scholarly practitioner and public educator. Engaging in this mixed-methods research has uncovered questions, deepened my understanding, and increased my empathy. The cyclical nature of my journey can best be described by Paulo Freire (1968), world-renowned educational philosopher, who said, "*Knowledge emerges only through invention and re-invention, through the restless, impatient, continuing, hopeful inquiry human beings pursue in the world, with the world, and with each other*." My journey continues…

Appendix A Survey Instrument

Q2 Please choose your current assignment. Select all that apply.

- ☐ Early Childhood (pre K) (1)
- ☐ Primary Level (Kindergarten - Second Grade) (2)
- ☐ Intermediate Level (Third - Fifth Grade) (3)
- ☐ Middle Level (Sixth - Eighth Grade) (4)
- ☐ Secondary Level (Ninth - Twelfth Grade) (5)
- ☐ Post-High School (College/University/Beyond Twelfth Grade) (6)

Q3 Which content area best describes your current position? Select all that apply.

- ☐ STEM (1)
- ☐ STEAM (2)
- ☐ Arts (3)
- ☐ Design (4)
- ☐ Making (5)
- ☐ Humanities/English Language Arts (6)
- ☐ Computer/Drafting (7)
- ☐ Mathematics (8)
- ☐ Science (9)
- ☐ Library (10)
- ☐ Elementary - all subjects (11)
- ☐ Academic Coaching (12)
- ☐ Other (13) _____

Q4 My place of practice is:

- ○ Rural (1)
- ○ Urban (2)
- ○ Suburban (3)

Q5 The context that best describes my place of practice is:

- ○ Public School (1)
- ○ Charter School (2)
- ○ Laboratory School (3)
- ○ Independent/Private School (4)
- ○ Informal Learning Environment (for example: museum, library, etc.) (5)
- ○ College/University (6)
- ○ Other (7) _____

Q6 The socio-economic status of constituents in my place of practice is:

- ○ Mostly high (less than 20% of students qualify for free/reduced lunch) (1)
- ○ Average (around 20-50% of students qualify for free/reduced lunch) (2)
- ○ Low (50% or more students qualify for free/reduced lunch) (3)
- ○ Not applicable to my place of practice (4)

Q7 How many years have you been an educator?

_____

Q8 Which category best describes your role in the Learning Community today?

- ○ Mentor Educator (1)
- ○ Participant Educator (2)
- ○ other (3) _____

Q9 What is your highest degree obtained?

- ○ Doctorate (1)
- ○ Master's Degree (2)
- ○ Bachelor's Degree (3)
- ○ Some College (4)

End of Block: Demographics

Start of Block: Inquiry Question #1 - Identify who provides support

Q10 In my organization, there are practices that support a culture of making.

- ○ Agree (1)
- ○ Disagree (2)
- ○ Unsure (3)

Skip To: Q11 If In my organization, there are practices that support a culture of making. = Agree
Skip To: Q12 If In my organization, there are practices that support a culture of making. = Disagree
Skip To: Q12 If In my organization, there are practices that support a culture of making. = Unsure

---

Q11 Share some examples/evidence of practices that support a culture of making in your place of practice.

Q12 In your current place of practice, who is your direct supervisor?

- ○ Principal (1)
- ○ Assistant Principal (2)
- ○ Other (3) _____

Q13 The degree to which my direct supervisor values maker-centered learning:

- ○ A great deal (1)
- ○ A little (2)
- ○ None at all (3)

Skip To: Q14 If The degree to which my direct supervisor values maker centered learning: = None at all
Skip To: Q15 If The degree to which my direct supervisor values maker centered learning: = A great deal
Skip To: Q15 If The degree to which my direct supervisor values maker centered learning: = A little

Q14 Which of these factors may prevent your direct supervisor from valuing maker-centered learning?

- ○ He/she is unaware or uninformed (doesn't know enough about the subject of maker-centered learning practices) (2)
- ○ He/she is opposed (has a negative perception of maker-centered learning practices) (3)
- ○ He/she doesn't consider maker-centered learning practices an educational priority (4)
- ○ Other: (5) _____

Q15 Please rate your supervisor's knowledge about maker-centered learning practices:

- ○ Extremely knowledgeable (1)
- ○ Moderately knowledgeable (2)
- ○ Not knowledgeable at all (3)

Skip To: Q16 If Please rate your supervisor's knowledge about maker centered learning practices: = Not knowledgeable at all

Q16 Please explain why you think your supervisor lacks knowledge about maker-centered learning practices?

Q17 In your current place of practice, who most supports your implementation of maker-centered learning practices?

- ○ Principal (1)
- ○ Assistant Principal (2)
- ○ Other (11) _____

Q18 The degree to which the leader (as identified in the last question) values maker-centered learning pedagogy:

- ○ A great deal (1)
- ○ A little (2)
- ○ None at all (3)

Q19 Please rate this leader's (the one who most supports your implementation of maker-centered learning practices) knowledge about maker-centered learning practices:

- ○ Extremely knowledgeable (1)
- ○ Slightly knowledgeable (2)
- ○ Not knowledgeable at all (3)

Q20 The person who I identified as my supervisor and the person who most supports my practice as a maker educator are the same person?

- ○ Yes (1)
- ○ No (2)

End of Block: Inquiry Question #1 - Identify who provides support

---

Start of Block: Inquiry Question #2 - Leadership Supports

Q21 Leaders support maker educators in many different ways. From your perspective, please classify these supports as received, not received, or not received and not needed.

	Received (1)	Not Received (2)	Not Received and Not Needed (3)

Ample budget for materials and supplies (1)	○	○	○
Assistance writing grants (2)	○	○	○
Participation in national/regional partnerships (3)	○	○	○
Clear expectations/vision for maker learning (4)	○	○	○
Supports maker thinking (5)	○	○	○
Personal encouragement and trust (6)	○	○	○
Encourages responsible risk taking (7)	○	○	○
Aligned curricular documents (8)	○	○	○
Flexible assessment opportunities (9)	○	○	○
Networking opportunities (10)	○	○	○
Professional development with maker-centered approaches (11)	○	○	○
Professional development with hands-on opportunities (12)	○	○	○
Time for organizational collaboration (13)	○	○	○

Purposeful time for innovating, creating, making & doing (14)	○	○	○
Extended time for learners engaging in maker-centered learning (15)	○	○	○
Before/after school opportunities for making (16)	○	○	○

Q22 Please rank the following leadership supports by the one that is most important for your implementation of maker-centered learning practices. Assign a value from 1 (being the most important) through 7 (being the least important).

_____ General Leadership (defined as personal encouragement or support) (1)
_____ Financial Support (2)
_____ Curricular Support (3)
_____ Networking (4)
_____ Professional Development Opportunities (5)
_____ Collaboration with Colleagues (6)
_____ Time for Implementation (7)

Display This Question:

If Please rank the following leadership supports by the one that is most important for your implemen... [General Leadership (defined as personal encouragement or support)] = 1

Q23 Describe how general leadership (defined as personal encouragement or support) most influences your ability to enact maker learning.

_____

Display This Question:

If Please rank the following leadership supports by the one that is most important for your implemen... [Financial Support] = 1

Q24 Describe how financial support most influences your ability to enact maker learning.

_____

Display This Question:

If Please rank the following leadership supports by the one that is most important for your implemen... [Curricular Support] = 1

Q25 Describe how curricular supports most influences your ability to enact maker learning.

_____

Display This Question:

If Please rank the following leadership supports by the one that is most important for your implemen... [Networking] = 1

Q26 Describe how networking most influences your ability to enact maker learning.

_____

Display This Question:

If Please rank the following leadership supports by the one that is most important for your implemen... [Professional Development Opportunities] = 1

Q27 Describe how professional development opportunities most influence your ability to enact maker learning.

_____

Display This Question:

If Please rank the following leadership supports by the one that is most important for your implemen... [Collaboration with Colleagues] = 1

Q28 Describe how collaboration with colleagues most influences your ability to enact maker learning.

_____

Display This Question:

If Please rank the following leadership supports by the one that is most important for your implemen... [Time for Implementation] = 1

Q29 Describe how time for implementation most influences your ability to enact maker learning.

_____

End of Block: Inquiry Question #2 - Leadership Supports

Start of Block: Inquiry Question 3 -What supports are needed?

Q31 Are there leadership supports missing in your current place of practice?

- Yes (1)
- No (2)

Skip To: Q32 If Are there leadership supports missing in your current place of practice? = Yes

Skip To: Q33 If Are there leadership supports missing in your current place of practice? = No

Q32 Please list or explain the supports that are lacking in your place of practice?

_____

Q33 What are your identified values for student learning that you are observing as part of the A*b*D Learning Community this year?

Q34 How does the person you identify as the person who most supports your implementation of maker-centered learning support your identified values in your place of practice?

Q35 What else would you like to share with your direct supervisor about leadership supports for maker-centered learning and teaching?

End of Block: Inquiry Question 3 -What supports are needed?

Appendix B Survey Invitation Script

You are now invited to participate in survey that explores leadership supports for maker educators. Most importantly, I'd like to thank you in advance for participating. The survey is an electronic survey created through Qualtrics Software as approved by the University of Pittsburgh.

This survey serves 3 purposes:

1. It gives me data for my personal Dissertation in Practice

2. It provides important information to the leaders in your organizations about how we can better support our maker educators

3. The results will be connected to Agency *by* Design's learning community and will inform leadership practices around the world including Hong Kong, Washing DC, San Francisco to name a few.

This survey is anonymous. There are some demographic questions, however, none of the responses will link to your identity.

This survey is voluntary; however, we hope you choose to participate because this survey holds significant value in our region. Your responses have the potential to inform the practices of maker leaders. Your responses will be analyzed and reported out to the leaders in your places of practice.

We feel that this research is so important that we have included in the agenda for today so that you can take it without feeling rushed and you are in a space that is free from distractions. You will be provided lap top for the survey to make typing the open-ended questions a bit easier than on a mobile device.

This survey has been vetted by other educators and should not take you very long to complete – only 15-20 minutes. Please provide thoughtful feedback on the open-ended questions so that the data will be rich enough to offer analysis and will be useful to regional leaders.

You can take the survey at any time over the next hour. Mr. May, the Edgeworth Computer teacher will be available in the lab to assist you with any technology related questions and I will be on-hand to clarify any of the content questions.

Thank you again, for sharing your thoughts and perspectives!

Appendix C Survey Instrument Consent

Dear A*b*D Participant,

You are receiving this survey because you have been identified as someone who is a maker educator and part of the Agency *by* Design Pittsburgh Learning Community. Thank you for considering participation in this study. You are being asked to participate in a survey research project entitled "**Leading a Culture of Making: Investigating Leadership Capacities that Impact Learning**," which is being conducted by Carol Sprinker, a graduate student in The School of Education at the University of Pittsburgh. The goal of this project is to identify who, in a position of leadership, supports you in enacting maker-centered teaching and learning practices and to discern which supports are most helpful to your practice. Participation of current maker educators is critical to my inquiry.

The survey should take approximately 20 minutes to complete. This survey is anonymous. No one, including the researcher, will be able to associate your responses with your identity. Your participation is voluntary. You may choose not to take the survey, to stop responding at any time, or to skip any questions that you do not want to answer. Thank you in advance for your time and for sharing your thoughts and ideas.

By completing this survey, you are agreeing to participate in this research project. Questions regarding the purpose or procedures of the research should be directed to Carol Sprinker at CES129@pitt.edu. This study has gone through the Institutional Review Board (IRB) Process at the University of Pittsburgh, in accordance with Federal regulations. The IRB, a university committee established by Federal law, is responsible for protecting the rights and welfare of research participants. If you have concerns or questions about your rights as a research participant, you may contact the IRB Administrator at (412) 383-1480 or askirb@pitt.edu. Thank you very much for participating in this survey.

Carol Sprinker
Graduate Student
University of Pittsburgh
CES129@pit.edu

Appendix D Codebook for the Analysis of Qualitative Inventory Data

Inventory Question 11

Code	Description	Example
Space	Participant references a physical space. Examples include: maker space, wonder lab, lego lab, fab lab, STEM space, STEAM studio, recording studio, classroom.	*Our school has two maker spaces that students can utilize during instruction.*
Time	Participant references time (directly or indirectly) for planning, preparing, implementing, or in training. Time may be referenced as weeks, periods, hours, days, or as “in a schedule”.	*We have the opportunity to plan, prototype, and execute different activities. these activities include, but are not limited to, soft materials, hard materials, electronics, and digital making. These are practiced daily and are also shared via professional developments.*
Leadership	Participants reference encouragement, support, vision, or optimism from administration.	*Encouragement from administrators to continue making and experimenting within the classroom.*
Materials	Participant specifically mentions hard or soft physical materials or equipment including: poster maker, printer, 3D printer, electronic pieces, robotics, or paper.	*1. utilizing our "poster maker" in a learning pathway to print student poetry/photography, followed by presenting in our "hub" space in the library* *2. students programmed robots to travel along a self-designed map/course*
Professional Development	Participant lists professional development, PD, or in-service training.	*PD around making, making Lab, making in regular ed classroom time*
Collaboration	Participant uses the word collaboration referencing teachers or students.	*Learning is showcased in classrooms and around the school with students and teachers collaborating to document learning*

Community/ Relationships	Participants lists relationships, partnerships or community organizations.	*...partnership with CMU to introduce/integrate robotics into our curriculum*
Financial	Participant lists budget or grant support.	*administration supports the budget for supplies that are necessary to support making*

Inventory Question 16

Code	Description	Example
Not a priority	Participant lists other initiatives or compelling leadership priorities.	*I think he knows about maker learning and considers it valuable but holds traditional method (testing, notes, essays etc.) as the priority practice and assessment.*
Lacks maker implementation or culture	Participant explains or describes the lack of maker- centered culture or inability to implement maker teaching/learning practices.	*In our district the idea of maker-centered learning is a new topic. She has researched the idea of maker centered learning, but has not helped to develop a culture of make- centered learning.*
Doesn't have a maker background	Participant explains the administrators background or beliefs about maker learning.	*Because their background is not technical. Technology education resources are different than maker ed. resources. There are overlaps but when it comes to learning the process of making they are desperate*
Other managerial priorities	Participant lists other managerial priorities such as: paperwork, discipline, grant writing, office issues, or "principal issues".	*I think my admin/supervisor/principal is aware of the practices and knowledgeable as best as he can be, however, his time is spent doing principal things, so he is more focused (understandably so) with them.*
More focused on data	Participant directly uses the word data, tests, PSSA, PVASS, or scores.	*My principal's first focus is on data. Showing student growth in tested subject areas is a priority in my district.*
Lacks interest	Participant directly says that administrator lacks interest.	*I think she lacks knowledge and interest because she is not curious about my process in this AbD Professional Development. Because she doesn't care to learn more about my experience here, I feel like she doesn't see the benefit in incorporating it school wide.*

Inventory Question 17

Code	Possible Roles
Director/Manager	Director, Manager
District Office Administrator	Another Administrator, Curriculum Director, Superintendent,
Teacher/Colleague	Teacher, Mentor Teacher, Colleague, STEAM Cohort, Teacher Teammate
Myself	Me, I
Unidentified	Role not identified

Inventory Question 23

Code	Description	Example
New things	Participants describes or gives examples of how they are encouraged to try new things, projects, or initiatives.	*Our building administration and Superintendent encourage trying new things and taking risks.*
Risk taking	Participant discusses positive support or outcomes associated with with risk taking or experimentation.	*...the risks associated with it are recognized and accepted.*
Supports projects	Participant identifies support of projects or maker activities.	*Both of my principals (and past principals in the same district) have been supportive of projects/initiatives in which I've shown interest. Their support and "green light," so to speak, is the first and crucial step in planning to engage in a project.*
Validates	The participant shares an experience of feeling validated or describes how maker learning is valued.	*It shows this type of learning is valued*
Personal Encouragement	The participant shares a personal or professional example of administrative personal encouragement.	*Had I not ended up teaching at a school with a vision for maker learning, I may not have realized its importance! The encouragement that I received actually caused me to change my style of teaching!*

Inventory Question 29

Code	Description	Example
Implementation	Participant references time for implementation, teaching, or actively engaging in maker learning.	*Having control of time in the classroom and order of academics makes it possible to implement more making opportunities in classroom.*
Competing content areas	Participant discusses the content areas (such as core classes: ELA, Math, Science) that compete with maker lessons or classes.	*Time is not a factor during the planning & development phase. It does become issue when working around the students' schedules. Certain times and subjects are untouchable. With lots of creative planning we can usually find a time that works.*
Preparation	Participant references planning, collaboration, lesson planning, or time to prep materials for maker-centered learning.	*Time allows me to collaborate with other teachers and allows me to prepare projects, materials, and equipment for classes to use.*
Scheduling autonomy	Teachers use the words: autonomy, control, individual discretion, or personal schedule when referencing time for maker learning.	*Having control of time in the classroom and order of academics makes it possible to implement more making opportunities in classroom.*

Inventory Question 30

Code	Description	Example
Planning/ Collaboration	Participant uses the words planning or collaboration referencing teachers or students.	*Time for collaboration/planning - Teachers aren't given the time or resources to collaborate and plan with others to be sure they are creating solid lessons using maker-centered learning.*
Finances	Participant discusses funds, budget, or grant support.	*Funds. Money is always a hurdle. Innovation can take place within the financial constraint, but moving forward and truly making changes takes funding.*
General Encouragement/ Trust	Participants reference encouragement, support, vision, trust, or optimism from administration.	*I feel that for me, the main lack of support is the trust in my ability to begin creating this space. I know that there is a lot that goes into creating this type of space, but every time I approach my*

		leader with ideas, I feel that I am put on hold and told to slow down.
In-Service Training	Participant lists professional development, PD, or in-service training.	*I feel there could be more embedded support (in-service time) for staff to learn about maker-centered principles.*
Time for Implementation	Participant references time for implementation, teaching, or actively engaging in maker learning.	*Time is lacking to implement new maker movements*
Competing Priorities	Participant discusses the content areas (such as core classes: ELA, Math, Science) that compete with maker lessons or classes.	*Most focus is placed on core content areas, and they are encouraged to follow the curriculum aligned to the Keystone tests.*
Curricular Alignment	Participant references mapping or alignment to standards, curriculum, PSSA or Keystone exams.	*We could definitely do a better job of mapping learning goals and projects from year to year. Because my school is relatively new and is constantly in the process of generating its own curriculum (the teachers create the curriculum), students sometimes miss the larger picture of their learning and feel as though they aren't learning much through projects.*
Teacher Leaders	Participant describes an opportunity to lead others or the need to have teacher-level leadership in the place of practice	*Opportunities for me to lead/involve my colleagues and introduce them to maker learning in a regular classroom to enhance curriculum*

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