

I'm the Smart Kid: Adult Attitudes and Perceptions about Enrichment and Special Education

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ABSTRACT

Within the educational community, there is a growing shift towards the development of essential skills, emphasizing process-skills over mastery of content. This shift is mirrored in the rapid changes in workplace-related technology, outpacing the creativity and flexibility of current graduates. Makerspaces and related technology education approaches have been increasingly implemented to offer students opportunities for developing these desired skills. Parallel to this effort, students who receive special education services but access the general education curriculum continue to lag behind the general education population in high-stakes testing, graduation-rates, and long-term employment outcomes. Remediation-based services often preclude students receiving services from exposure to technology- or other enrichment-based educational opportunities. The initial phase of this exploratory case study focused on the impacts of a technology-based enrichment club on a small group of special education learners. Through this proof-of-concept study, it became apparent that adult participants across stakeholder groups were showing evidence of transformative learning through their experiences with the club. The follow-up study, therefore, focused on changes in adult perceptions and/or practices resulting from these experiences, as evidenced through the Nerstrom Transformative Learning Model (2014). Following exposure, interviews were conducted with participating cosponsors, school-based educational leaders, and guest presenters from technical fields. These interviews were analyzed for both commonly identified and group-specific themes. Results suggest that experiences with the club challenged various assumptions held by participants, often leading to new perspectives on special education practices and students who receive services. These results suggest that potential shifts are a function of how many established perspective-based obstacles these challenged and reformed assumptions can address. Recommendations for future research include replication, extension beyond a club setting, and further exploration of identified themes, as well as investigating the deeper implications of obstacles to transformative learning.

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GENERAL AUDIENCE ABSTRACT

Within the educational community, there is a growing shift towards the development of essential skills, emphasizing process-skills over mastery of content. This shift is mirrored in the rapid changes in workplace-related technology, outpacing the creativity and flexibility of current graduates. Makerspaces and related technology education approaches have been increasingly implemented to offer students opportunities for developing these desired skills. Parallel to this effort, students who receive special education services but access the general education curriculum continue to lag behind the general education population in high-stakes testing, graduation-rates, and long-term employment outcomes. Remediation-based services often preclude students receiving services from exposure to technology- or other enrichment-based educational opportunities. The initial phase of this exploratory case study focused on the impacts of a technology-based enrichment club on a small group of special education learners. Through this proof-of-concept study, it became apparent that adult participants across stakeholder groups were showing evidence of transformative learning through their experiences with the club. The follow-up study, therefore, focused on changes in adult perceptions and/or practices resulting from these experiences, as evidenced through the Nerstrom Transformative Learning Model (2014). Following exposure, interviews were conducted with participating cosponsors, school-based educational leaders, and guest presenters from technical fields. These interviews were analyzed for both commonly identified and group-specific themes. Results suggest that experiences with the club challenged various assumptions held by participants, often leading to new perspectives on special education practices and students who receive services. These results suggest that potential shifts are a function of how many established perspective-based obstacles these challenged and reformed assumptions can address. Recommendations for future research include replication, extension beyond a club setting, and further exploration of identified themes, as well as investigating the deeper implications of obstacles to transformative learning.

Dedication

This dissertation is dedicated to my parents. Mom and Dad, I will never forget when I (finally) graduated from my undergraduate program. My mind was racing, thinking about my next graduate steps, and the eventual doctorate that I knew I wanted to attain. You stopped me in my tracks by gently suggesting that I “slow down, enjoy your accomplishments, and appreciate that you are the first person in our family to get a four-year degree.” Thank you for helping me break free of the Northern Virginia mentality of “faster, higher, no matter the costs.” Thank you for learning, alongside me, that if my emotional state is healthy, all else tends to follow suit. Thank you most of all for giving me the parts of you that have made me a strong person.

This dissertation is dedicated to Ashley, my role model and partner in life. Thank you for seeing potential in a soul cast adrift; you believed in me, and it has been everything to me. I admire your work ethic, your drive, and your passion. No one has helped me push myself in positive ways the way you have. No one has helped me focus inward to find outward fulfillment in my life the way you have. There is no one else that I could imagine sharing these life experiences with. I will continue to stand with you through whatever life presents, and know that the best is yet to come.

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Chapter 1

Introduction

Students receiving some form of special education services make up a sizeable segment of the American public school population, with a total of 5.83 million receiving services under the Individuals with Disabilities Act (IDEA) in 2014 (Samuels, 2016). Unfortunately, this group consistently demonstrates performance gaps, as compared to other demographic groups, especially apparent in numeracy and literacy (National Center for Education Statistics 2015a; National Center for Education Statistics 2015b), with cross-curricular impact. Similarly, they are more likely than their peers to drop out of school, affecting subsequent employment opportunities (Common Core of Data, 2015). Upon leaving public K-12 education, students who received special education services are less likely to attend postsecondary school, less likely to live independently as young adults, and less likely to be fully employed and/or financially independent (Sanford, et al. 2011).

In parallel with these statistics, education and educational priorities are undergoing a paradigm shift. Educators increasingly emphasize the importance of essential skills (previously referred to as 21st century skills) such as critical thinking, creativity, and academic resilience (Eastern School District, 2014). Related to this emphasis, the burgeoning field of student technical education stresses the importance of preparing current students for the technological demands of future work and life requirements, focusing on Science, Technology, Engineering, Art, and Math (STEAM) (Matthews, 2007). One way in which this education is being delivered to students is through technology-based makerspaces (Martin, 2015). Currently, however, IDEA (2004) and related case law generally focus on minimum educational requirements (*Board of*

Educ. v. Rowley, 1982; *Andrew F. v Douglas School County*, 2017), rather than on any form of academic enrichment.

Problem of Practice

In its current form, special education tends to follow a remedial (Opitz, et al., 2017; Vaughn, Denton, & Fletcher, 2010; Ferri, 2012), rather than enrichment-based approach to education. In research and in practice, enrichment has primarily been considered in cases of twice-exceptional students, with identified learning needs but also identification of giftedness (Baum, 1988; Foley-Nicpon, Assouline, & Colangelo, 2013). Likewise, educators and educational leaders approach special education with minimum educational requirements as their baseline (IDEA, 2004), focusing on research-based remediation and intervention (Odom, et al., 2005; Opitz, 2016), rather than enrichment to help students meet academic expectations. The problem, therefore, consists of finding ways to emphasize the importance of enrichment-based education to teachers and educational leaders, both to help students with learning needs access the curriculum and to allow them opportunities to develop aforementioned essential skills. In order to transform the thinking of various stakeholders working with students, we must incorporate their input into design and revision of any initiative (Dufour & Eaker, 1998). In addition, adults, especially teachers, should engage in constructivist implementation, learning through experience with technologies alongside student participants (Liu, 2011).

Rationale and Significance

Having identified that enrichment as an educational approach in special education has not been adequately explored in research or practice, I sought out an appropriate means of trialing such an approach. My personal experiences with the Qualcomm Thinkabit Lab, through Virginia

Tech, provided a plausible means of developing students' practical, vocational, and academic skills in a technology-based enrichment setting. Furthermore, the director of the program shared, anecdotally, that students with special learning needs often thrive when engaged in field trips to the lab. In considering the potential of on-going, rather than one-time exposure to this approach, I conducted a proof-of-concept study, approved by both the Virginia Tech Institutional Review Board and Eastern School District (pseudonym), involving a small group of students receiving special education services. This study and program focused on the potential of a technology-based enrichment approach to special services with regards to student growth, with student participants in the original phase sharing perception shifts on their own self worth (See Appendix A). During and after participation, students were able to speak to specific examples, such as, "We did a lot of cool things like when we were making the thing that would read the temperatures of the rooms. I thought that the science behind it was cool," as well as general career ambitions, such as, "When I grow up, I want to become a successful businessman, advancing technology to make life easier and giving jobs to people." They also enjoyed and appeared to gain from guest presenters from technical fields, sharing that, "The guests were amazing; their jobs sound pretty cool, and how they use technology in the things that they have to do." At its core, results from this study suggested growth in student self-esteem: "This club showed me that I'm the smart kid."

A secondary, unexpected outcome also rose from this initial study. Participating teachers, educational leaders, and even the larger community exhibited evidence of potential transformative learning. For example, one cosponsor shared, "This [program] showed kids that they can be successful and do something that's complex that not everyone else can do, and in

some ways, to show teachers that [students] can do more than we think they can do when we see them in the classroom or are only expecting written or read work...” As another example, at the conclusion of the year-long program, an administrator shared, “I’m now questioning my own understanding of equity and access, and what it means to be equitable does not necessarily mean that everyone gets the same thing. It’s giving kids what they need.” These findings suggested further potential in exploring how enrichment-enhanced programs serve not only as a learning tool for students, but how they can be used to transform the thinking, attitudes, and even practices of adults around their preconceptions of enrichment as it pertains to special education learners. These adult experiences, in turn, became the basis for the ultimate study.

Operational Definitions

Computational Thinking - Approaching information and stated problems through “reasoning at multiple levels of abstraction, understanding and applying automation, and analyzing the appropriateness of the abstractions made” (Lee, et al., 2011, p. 32).

Education Technology - Distinct from *Technology Education*, education technology facilitates student/staff collaboration to address equity concerns, with the ultimate goal of helping students access the curriculum (U.S. Department of Education, Office of Educational Technology, n.d.)

Enrichment - In education, enrichment goes beyond content areas, whereas extension expands upon and links between curricula; for the purposes of this study, *enrichment* will be used to commonly define both concepts (Loudoun County Public Schools, n.d.).

Essential Skills (Commonly referred to as 21st Century Skills) - Student traits of effective communication, collaboration, ethical and global citizenship, creative and critical thinking, goal-directedness, and individual resilience (Eastern School District, 2014).

Executive Function - Broadly speaking, higher order thinking skills such as planning, organizing, self-regulation, and self-awareness (Reber & Reber, 2001).

Makerspace - Flexible spaces with physical and/or technological materials where “makers can envision a project, find an expert, and create something” (Graves, 2014, p. 8).

Microcontroller - Simple computers, best used for building and coding products around simple one- or two-step mechanics or sensors (Di Justo, 2015).

Microcomputer - More complex than microcontrollers, capable of completing multiple simultaneous tasks and complex processes (Di Justo, 2015).

Project-Based Learning (PBL) - Authentic student learning involving statement of a problem and student driven, creative, critical, and collaborative problem-solving (Virginia Department of Education, n.d.).

Remediation - A program or approach designed to improve at-risk students’ academic performance (Virginia Department of Education, n.d.).

Special Education - For the purposes of this study, special education is limited to students with identified disabilities who access the general education curriculum through use of accommodations and/or modifications.

STEAM vs. Technology-Based Education- For the purposes of this study, STEAM and Technology-based education will be used interchangeably, meaning the cross-curricular intersection of science, technology, engineering, and math (Basham, 2010), while also integrating art and design (Rhode Island School of Design, n.d.).

Technology - Modifying the natural world to assist with human wants and needs; for the purposes of this study, it more narrowly refers to *technology education* and *technological*

literacy, or studying technologies and their evolution in order to use them, understand them, solve problems, and contribute to further technological advancement (Dugger & Naik, 2001).

Transformative Thinking/Learning - Utilizing experiences to challenge existing beliefs and perspectives, potentially leading to changes in attitudes and/or practice (Nerstrom, 2014).

Research Questions

As previously discussed, I changed the focus of this research after completing the proof-of-concept study. During the proof-of-concept study, I addressed the following question: How does exposure to STEAM-based enrichment opportunities and vocational skills/profession training impact self-confidence and/or cross-curricular self-efficacy for students receiving special education services?

When the focus of the study changed, the research questions changed, accordingly.

Therefore, the research questions that guided this study are:

1. What are the impacts of a STEAM enrichment program for students receiving special education services on the attitudes and perceptions of adults involved with the program?
2. What direct and/or indirect impacts can transformations in adult thinking have on school-based special education practices?

Limitations

This targeted study took place in one school location over a two-year implementation. This, in addition to my close involvement with both phases of the study, limit the potential generalizability of findings to a larger, educational system-wide basis. The current study focused on adult perceptions, limiting conclusions about student outcomes following participation in this program, both short- and long-term. Adults had limited exposure to this program, also limiting

conclusions about long-term impacts on challenged perspectives and/or potential changes in practice. As such, any potential findings will require replication in other, diverse settings in order to test their application beyond the currently participating school. I will welcome collaborations with other educators interested in modeling similar studies on methods employed herein.

Delimitations

This study initially explored a technology-based enrichment club designed for upper elementary students who receive special education services but access the general education curriculum, and transitioned to studying the adults who supported student-participants. The program was delivered as an after-school club, rather than during the school-day, and was novel to all participants. Adult participants included cosponsor teachers, school-based educational leaders, and experienced practitioners in technology-based industries as guest presenters. The selected mid-Atlantic public elementary school provided after-school clubs, but did not have a club focusing on either technology or on students who receive services. I was a prominent participant in the study, serving as the club sponsor and recruiting adult participants to provide a broad cross-section of experientially informed viewpoints (e.g. in terms of roles within the school and from various industries), and working with classroom teachers to identify student candidates for the club.

Overview of the Dissertation

The current chapter of this study identifies the need for this research, operationalizes terms that are used in this study, states the research questions, and identifies limitations and delimitations. Chapter 2 reviews available literature about the topics identified through both Year One and Year Two of the study and introduces the utilized conceptual framework. Chapter 3

presents my approach to answering the research questions, in terms of tradition, recruitment, instrumentation, data collection, and analysis. Chapter 4 explains participant demographics, and explores analyzed interview data, both across and within stakeholder groups. Chapter 5 delves into the implications of findings, both by research question and stakeholder group, poses recommendations for further studies, and provides final conclusions.

Chapter 2

Literature Review

In order to better assess the current state of special education services for students who access the general curriculum, as well as the potential of enrichment-based opportunities, I conducted a literature review of relevant research. Due to the observed changes in thinking that adult participants underwent during the initial phase of this study, I then conducted an additional review of available literature, focusing on adult transformative learning. This literature review focuses on the following: Special education law and current practices, outcomes for students receiving special education services, remediation vs. enrichment, an overview of and potential benefits from technology-based education, and transformative thinking for educators and educational leaders. I also considered impressions from the proof-of-concept STEAM-based enrichment program. All topics were considered, holistically, in developing the ultimate research questions.

Special Education

Having identified special education as an area of persistent concern regarding K-12 performance, graduation rates, and eventual employment, I explored relevant statutes and fundamental legal cases and conducted a deeper investigation into current approaches to instruction and their resultant outcomes. Additionally, I reviewed current uses of technology and/or enrichment for students receiving services, as well as current approaches to transitioning students towards post-secondary goals and careers.

Law

Initially enacted in 1990 and reauthorized in 2004, IDEA outlines the statutes and regulations that govern education for students with documented disabilities. This act contains six key components: Individualized Educational Programs (IEP), Free and Appropriate Education (FAPE), Parent and Teacher Participation, Appropriate Evaluation, Least Restrictive Environment (LRE), and Procedural Safeguards (IDEA, 2004). Of these components, FAPE and LRE are the sections chiefly related to instructional setting. Broadly, FAPE dictates that all school-aged children are entitled to educational experiences appropriate to their needs (Yell, 2016). LRE dictates that students be educated in a general education setting to the greatest extent possible (Yell, 2016). In case law, major cases around instructional setting for students largely involve FAPE and LRE, as in 1982's *Board of Ed. v. Rowley*. More recent cases, such as *Andrew F. v. Douglas County School District* (2017), have begun addressing instructional levels and outcomes, but typically focus on minimum educational expectations. Existing laws, regulations, and cases do not provide requirements around or guidance for enrichment in special education services.

Current Practices

In order to reach these legally mandated minimum education expectations, special education-specific instructional approaches have been developed. These approaches and their formulation were explored in terms of meeting the needs of student-specific Individualized Education Programs (IEP).

Researched-based IEPs. The chief driving factor behind modern special education instructional methods, as outlined in IDEA (2004), is the expectation that they be research-based.

Historically, insufficient emphasis on empirically tested, peer-reviewed approaches have been used in designing and delivering instruction for students receiving services (Etscheidt & Curran, 2010). This expectation is mirrored in the 2002 No Child Left Behind Act, defining educationally peer-reviewed research as “...research that has been accepted by a peer-reviewed journal or approved by a panel of independent experts through a comparably rigorous, objective, and scientific review” (No Child Left Behind [NCLB], 2002, No Child Left Behind Act of 2001, P.L. 107-110, 20 U.S.C. § 9109(37)). Rather than delivering instruction arbitrarily, programs must be validated as effective in order to be included as a viable instructional method. This approach to special education continues to undergo refinement, with research being conducted to outline and clarify the rigor required for an instructional approach to move from concept, to research, to empirically-based implementation (Odom, Brantlinger, Horner, Thompson, & Harris, 2005).

Representation of student strengths in IEPs. There have long been pushes to include and incorporate identified strengths in students receiving special education services (Trent, Artiles, & Englert, 1998). For example, the inclusion of school counselors on IEP teams can encourage “strength promotion over problem reduction” (Geltner & Leibforth, 2008, p. 164), both socially and academically, framing needs positively to all members of the team. Largely, however, eligibility still largely follows a deficit- and/or discrepancy-based model, relying heavily on educational deficits identified via cognitive and/or educational achievement testing, as well as any medical diagnoses (Yell, 2016).

When coupled with the minimum legal educational expectations, these realities lead to IEPs and instruction designed around intervention, accommodation, and modification (IDEA,

2004). Furthermore, students receiving services for significant literacy and/or numeracy needs very often do so in pull-out settings, separate from the general education setting (Opitz, et al., 2017; Vaughn, Denton, & Fletcher, 2010; Ferri, 2012). Even in cases of inclusion, teachers engaging in traditional, lecture-based explicit instruction dominate classroom learning while many at-risk learners experience difficulty due to the following factors: Lack of opportunity for oral academic discourse, passive learning, lack of meaningful engagement, limited access to language and content, lack of productive collaborative group working time, and low expectations (Echevarría & Short, 2011).

Educational technology in IEPs. Students who receive services are entitled to integrated use of technologies via their IEP only insofar as these tools act as accommodations to assist with accessing the curriculum (Yell, 2016). Communication devices, electronic word-processors and/or word-predictive software, etc. fall under this category, but enrichment-based technologies are not explicitly mandated or mentioned under law.

Multimodal learning activities can be very effective with students receiving services in order to tap into their preferred or strength-based learning styles (Vaughn & Linen-Thompson, 2003). Likewise, allowing students receiving services to learn and express themselves through non-traditional, multi-modal means has been evidenced to increase social and academic success, shifting the educational paradigm from “‘Do you really belong here?’ to ‘How do we support you belonging here?’” (Collins, 2011, p. 417). In spite of these findings, I did not readily find research exploring the potential of enrichment-based opportunities to build on strengths or address needs in students receiving special education support.

Student Outcomes

In order to assess the effectiveness of current instructional approaches to special education, I explored several measures of student outcomes. In-school performance on mandated accountability measures and graduation rates, as well as post-secondary education, employment, and independent living, were all found to correlate negatively with student K-12 special education status.

As a whole, students receiving special education services consistently fall behind their peers, demonstrating significant achievement gaps on nearly every measure of national and state assessments (National Center for Education Statistics 2015a; National Center for Education Statistics 2015b). They graduate high school within four years at substantially lower (63.1%) rates than the national average (82.3%) (Common Core of Data, 2015). Post-secondary, they enroll in educational programs at a lower rate than the general population (55% vs. 62%), they are less engaged in job training, employment, or active attendance of postsecondary education than the general public (85% vs. 95%), they are less likely to live independently than the general population (36% vs. 44%), and are less likely to be financially independent than the general population by having a checking account (60% vs. 71%) or a credit card (45% vs. 55%) (Sanford, et al. 2011). Of those that do enroll in a four-year college, only about one third graduate within eight years (Mader, & Butrymowicz, 2017), as compared to the overall national average of 59% graduating within six years (National Center for Education Statistics, 2017). Although these cited statistics represent the totality of special education learners, hence being broader than the population targeted by the current study, they are illustrative of the multi-dimensional short- and long-term obstacles facing these populations, at large.

Enrichment in Special Education

Having established that current approaches to special education have not eliminated short- or long-term achievement gaps in students receiving services, I conducted a review of potential enrichment-based approaches. I did not find evidence in either the body of research or related best practices to explicitly suggest enrichment as a currently utilized means of delivering special education services. Some available research does, however, explore integration to general education classrooms as potential enrichment for students receiving services, as well as specific enrichment for students identified as twice-exceptional.

Inclusion and mainstreaming under IDEA (2004) refers to educating students who receive services with the general population. Although some educators view this as providing enrichment opportunities for students receiving services, more often it simply reduces the level of restriction placed on services, sometimes in compliance with and sometimes in violation of LRE requirements (Yell, 2016). In my investigation of enrichment in special education, I did not find research suggesting widespread use in the United States. The only targeted area where I found evidence of implementation involved cases of twice-exceptionality: Students with identified areas of special education eligibility, as well as identified gifted traits. For these students, enrichment and talent-development have been found to result in gains in self-esteem, academic performance, creativity, and development of expertise (Baum, Schader, & Hebert, 2014; Baum, 1988). Similarly, faculty education-levels appear to have little overlap in this area, with special education teachers reporting that they know little about enrichment-based education and, conversely, gifted education teachers reporting that they know little about special education-based education (Foley-Nicpon, Assouline, & Colangelo, 2013).

As was previously described, technology is utilized in special education, but generally as a tool to make the curriculum accessible rather than as a means of enrichment. Although the general promise of technology-based enrichment was noted in Chapter 1 as a means of developing essential skills in students, this approach is not currently being widely utilized in special education implementation. STEAM-based programs have been suggested to offer at-risk groups the opportunity to develop multimodal academic language and skills by authentically and collaboratively touching, feeling, and interacting with real world problems (Israel, Maynard, & Williamson, 2013). These experiences provide students with avenues to alternately bypass and further develop their areas of weakness across academic domains. As such, enrichment-based special education appears to be a gap in the available research.

Transition Services

In order to better contextualize student preparation for their post-special education and post-secondary lives, I explored current transition services, as outlined by IDEA (2004) and the IEP process. By law, students receiving special education services must participate in setting post-school goals as part of their annual IEP by age 16, with a recommendation that they begin by age 14 (deFur, 2000). This goal-setting transition includes an adult-facilitated exploration of short- and long-term career and life interests, as well as a discussion of requisite skill-development needed to attain these goals (deFur, 2000). This transition plan should be ongoing and revisited on an annual basis, with accountability for attaining goals shared by all participating members of the IEP team (deFur, 2000).

Although these transition services are designed to build executive function skills and elicit long-term planning in students through incremental goals, research indicates that existent

services may not currently be realistically aligned with actual student needs (Peterson, et al. 2013). A student with multiple disabilities and assistance with daily living skills, for example, is unlikely to reach a stated goal of living independently without roommates; transition goals created along these lines are not likely attainable for this student, no matter the level of support (Peterson, et al. 2013). Teachers of special education often allow these unrealistic goals to be logged, limiting the effectiveness of these services. Although no legally prescriptive manner exists in which to conduct transitions, knowledgeable educators must facilitate a student's formation of meaningful, realistic goals, along with intermediate steps to help them attain these goals (Peterson, et al. 2013). Similarly, explicit development of vocational skills and career development in students receiving services are documented to improve the relevance and attainment of long-term student-set goals (Cummings, 2000; Collett-Klingenberg, 1998). Although some researchers suggested benefits of students participating in the IEP process at a younger age (Barnard-Brak & Lechtenberger, 2009), I was unable to find studies investigating any potential benefits from implementing transition services before the age of 14.

Technology Education Overview

Having examined limitations in the current state of special education services, coupled with the anecdotal potential evidenced by my previously described special education enrichment case-study, I next considered technology-based enrichment approaches. This section of the review covers the short- and long-term relevance of these approaches, specific implementations of them, and considerations of equitable uses of technological education.

Workforce Needs vs Current Reality

Technical education programs emphasize preparing students for the technological demands of future work and life requirements (Matthews, 2007). The rapid evolution of workplace technologies within various industries, which outpaces the creativity and flexibility of current graduates, requires such preparation (Wagner, 2012; Martinez & Stager, 2013). In order to provide students with the flexibility to become creative innovators across diverse settings, many educational settings have begun implementing technology-based education programs (Egenrieder, Flanagan, & Sun, 2017). Programs such as these focus on developing cross-curricular skills to meet growing demands in STEAM-based careers to keep pace with domestic employment needs (National Research Council, 2011). They teach students how to engage in computational thinking (Lee, et al., 2011), shifting along the continuum from technology use, to modification, and finally to creation. This approach is in line with current educational practices around Problem-Based Learning (PBL).

Vocational Awareness

Employees who do not possess relevant skills are unable to compete for high-tech, often specialized jobs (Basham, 2010). In order to effectively attain these skills, however, prospective employers and students must pair general instructional practices with specific vocational awareness training, paving the way for setting long-term goals and building skills to work towards these goals (Mills, 2018).

Analysis of current vocational training practices in the United States suggest that simply making information about potential jobs available is insufficient; rather, career planning must be embedded within the curriculum (Mourshed, Farrell, & Barton, 2013). Similarly, stigmatized

perceptions around vocational education must be addressed, shifting away from valuing pure academics over job training (Mourshed, Farrell, & Barton, 2013). As part of training, hands-on opportunities are valuable, complete with either apprenticeships/internships or ways of simulating workplaces in the classroom (Mourshed, Farrell, & Barton, 2013). Also importantly, prospective employers are encouraged to work more closely with school divisions, communicating and/or helping to develop desirable candidate traits (Mourshed, Farrell, & Barton, 2013). Finally, school divisions are urged to work with students earlier in their careers, to more holistically prepare them for future employment in preferred fields (Mourshed, Farrell, & Barton, 2013).

As was previously outlined in the special education transition section, transition services do afford students the opportunity for setting career goals, but student-generated goals are frequently not grounded in terms of realistic expectations or with clear pathways to attain these goals (Peterson, et al. 2013). All of the preceding research-based suggestions apply as well to the current special education transition process as they do to the general student population.

Makerspaces

I explored makerspaces in public education settings as a potential means for providing technology-based vocational awareness and skills-based training. These spaces are defined as flexible spaces where “makers can envision a project, find an expert, and create something” (Graves, 2014, p. 8).

Makerspaces foster the identified need for computational thinking (shifting from using to creating) (Lee, et al., 2011) in participants, encouraging inquiry-based exploration, creativity, and improvised problem-solving (Bevan, Petrich, & Wilkinson, 2015; Bevan, Gutwill, Petrich, &

Wilkinson, 2014). From a wider scope, these spaces allow participants to construct knowledge about the world around them through pursuit of self-selected interests in a play context, all while reinforcing principles of engineering (Honey & Kanter, 2013). Also importantly, embedded within making is the concept of meeting challenges and working within and around them (Petrich & Bevan, 2013). Furthermore, the recursive nature of design and modification builds social and academic resilience through acceptance of and working through failure (Kapur, 2016). When coupled with technological maker tools, often housed in school libraries or other dedicated spaces, makerspaces are suggested to be an effective way in which to increase student awareness of potential career paths, while concurrently allowing them to self-develop relevant skills towards those career paths (Peppler, Maltese, Keune, Chang, Regalla, 2015; Graves, 2014)

Microcontrollers

In exploring potential tech-based makerspaces for upper elementary students, I explored the potential of VT Thinkabit's approach of utilizing microcontrollers, as opposed to microcomputers. Microcontrollers, such as the Arduino or micro:bit, are described as simple computers, best used for building and coding products around simple mechanics or sensors (Di Justo, 2015); microcomputers, such as the Raspberry Pi, are much more complex, capable of completing multiple tasks and complex processes (Di Justo, 2015). Microcontrollers, then, are appropriate for novice level students learning simple engineering and coding tasks such as building a sensor to monitor soil moisture and tweeting when plants may need watering (Di Justo, 2015).

Microcontrollers are versatile templates for maker projects, capable of innumerable applications through simple code and connection of separately attainable sensors and devices

(Parrish, 2017), allowing students and educators the ability to brainstorm and differentiate for interests and skill-levels. In England, the BBC has provided all upper-elementary aged students with micro:bit microcontrollers and educators with resources and training for their use (Rocks, 2017). Results from the first year of implementation have indicated that a vast majority (90%) of participating students now find coding to be accessible, with significant growth in interest about tech-based careers (45% post exposure, as opposed to baseline data of 36%) (Rocks, 2017).

Equity in Technology-Based Education

Historically, career and technical or “vocational” education, such as technology and engineering or “shop class,” have been considered to run contrary to the college-preparatory track (Rose, 2014). In spite of recent pushes to increase programmatic cross-curricular rigor and increase relevance to both vocational and post-secondary education preparation, this stigma still persists (Rose, 2014). This deprioritization is exacerbated by public high school graduation requirements; students often take electives to fulfill advanced diploma requirements (e.g. foreign languages) to the exclusion of technical education (Katsioloudis & Moye, 2012). Furthermore, school counselors do not understand or recommend technical education, owing again in part to the fact that it often fulfills no academic requirements prior to high school (Katsioloudis & Moye, 2012). These factors combine to form an overall barrier to technology-based education, especially at the secondary level.

In schools that implement successful technology-education curricula at the primary level, where there is less set curriculum and limited self-selection amongst participants, equity can come in the form of lack, or perceived lack, of inclusion or resource sharing (Egenrieder, 2015). In order to address this concern, existing and prospective initiatives must consider that

documentation of curriculum, goals, outcomes, etc. are critical for replication across settings and to address outside concerns around exclusivity (Egenrieder, 2015); likewise, such programs must be willing to share resources, within and between specific sites. One potential solution for eliminating specific participant inequity is through lottery-based enrollment (Egenrieder, 2015).

Equity for students receiving special education services currently only extends to meeting the aforementioned minimum legal education requirements. So long as public school divisions implement IEPs and special education programs act in accordance with IDEA requirements, they are guaranteed IDEA funds, 75% of which flow to local schools (Yell, 2016). This funding guarantees a base-level of equity in special education, irrespective of the overall financial means of any individual school, at least insofar as placement options and instructional programmatic needs. No such funding provision exists for enrichment in special education, in fields of technology education or otherwise. This funding model partially explains the lack of widespread enrichment for students receiving services, aside from students identified as twice-exceptional.

Current Best Practices

In exploring how special education and technology education, distinct from education technology designed to make content accessible for students, fit within current educational frameworks, a brief examination of research-based best practices provides larger context. Many current precepts of best practices concerning student learning emphasize student responsibility, self-motivation, and self-evaluation, and allow for demonstration of learning in a variety of manners (Eastern School District, n.d.). These stated approaches, in turn, promote higher-order student executive function skills (Reber & Reber, 2001).

Schools utilize PBL activities as a popular method of incorporating these priorities and student-driven approaches (Virginia Department of Education, n.d.). By posing authentic projects and/or problems to students, educators provide opportunities to construct cross-curricular knowledge around centralized learning goals, shifting the educator role from knowledge-source to knowledge facilitator (Krajcik & Blumenfield, 2006).

As a related super-category of both project-based and problem-based learning, inquiry-based learning focuses less on a stated problem and more on process (Savery, 2015). Commonly used in science education, this hands-on philosophy of teaching engages educators more actively in providing information to students (Savery, 2015). This approach mirrors the scientific process, with emphasis placed on trial and error and subsequent retrieval based on newly formulated approaches (Padeste et al., 2015).

In exploring these examples of best practices, available research suggests that while technology and engineering education prioritizes establishing student goals around skills and competencies, special education services do not currently meet this threshold. Attempts to incorporate this approach to special education, therefore, do merit further examination.

Adult Perspectives and Attitudes

The aforementioned proof-of-concept study with students receiving special education services provided evidence that students made gains in acquisition of specific skills, confidence, and vocational awareness through technology-based enrichment opportunities. However, it also suggested unanticipated transformative thinking in the participating adults. This finding prompted a review on general adult attitudes and perspectives regarding special education

services, adult attitudes and perspectives about technology- and enrichment-based education, and an exploration of more general theoretical approaches to transformative thinking in adults.

Attitudes Towards Special Education

In light of current legal mandates and related accountability measures, great pressure is currently placed on special education teachers (Minthrop & Zane, 2017). Within their working days, special education teachers only spend, on average, 15.6% of their working day on academic instruction, with the majority of time split between various social/disciplinary intervention, as well as advisory and administrative tasks (Vannest & Hagan-Burke, 2010). In addition to affecting availability to work with students, this reality has led to significant burnout and attrition amongst special education teachers (Lavian, 2012). From a less administrative perspective, special education teachers consistently rated students who receive services higher on their overall efficacy, ability, and overall understanding of content than ratings from general education teachers (Minthrop & Zane, 2017). Both general education and special education teachers appear less likely to refer students receiving special education services to gifted programs than abilities-matched students without disabilities (Bianco, 2005). Additionally, special education teachers were less likely to refer *any* students with suggested gifted traits to receive gifted services as a vehicle for enrichment, irrespective of ability level. General education teaching experience, both in terms of overall time in the classroom and specific experience in inclusion special education settings, are suggested to improve attitudes towards learners with special needs (De Boer, Pijl, & Minnaert, 2011). Initiatives such as Response to Intervention, inclusion, monitoring, and specific intervention strategies have shown potential for improving teacher attitudes towards working with learners with special needs (Greenfield,

Rinaldi, Proctor, Cardarelli, 2010). Positive approaches to behavior management have also been suggested to improve teacher attitudes towards students receiving services (Kelm & McIntosh, 2012; Lewis, Jones, Horner, & Sugai, 2010).

Non-teacher stakeholders also have an impact on special education implementation and outcomes, although their specific attitudes towards learners who receive services was less represented in the available research. Principals have the ability to shift school thinking about populations with special needs. The research-based literature makes several references to the benefits of educational leaders who prioritize inclusion as a means of supporting students who receive services (Hopper & McLeskey, 2013; Lynch, 2012). These studies largely framed leaders' role within the learning environment as supporting teachers' work with students receiving services. One suggested explanation for principals' focus on inclusion-based services is that the majority of principal preparation programs emphasize legal and funding issues relevant to special education, rather than student profiles or instructional needs (McHatton, Boyer, Shaunessy, Terry, & Farmer, 2010). Attitudes about inclusion have also been measured in parents, with the majority supporting inclusive education (De Boer, Pijl, & Minnaert, 2010). Parents of students receiving services are actually more skeptical of inclusion than parents of general education students, citing concerns as to whether specific needs can be met in this broader setting.

Of note, I did not uncover research exploring adult perceptions of enrichment in special education. This identified gap in the literature further suggests the necessity of more exploration.

Attitudes Towards Technology Education

As was earlier discussed in this chapter, technology-based education has not been historically considered to be congruent with post-secondary educational tracks (Rose, 2014), which has suppressed career advisement towards enrollment in tech-related electives (Katsioloudis & Moye, 2012). Likewise, emphasis on standardized accountability measures currently acts as a barrier to educators adapting technologically student-centered learning; teachers fear that they will not have the time to teach required content if they adopt a constructivist model of education (An & Reigeluth, 2011).

Mindset and Transformative Thinking

Recently, renewed interest and specific initiatives have been implemented in an attempt to reverse the trend of viewing technology-based enrichment as lesser than or contrary to other instructional approaches. In England, wide distribution of microcontroller technology to upper-elementary students (i.e. micro:bits) has positively impacted teacher perceptions of their instructional potential, with half of respondents stating that “...they now feel more confident as a teacher, particularly those who say they’re not very confident in teaching Computing” (Rocks, 2017). Research has suggested that in instances where teachers incorporate technologies into their instructional delivery in a constructivist manner (i.e. learning through their own involvement in the process), experiencing alongside students, in turn, influences instructional beliefs and practices (Liu, 2011). The desired mindset shift, therefore, is for incorporation of technology-based education into instruction to be considered indispensable to facilitation of student learning (Ertmer, & Ottenbreit-Leftwich, 2010).

On a more global level, engaging stakeholders in building culture is central to implementation of any new initiatives or overarching visions. If all stakeholders do not ultimately feel as if their input has been incorporated and their values and priorities mirrored in school-based initiatives or guiding principles, then they may never fully believe in their role in the larger community (Dufour & Eaker, 1998). American school-systems rely heavily on business capital, investing great amounts in technologies to bolster education (Hargreaves & Fullan, 2012). These technological tools, whether for instruction or enrichment, can be very powerful in a supplemental role, but they cannot replace the need for adult facilitation (i.e. human capital) and collaborative efforts (i.e. social capital) (Hargreaves & Fullan, 2012). Once adequately represented within an initiative, participating members' underlying beliefs and values are more likely to be consistently reflected through practices (Reason, 2010). This speaks to the importance of solidarity in approach between *all* stakeholders: Division, school administration, school teachers, support staff, students, parents, and community representatives (Mendez-Morse, 1993). Educational leaders, therefore, are obligated to invite participation by all stakeholders in the learning community if they hope to effectively nurture interest and success in any technology-based or makerspace-style initiative (Bonagura, 2017)

Conceptual Framework

In considering an appropriate framework through which to measure adult transformative thinking and learning in the area of technology education in elementary school, I selected the Nerstrom Transformative Learning Model (Nerstrom, 2014; see Appendix B). This model was utilized in conjunction with the implemented student technology integration program, following participating adults in their journey of “(a) having experiences, (b) making assumptions, (c)

challenging perspectives, and (d) experiencing transformative learning” (Nerstrom, 2014, p. 327).

Chapter 3

Methodology

This investigation evolved from a pilot study of the impact of an after school STEAM-based enrichment program on students with disabilities. While gathering data for that study, I observed that the adults associated with the program experienced changes in a variety of ways. I shifted the focus of the subsequent study to better understand the ways that adults involved in multiple capacities were impacted by the program. Adult participants were interviewed after their participation; analysis of transcripts focused on evidence of transformative learning and potential changes in practice with regards to students who receive special services.

Tradition and Focus

The conducted research is best described as an exploratory case study. The original study had much in common with an auto-ethnography, owing to my active roles in designing and adjusting the study for specific student outcomes (Patton, 2002). The follow-up study, however, focused more narrowly on describing the transformation of adult participants. I intend for it to serve as an example for potential future direction and implementation, putting it more in line with an exploratory case study (Patton, 2002). Irrespective of nuanced methodological tradition, the major thrust of this research is clearly exploratory in nature, as I was unable to find widespread, public-school based research exploring the impact of: (a) providing technology education opportunities to populations receiving special education services, or (b) the impact on adults delivering or participating in the technology-based enrichment. As I worked directly with

participants through both phases of the study, with the intention of positively affecting outcomes, this research is also best described as action-based and applied (Patton, 2002).

Orientation

I am a doctoral student of Educational Leadership at Virginia Tech and work for a large public school district in the mid-Atlantic region of the United States. I am a STEAM resource teacher at an elementary school in close proximity to the school where I am conducting research. I had previously worked with some of the student participants in the second year of the study, during their scheduled weekly Science Laboratory block, but I was not a general classroom teacher. I did not assign grades or make grade-based recommendations for student performance or participation in class and did not do so for their performance or participation in the study. I received no credit or monetary compensation for running the tech program and did so wholly in my capacity as a faculty member within the division. I would have run the club irrespective of consent from study-related participants.

Research Questions

As was noted in Chapter 1, the research focus shifted from examining student experiences and potential growth to that observed in adult participants. The two questions that emerged from the original exploration were:

1. What are the impacts of a STEAM enrichment program for students receiving special education services on the attitudes and perceptions of adults involved with the program?
2. What direct and/or indirect impacts can transformations in adult thinking have on school-based special education practices?

Population and Sample

Initial Study (Year One)

I collected data from six upper elementary-aged students (6th grade; 11-12 years of age) at Mid-Atlantic Elementary School (pseudonym), located in Eastern School District, as well as from faculty cosponsors (two adults), guest presenters to the club (two adult professionals in technology-based disciplines), and the principal of the participating school. Student participants included male and female club members who receive Special Education services, but access the general education curriculum.

Follow-Up Study (Year Two)

Student participants in the club were similar in demographics to members of the Year One study. All student participants from Year One had moved to middle school by Year Two. The purpose of the follow-up study involved exploring changes in adult attitudes and philosophies as they observed new students grow through the program. Data collection for the second phase shifted focus from student experiences and growth to reflections on perceptions and attitudes of participating adults, across stakeholder group. To this effect, participants included new adult cosponsors, new members of the school-based leadership team, and new guest presenters. In all, data were collected from six new adults in the Year Two study, with a cumulative 11 sources of data for analysis.

Sampling Procedure

Potential student participants were identified by consulting with general education teachers, special education teachers, and school records (e.g. IEPs, student academic records). I only accessed these resources during my previous role as a teacher at the proposed school, and

did so in accordance with FERPA and IRB requirements. Identified student members received special educations at the time of participation, with academic and/or socioemotional accommodations to access the general curriculum, and were generally reported by these knowledgeable sources as not consistently performing to their academic potential.

Adult participants for Year One were identified by considering the various stakeholders that work with students. The school principal, the advanced academics resource teacher, and the librarian represent diverse roles within the school. Moreover, these adults differed in terms of their levels of interaction with students. A mechanical engineer and an electrical engineer, serving as guest presenters, added career/vocational diversity to the adult participants. These presenters shared their educational journey, work duties, and led group members through high interest activities (e.g. a tour of the school boiler room). For Year Two, I expanded the diversity of participating stakeholders to provide further experiences to the body of collected data. I sought a general education teacher and a special education teacher to be cosponsors, assistant principals from the school as program overseers and leaders within the school community, as well as a software developer and the CEO of a web-based company as guest presenters representing other technology-related fields.

Recruitment

All student participants in the study were students at Mid-Atlantic Elementary School at the time of their participation. The existing tech club was advertised as an available after-school enrichment opportunity, taking place at the same time as other after-school clubs and run within the typical work capacity of the school and sponsors. For the Year One study, I approached the parents of student participants directly or with the help of a translator/liaison to explain the

purpose of the study (i.e., studying the effects of enrichment opportunities on academic performance and motivation/self-esteem) (See Appendices C and D). I obtained contact information for students and parents through my affiliation with Mid-Atlantic Elementary School. All relevant consent forms were provided in dual-language (English and Spanish), where appropriate. Parents were contacted via telephone and/or in person. A translator was available for non-English support in explaining forms/consent and answering any related questions. The parent forms include a section for students to assent to participation.

Similarly, all school-based adult participants were employees at Mid-Atlantic Elementary School when they participated in the study. Adult participant members (i.e. cosponsors) of the tech club, as well as existing members of the school leadership team, were recruited after a discussion about the purpose of the program and a brief overview of the related study (See Appendices E and F).

The guest speakers were recruited in order to show linkages between K-12 education and vocational outcomes, and to explore potential transformative thinking through their experiences presenting to the group. I know the guest speaker participants either personally or through my professional circle of acquaintances. I contacted them via telephone and gave them an overview of the program in order to build interest.

I utilized the same consent forms for recruiting school-based adults and guest speakers. I obtained written permission from Mid-Atlantic Elementary and Eastern School District before beginning recruitment activities.

Data Instrumentation

I took a purely qualitative approach to the conducted dissertation study. This exploration of whether and why adults involved with this enrichment program undergo transformations regarding students is preliminary in nature; this qualitative approach will help to identify emergent themes and subsequent areas of potential for student- and adult-outcomes. The results of this study are intended to inform potential methods researchers and practitioners will use to conduct future follow-up, mixed-methods study with a larger sample, potentially following student and adult participants for multiple years to track magnitude of impacts over time.

At the conclusion of Year One, student and adult participants engaged in conversational interviews about their experiences with the enrichment club. Owing to the aforementioned potential of this enrichment approach to impact adult attitudes and practices, a similar retrospective approach was taken in Year Two, focusing on these adult experiences after exposure. Interviews were largely comprised of responses to a set of standardized open-ended questions posed to adult participants in the study (Year Two). Standardized open-ended interviews were utilized to allow participants across levels to share their experiences in a personalized manner while ensuring that analysis was possible between subjects (Patton, 2002). The questions were developed by identifying overall themes in Year One interviews.

Additionally, I continued to take qualitative notes on student and adult experiences during Year Two, as well as on empowering/leadership opportunities for participating students and observed changes in philosophy or practice in participating adults. These observations were used to illustrate and supplement interview-based data.

Student Interviews (Year One)

These conversational interviews revolved around experiences that students had as participants in the tech club, both in regards to the activities and student perceptions of themselves at the club's conclusion. Students self-reported enjoying the program and increased self-esteem (See Appendix A). As the follow-up study focused on adult experiences, further student interview data were not collected during Year Two.

Educator Interviews

Both phases of the study involved two categories of school-based adults: Cosponsors and administrators. Teachers are the core stakeholders who work with students. As such, the purpose of these interviews was to assess their attitudes about student participants, the club, and how their participation challenged their beliefs and/or led to changes in their educational philosophy or practice (See Appendix G).

Although administrators are only indirectly involved in student education, the literature review explored how school-based leaders guide the operations of schools. My interviews with administrators included discussions of big-picture considerations of enrichment experiences such as the one underlying this study, again probing for resultant changes in their philosophy and/or practice (See Appendix H).

Guest Presenter Interviews

Although not traditionally connected to student education, Year One responses suggested transformative thinking in guest presenters, as well as spontaneous assessments of their own assumptions about their professions. As such, interviews also focused on participation-based changes in philosophy, as well as proposed industry changes (See Appendix I).

Data Collection

I collected and control all collected data. Physical data (chiefly consent forms) were stored in a locked cabinet, and electronically collected data were stored on the research-team's computers, with password restricted access. Any identifiable participant data were coded by title only, again maintained directly by me. Interviews were audio recorded and have been stored on a password protected hard-drive, accessible only to me.

As participating students and adults were a small group working with me through my affiliation with the target school, with a highly cooperative principal, I experienced no difficulty conducting interviews or collecting observational data. Data were collected within the school setting, during school hours and whenever after-school clubs met. Participants did not engage in the study beyond these regularly scheduled times. Upon successful completion of my dissertation leading to an Ed.D. in Educational Leadership and Policy, all files will be retained by the research team for a period of three years after publication.

Data Analysis

While some of the collected qualitative data have been used to contextualize suggested findings (e.g. investigator notes on observed adult experiences to give depth to any self-reported participant changes in attitude or practice), most qualitative data were analyzed within and across interviewed subjects by theme. Use of standardized open-ended interviews, identical within stakeholder level and thematically similar but adjusted for relevance between level (e.g. identical for all cosponsors, but similar between cosponsors and school leaders) allowed for cross-case analysis (Patton, 2002) of resultant data. During interviews, standardized probes were utilized to focus responses around the research questions, when necessary (Kennedy, 2006). Answers to

posed questions were analyzed and coded for thematic similarities. Adult participant data from Year One and Year Two were collapsed for final analysis, as they are complementary, rather than incremental or oppositional. Thematic coding took place in two stages: Primary coding identified major common themes, secondary coding identified sub-themes and items of particular interest.

Reporting of Results

All interviews were transcribed, with participants labeled by title, but not name (e.g. Principal; Librarian). Validation of overall results was externally obtained through cross-referencing against the limited available resources on the power of STEAM-based enrichment approaches, as well as the larger body of literature on transformative thinking. Due to the potentially subjective nature of interpreting answers to open-ended questions, trustworthiness was ensured through triangulating data from multiple interviews representing the various stakeholders in student education (Patton, 2002). The critical self-reflection necessary to answer the interview prompts produced robust data for analysis; participant candor was attained through the personal and professional rapport that I have with each interviewee, as well as guarantee of anonymity. As an active component of the research, I cannot completely address concerns of impartiality (Patton, 2002); as an exploratory case study, however, I was not testing a specific hypothesis, so I do not view this potential conflict as invalidating of observed results.

Once data analysis was complete, results obtained through both interviews and my illustrative observations were presented through theme-specific narrative means in the results section, were investigated further in the discussion section, and selected quotes were utilized to illustrate key points throughout the resultant research paper.

Chapter 4

Results

I analyzed adult experiences from both the proof-of-concept (Year One) and follow-up study (Year Two) for commonalities, emergent themes, and insights. I primarily sought out evidence of transformative learning (See Appendix B), largely through the scope of my defined research questions:

1. What are the impacts of a STEAM enrichment program for students receiving special education services on the attitudes and perceptions of adults involved with the program?
2. What direct and/or indirect impacts can transformations in adult thinking have on school-based special education practices?

Year Two data were collected following the development of semi-structured interviews (See Appendices G-I), then transcribed and analyzed, whereas Year One data, which largely informed the research questions and interview protocols, consisted of quotes pulled from participant experiences during the Year One study. In addition to analysis with regards to the stated research questions, I explored the data for themes within and between stakeholder group (i.e. cosponsor, educational leader, and guest presenter), as well as unexpected themes.

Adult Participant Demographics

All school-based participants worked at Mid-Atlantic Elementary School at the time of the study. Cosponsor participants were comprised of an experienced gifted education resource teacher who has worked in multiple states and educational settings and an experienced librarian who has worked at multiple elementary schools (Year One), as well as an experienced upper

elementary special education teacher and an experienced 6th grade general education teacher (Year Two). Educational leaders were comprised of an experienced elementary school principal with a background in division-level curriculum design and planning (Year One), as well as an experienced elementary school assistant principal with a background in special education and an experienced assistant principal with a background in English for Speakers of Other Languages (Year Two). Guest presenters were comprised of a mechanical engineer who has worked in government and the private sector and an electrical engineer who works predominantly on government contracts (Year One), as well as a software developer who works in the private sector and the CEO of a web-based company (Year Two). Participant trustworthiness was ensured through assurance of anonymity and through the rapport that I have with them as a colleague and/or through a personal relationship.

Thematic Analysis Overview

Once I collected and transcribed participant data, I analyzed them with both research questions in mind. As a whole, I found many instances where participants directly reported or, more often, alluded to ways in which their experiences with this tech club either a) challenged their assumptions or b) might lead to changes in their practices. I analyzed these experiences holistically, focusing on evidence of transformative experiences and/or learning, because although they are a subset of the totality of adult experiences, they showed the most explicit potential for changes in practice. Over multiple passes, I identified themes commonly supporting challenges to perspectives and/or changes in practice between stakeholder groups (i.e. cosponsors, educational leaders, and guest speakers), as well as more group-specific themes.

Themes Common Across Stakeholder Groups

Multiple groups noted similar themes on the following: Students' utilization of this program to demonstrate their learning and knowledge in a novel manner, changing perceptions about students who receive services, evolving perceptions of the effectiveness of small groups, enrichment as a means of addressing academic needs, adult perceptions on program impacts beyond academics, perceptions about vocational awareness training, and adult reflection on current enrichment practices. I discuss these themes, below.

Alternative Manners of Demonstrating Knowledge and Learning

One of the most prevalent themes to arise from the data was adult acknowledgement of students demonstrating abilities in a novel manner through the tech club. This form of exhibiting competencies contrasted with reliance on the established curriculum and traditional measures of academic success.

Through interviews, the gifted education teacher observed the value in others seeing this success:

... In some ways, [this] show[s] teachers that they can do more than we think they can do when we see them in the classroom or are only expecting written or read work—this is a more hands on, but still complex, thinking process that incorporates a lot of skills.

The librarian added on to this, observing the intrinsic value of students finding success: “...We’re not looking at what they can do, we’re looking at what they can’t do, and we need to see what they can do—what they’re capable of doing.”

The general education teacher connected what was observed in the club to a new way of regarding students in the classroom:

I think it really just shows, like, what they can handle. Even in the classroom when they're not sharing and speaking doesn't mean that they're not listening, it doesn't mean that they're not absorbing the information that we're sharing with them, and sometimes we don't have enough time to give him those on-hands opportunities to express, in like different ways, that they do understand what's happening in the classroom.

This teacher also specifically noted that the current model of testing for mastery may not always be appropriate for this population:

...The hands-on component, too. I think it's really important, I mean common, especially in this grade, is that we get them ready to go to middle school, that we're worried about a lot of data points, and testing, and picking their classes for middle school, and we have to prove what they can do, and usually the only way that we can prove that to people is by providing them passing test scores. We actually just met with the middle school counselors and reading specialist yesterday to do that, and it just continues to prove that, like, that doing the experiments and doing the hands-on and providing them with, like, rubrics; things that are usually difficult to put together and take a lot of time to do so, will continue to give these kids a better chance.

An assistant principal also found value in “looking sometimes outside of just the academic curriculum, too, and saying, ‘Oh, these are some cool things, and this is how you can apply this in life.’” Along this same theme, the special education teacher spoke to the experiential vs. outcomes-based nature of this program:

...It wasn't like a huge, it wasn't hugely project-based, but when we did get to the mini project of it, they kind of went, they started seeing the pattern, and what they were doing, and how it connected to the end product, because they had time to play with the mini parts of it, then they were more engaged in that because they understood the magic behind it, or whatever. They were “hacking.”

She went on to speak of the impacts that building this knowledge-base had on students, as opposed to their experiences in traditional education:

It's also kind of your standard breadth of experiences that you offer a kid, and the more opportunities you can provide, the more likely they're going to find something that's successful for them, and that's going to give them confidence, which overruns into every other content area, and I think that with kids with special services, in particular, finding the strengths, and what makes them feel good about themselves, is sometimes a challenge, but it's also the thing that, once you find it, it keeps giving back, it just keeps going, because it has a tendency to overflow, and it changes their perspective on themselves, and what they can do, and how they think. And it gives them something to talk about, you know? Like, if all the kids do all day is sit in math and science and reading in a GenEd environment, and they don't really have any, that's what their peers are talking about, and they don't necessarily have the same background to participate in those conversations. But if they are doing STEM activities, too, and their peers are engaged in it, then that's something that they're successful in and they can also have a discussion about, a sense of belonging, I guess.

She also suggested that this program revealed strengths that students who receive services might have over typically achieving peers:

This was really intuitive for them. They started doing stuff, they weren't afraid to start playing with stuff, obviously, for better or for worse, and they dove right in with all of the materials, whereas somebody who has been typically trained and typically educated, I wanted to wait for instructions to know how to do things, and I think a lot of typically achieving students their age would be more inclined to sort of wait and have somebody teach them how to use these things, but these kids, in particular kind of jumped right in and tried to figure things out, and didn't seem intimidated by the content at all.

These reflections speak to perceptions of how special education learners can successfully interact with and learn from instructional materials. This theme suggested that participants were also exploring their attitudes on student strengths and ability levels, which warranted closer examination.

Perceptions about Students who Receive Services

As a second, related commonly identified theme, multiple stakeholders involved with this enrichment club shared the power of this approach to changes underlying perceptions of students who receive special education services. The gifted education teacher spoke to its power to transform teacher- and parent-perceptions of students who receive services:

...It's something that can be used to educate staff, and maybe even for parents to learn, not just parents of students in special education, but those who aren't, so they can learn that just because these kids are in [their child's] classroom, doesn't mean that they can't contribute.

Speaking more directly to teachers' perceptions of students who struggle in the classroom, the special education teacher stated:

I guess what you mean is, like, that because they're so unsuccessful in a lot of other areas that this would be a difficult... like, they can't even read, so why are you trying... I would hope that I wouldn't meet a teacher that might have that perspective; just, especially with kids with special needs, it just makes so much sense to me, that you would find other, that you would focus on something that they enjoy, if I want to get Hallmark about it, I guess, you know, like, everybody can do something, and if you have crossed off a bunch of things that obviously they're not successful at, why wouldn't you keep going down the list until you find the thing that they are, and this is another thing that is not only something that kids can be good at but, something that opens a lot of doors, and that really gives possibilities to their future that wouldn't be there under a standard curriculum.

Two of the visiting speakers commented on the participating students' ability levels. One shared that, "I was under the impression that [these students] had some sort of learning issues, but they all seemed bright enough to me to get what we were doing." Another shared, "I would not have been able to tell that [these students] had special learning needs—if anything I was surprised by how engaged they were." A group of visiting government officials, engaged in a partnership with the school unrelated to the club, quietly took me aside after observing our club's activities and the students' participation, asking whether the club was for "gifted" students. When I confided that all students in the club had special education needs, they were both surprised and apologetic.

When viewed in conjunction with the previously discussed theme, adult participants in this club recognized this club's novel approach as a means of capitalizing on students' learning strengths. This, in turn, challenged their underlying perspectives on student ability and achievement, as well as the appropriateness of varied, high-level programming for all learners.

Perceptions of Small Groups

Another common theme was stakeholder reflection on small group settings for students receiving services. Within this category, two sub-themes emerged, but remained too interwoven to explicitly separate: Small groups with regards to safe spaces for learning and small groups with regards to Least Restrictive Environment (LRE).

Most teacher-participants commented on how students acted in the club, as compared to how they act in their general educational setting. The gifted education teacher observed that: "Even in the hallways, sometimes, when I would see [the students], they seemed less confident than they did when they were in the club." The librarian built on this perception, stating that:

I think it gave them, they had a confidence that they don't always have in the classroom, because I think they're always comparing themselves to their peers, and feel somewhat intimidated by that. Like I was so happy to see [specific student] in there; she was one of those students that I've watched her since 1st grade, Headstart, really, and watched her struggle... ..I watched her succeed in this group... Some of the behavior things that you would see in a classroom, they weren't there. They took it seriously, and they were very good about helping one another, and I don't look at those kids as, they don't get the chance to do that very often, so you could see it was good for them to help another student figure something out.

The general education teacher also spoke to behavioral differences observed in the club, as opposed to her classroom:

Two of them in particular are very quiet, very timid, during the day; one of them, we actually have been discussing with a parent about their social anxieties at home, when there are, like, friends or other extended family members at the dinner table, the child doesn't even come out of his room to eat with them, he chooses to take food to be delivered to his bedroom, and he came every day, ate snack with everyone, participated in the tasks, like joined the group, never really had to be invited to be part of the club. So it's interesting to see how comfortable he was interacting with everyone else.

Speaking more generally about the group dynamics within the club, she shared that:

I think the tasks that they were engaging in were really complex tasks for a lot of them, and the students that have participated in the club, some of them tend to be kids that kind of fly under the radar in the class during the day, don't usually share a lot, don't usually participate in lessons a lot, some of them didn't even typically interact with peers a lot during the school day, and that was not true to this club at all; they were very engaged, they interacted with each other, they shared and spoke and enjoyed their time more than during the day.

The educational leaders also made note of the small group format of the program, noting the safe learning-environment component but also focusing on LRE implications. According to one assistant principal:

I think sometimes we worry about selecting kids, and because they have a special education level label, and putting them together, but if we can see it as an opportunity to

expand or maybe creating that, knowing what things might challenge them, by giving them the opportunities to then work on some of those challenges in a fun environment after school, it might not necessarily be a stigma; it's using what we already know their strengths and their challenges might be, and then help to harness it or focus it, or even move them forward, and so I think, if anything, it's just made me look at how can we leverage even more of their learning possibilities.

She further noted that “small group” in this context is not necessarily restrictive:

Even if we build an environment where students feel comfortable to express themselves or take those risks, it's sometimes really and truly in the small group setting that we really see them flourish. If they are in that inclusive setting, they might be, some other voices might have more space in that room instead of their voices, or they might not still not feel that comfort level to share, where I notice when the small group, and when they were working together, they felt, I could see that equity feeling like they could share those conversations and their feelings, or thoughts on how to change things or asking questions about how to do things, they felt comfortable and obviously that's building that safe environment for them, but I think in that small group setting, they all seem to be so engaged, so excited, and I felt that comfort level to have that exchange and discourse with each other, as well as the staff who were helping them.

The other assistant principal mirrored these opinions, sharing that:

I think, I *know*, some may feel like that's not being inclusive, that you're targeting a specific audience, but I also think, like, fair is not always equal, and I think that it is important to give these kids a safe space, where they can just speak their mind, and not

feel judged by peers who they may be perceived as being more able than them, because they don't have an IEP, and they can just really freely explore something that that they're interested in, having conversations. I think the club is a great way for kids to start to build that confidence, and then maybe they can take that into more integrated club settings.

They say, 'Oh, I am capable about this, I feel really good about this, and I'm going to feel more confident,' and go into, maybe take more risks, and come into a club where it's not only peers who have an IEP, and show them, "I have this ability," but I think a lot of our kids with IEPs, do sometimes, like, hold back, or, especially as they get older, cuz they are very aware of differences, they are hesitant to just take those risks and join clubs, because they are afraid of looking like they don't know something, and there is just that social pressure, because you so desperately, at that age, just want to fit in. You want to be, for all intents and purposes, what they view as normal.

The presenting CEO was concerned that the scope of this approach to enrichment was too narrow to reach enough prospective members of the workforce to have meaningful impact on his industry, stating that:

The number of, for every hundred people that go out into the workforce, there may be one that is possibly in the realm of our area of work, and the more, just playing a numbers game, I think you'd want to find ways to reach, maybe, far more students, and have a, on the hopes that you would influence a couple of them.

Another presenter offered a very contrasting view to this approach, finding benefits to the small group approach, sharing that:

The fact that it was specialized, and there were a few kids, we were able to give them better, engage them one-on-one, give them better answers. I know we didn't always see it, but I think it also tends to let the quieter ones ask some stuff, maybe they feel more interested and engaged in that smaller group.

Through their interviews, participants expressed their established views on small group instruction as well as evidence of viewing it through a new lens. After their involvement with the club, most participants reframed small group settings for special education learners as potentially safe learning and rigorous environments in which to take academic risks, which challenged perceptions formed throughout the standard academic day.

Addressing Academic Needs through Authentic Learning Opportunities and/or

Enrichment

Another common theme that participants alluded to was how this approach can be utilized to address identified academic needs. The special education teacher spoke to providing authentic learning opportunities to address student needs, rather than sole reliance on proscribed remediation tools:

I think I'm willing to, I mean obviously I won't say, like, ignore the remediation part, but I think that there are ways to provide equal-looking access to kids. One thing I started doing this year that I think is sort of in line with the philosophy is, you know in 5th grade, kids are reading chapter books and they're in groups. And so my kids this year have started to be in groups instead of being pulled out to get boxed programs and things like that, because these kids are in 5th grade and they've never read a chapter book, and that's not really fair to them, and what is teaching them how to decode phonics really going to

support their ultimate reading, like when do they get to start any chapter books if we're going to teach them sounds, forever. So, so, they've been reading books in class, and they have assistive technology like books on tapes and books recorded, internet book programs or whatever they are, so they had access to the text and they can learn what the text is telling them, and they're also part of the community, and it doesn't, they have a book club to talk about when the rest of their peers are talking about book clubs, and so they can engage with the content and be part of that community on a very even playing field. So I think, you know, the more we can do to, like, find what these gap areas are and make them have a representation of the general curriculum, find ways to put the adaptations into the general curriculum, instead of making it an entire separate curriculum, that would be my take-away from that.

When asked about the club's impact on this instructional choice, the teacher shared that:

My decision was largely influenced by a similar theory that kids, with special needs in particular, benefit from authentic and self-directed learning experiences. The club certainly has affirmed that. This is especially after seeing the ineffectiveness of scripted programs as intervention, which is actually the county mandate for kids who receive pull-out services in general education, if you can believe it!

From the school-wide level, educational leaders agreed with enrichment's potential in addressing identified student needs. One assistant principal said that:

We're always looking at how can we leverage angles with trying to help further with their goals that they're working on, whether it's, you know, they have struggles in math, you incorporate that in the tech club, or if it's a matter of they have no language skills,

that you're working on it, too. We're always looking at how can we leverage their strength and how can we then help an area that they still need to continue to work on and grow in, so I think that's something to always keep in mind, too.

The second assistant principal added upon this, nesting the academic and social potential of this approach within the larger reality of supplemental services that students with IEPs generally receive:

I think it's just, I love the idea that it's not, I think a lot of times kids with IEPs aren't given enrichment opportunities for clubs, for, like, after school activities, a lot of times, unfortunately, they're getting signed up for ESY, they're getting signed up for reading remediation, or, like, tutoring or stuff, that this is something where they can, just, truly explore, work on something, "I feel more capable," and it's not constantly working on something that they feel like they have a deficit in, because that can be hard, that can be, like, heavy for a kid, so they actually got to do something fun, cool, and interesting, they're developing skills, and they're having an enrichment in, in science and technology, and, like, that's an opportunity that they don't necessarily have throughout their school day, because a lot of times it's working on remediation and intervention, in things that they're struggling in, if that makes any sense.

These observations suggest that an instructional approach such as this can be used in conjunction with traditional remedial approaches in order to meet academic needs. The program has the flexibility to be adjusted for identified academic and socioemotional needs of individual student participants in an authentic, enrichment-based manner.

Perceived Potential Beyond Core Academics

As a final but broad emergent theme, several stakeholders observed programmatic opportunities for students to show gains beyond traditional academic measures, as well as beyond the traditional school day. As one assistant principal stated:

I think we have to remember that the instruction doesn't have to be from 8:40 to 3:25, it's sometimes that instruction is beyond the classroom, and how can we, how can that help our special education students as well as our general education students.

Multiple observations were cited of students showing improvement in executive function skills, social/community skills, and overall confidence and integration to the school community.

Executive function. One assistant principal stressed the importance of what she called “soft skills” development in students, and cited this approach as a means of developing them:

So, I sometimes, like, people think about enrichment and get locked into, like, core content areas, but I think about soft skills, and soft skills, that's actually, I think, more important for all of our students, whether you have a disability or not, to practice, because we're getting, those are the things that are going to take them really far in their personal life and also in future career endeavors that they may encounter. Learning how to have interpersonal relationships with others, how to collaborate, like it doesn't matter what your ability level is in regards to academic curriculum, every child has to have, we have to continue to work on those soft skills and offer, like, more challenging opportunities to develop those skills.

The other assistant principal spoke to the importance of developing these essential skills in students at a young age, as well as the potential of doing so in a technology-based environment such as this club:

Tech is great because that's the future; we have to get our kids prepared, and I'm going to go right there, I'm going to go with [division-specific essential skills program], I mean, honestly, that's, it's building that collaboration and communication skills, and sometimes in small, that small group setting, they're going to feel more comfortable working on those skills, and if we're working on them here, well, we *are* working on them in elementary schools, they're going to be able to move further on if they go in middle school and high school, they're going to be able to continue to develop that. It's not something that just, just happens in middle school and high school; we're starting in kindergarten.

Community-building. Although small groups as potential settings for student-enrichment have already been discussed, participants also spoke to community-building perceived within the club.

One assistant principal spoke to the manner in which students were invited to the club: That special invitation, being invited, that's huge and that's an inclusive piece, sometimes, too, sometimes giving kids that permission to come to an after school program is very big and daunting, but that invitation, that invite, that you are wanted to come join, I think that even speaks volumes.

She observed that this approach reframed group membership to participating students:

Small group was seen [by participating students] as a good thing, and maybe not necessarily as, “I always get pulled academically,” or, “I’m picked academically for small group during the day,” to, “This is something I was invited to for fun,” and I think that the benefits even were outweighed even better because it had opportunities to, even work with different students that they would not have necessarily worked with during the academic day.

The other assistant principal shared in these sentiments, stating that: “I’ve enjoyed coming in. I even think about last year’s group; they became their own little community, of people coming together.”

The special education teacher spoke more specifically to the peer dynamics within the group:

I think it’s fantastic, obviously. I think that watching the kids bond with each other, too, so kids who have special needs tend to have difficulty maintaining peer relationships a lot of the time in appropriate ways, and the kind of teamwork that some of these projects, I can see some of these projects involving an interdependence of one person’s task on another person’s results, is another good lesson, just socially, that they don’t necessarily get exposed to in other environments.

She also pointed to the small group setting as a safe place in which to work on social skills and build a sense of community:

And also, just, it was interesting to see students who typically struggle, or might withdraw from a lot of content within the classroom, feel like there weren’t those kind of barriers in the classroom, because we’re all facing tasks that were unfamiliar, including

one of their teachers, and to some extent, they had more background knowledge than they even realized that they had, which I don't think is an opportunity that they have in the general education curriculum, very frequently.

To further stress the previous observation, the special education teacher made the observation that she self-defined her role within the group as a member who was learning alongside students, further facilitating this sense of community-building: "I was there to assist their access to a lot of the content, as well as to give them, I think, somebody to look to who also didn't really know a whole lot about this subject area."

Student confidence and transference of skills. Many teacher participants also referred to perceived increases in student participant confidence, as well as hypothesized application of acquired skills beyond the club setting.

According to the librarian:

I can imagine that the confidence that [these students] gained from being in there *has* to transfer into the classroom, and their teachers have got to see some bit of a change, because I'm trying to think, there has to be some transference of confidence, of ability to help others, because I think that's one of the biggest, you know this isn't just a club for fun, this is a club that is teaching them a skill, but yet they were very into it. You varied the activities, they were doing the coding, and they were doing the circuits, there were some things that you could see they were more comfortable with, and they could problem-solve, so every one of these skills will transfer to any, especially math, science, tech, as they go further.

Along similar lines, the special education teacher shared that:

This was, like, one of those opportunities to see [students] find that thing for them a lot of times, or see a thing that they happen to enjoy and were engaged in, and were really thinking about all of the hard parts of it, so I think that kids who receive special education services are always looking for something they're interested in or engaged in that they can really do without a whole lot of support, and that was this for them.

The general education, who had the benefit of working with students both in the general education setting and in the context of this program, noted specific instances of this confidence extending beyond the community built within the club's small group:

I think it [transfers]; some of our friends that are a little bit more quiet, when we have, like, free time, and break, and things like that, I do notice that they are interacting a little bit more and hanging out together, whereas, in the past, they weren't necessarily students I had seen mingling, and both of them have anxiety problems; one with the issues at home that Mom has brought up recently that we're working on, and another one that actually receives weekly therapy sessions because of being bullied and things like that in the past.

In addition to the social component, she observed changes in student academic confidence:

...I think exposing them to the content, and the science, and the hands-on piece, they were really excited and engaged. Whereas I'm thinking of one in particular, he's very vocal about reading and writing being hard for him, and words being hard for him, and even when he does share, he doesn't give himself enough credit to realize that what he's saying is something of value, and I don't think he ever questioned himself twice in his

interactions with you or the material in the club, ever, and we're starting to see that in the classroom.

Tied in with the themes of community-building and academic risk-taking, an assistant principal also noted increases in student confidence:

I know it's been exciting to build some of that camaraderie within that small group, be able to ask questions and investigate things, things that they might not have even had any information on or knew about, and it was a safe environment that was created for them so that they could take those risks. And it's really been exciting to see the outcomes and the things that they've produced with building that together, seeing the smiles, seeing the excitement that it's built, and their self-confidence by the end of seeing that product work.

Vocational awareness and career planning in education. Several stakeholders, across group membership, noted that student participants in the tech club were exposed to potential career paths. According to the special education teacher:

This [program] really opens up some idea about, obviously, career paths, and, certainly, what certain careers require, and not only require, but just involve, and what some of the options out there might be. I think, in particular, for kids who don't achieve as typically in the classroom, I think the environment of a club like this, or a class like this, where they're constantly experimenting and trying and learning technical skills that aren't necessarily connected to a bigger idea, not to diminish anything that, but like they're just doing a task and seeing the success and the immediate results of that, like whatever they

do impacts what happens, yeah, and so it was kind of like an instant gratification thing for them.

The general education teacher added that:

The technical component, the coding, beyond the video game, is like cool for them to, like, realize why those things work, and have a real life application. You guys talked about, like, the jobs they could have, just the exposure, in general, was a big deal for them, especially with a group of kids that don't necessarily always feel so successful.

Both assistant principals also commented on career paths, making the connection between vocational training at a young age and adult outcomes. According to one assistant principal:

I guess I'm always looking at, what's going to be the larger impact, is, I hope this could generate an excitement, or this could be a passion for them later, longer or further on, as they go to middle school and high school, this might be something they might want to go in, they might go to the Academy, they might start looking at other opportunities for them to then, the "what-ifs." "What if I tried this? What if I developed this? What if I..." you know.

Specifically referring to vocational awareness in technology fields, she added:

I think we always need to be looking at being cutting-edge, and what's next, and what can we do, because I think of our students, we're preparing them for jobs we don't even know [laughing], and so I think that as administrators, it's important that we're staying at the forefront as much as possible, and working together to see what opportunities to continue to build with our teachers, together for our kids, so that they'll be truly ready for

the world, for jobs that we don't even know, and so what does that mean, what is that, what are technologies we can put in kids' hands, tools that they can work on, use now, so that they'll continue to be ready, but not only that; build that, have kids try. That's the best thing about giving them enrichment now, what do they want to do, they want to be when they grow up? Giving them those opportunities to try, and not only that, building those life skills that if you fail, you learn, or if you succeed, you celebrate and then you learn how you can do it better. Those are life skills that we have to teach now so they'll be ready for what the world's going to bring as they continue to move on in their education.

The second assistant principal tied this vocational awareness back to student strengths and needs, suggesting that:

On a test, they may not show this knowledge so well, or, like, they're reading level may not be at their peers' level yet, but there are other areas where they excel in, and we really have to capitalize on that, and make them feel efficacious as a learner, and say, "Okay, you're still struggling in reading, but this is what other talent you have." You can harness, you can capitalize from that talent, if that kind of makes sense. I think sometimes, I feel like I'm going too philosophical, sometimes in [Eastern School District], I feel like we've knocked down vocational training and skills a lot, and we've moved into, like, "Oh, everyone has to go to college, and a 4-year degree," and stuff like that, and it's, like, vocational skills are just as valuable, if not more, because I can tell you first hand, I have no idea how to do anything with my HVAC unit, but I have paid someone \$15,000 to fix it at my house before, and I'm like, those are very, very valuable skill for kids to have,

and if, so I do think we just have to find unique ways to develop skills outside of just academics, the way we think of academic content, in that, I think at least in the elementary setting, and should talk to kids about other opportunities they might have, and like, “This is how you can apply science, and how you can apply math, and this is how you apply vocational skills, and this might be a great career path for you,” and that's great work, and it's valued work, and it does take a great deal of expertise in a lot of those career fields, like I couldn't do it; I have no idea.

One of the presenters also spoke to the benefits of exposing children to potential career paths from a younger age, sharing that:

Basically, we'd get some people interested, maybe something they never would have even thought of, but reaching out and encouraging them to try something new, I think that's really helpful. People aren't going to know to try something unless they try it.

When viewing these sub-themes holistically, adult participants were experiencing this club beyond a purely academic context. These perceived benefits of the club extend to essential skills domains, with implications beyond the classroom. Incidentally, these referenced observations are often relevant to special education learners' identified needs and related IEP goals.

Group-Specific Transformative Themes

Each of the participating stakeholder groups has a unique role and relationship with students. Teachers, who comprised the cosponsor group, work directly with students on a daily basis. Educational leaders work directly with teachers, but have more limited direct interaction with students on the basis of instruction. The business community has little contact with students,

but depends on them in order to build and replenish the workforce; their interaction is typically limited to special visits to schools or in interest/recruitment fairs. Due to these divergent roles, some emergent themes were specific to stakeholder groups.

CoSponsors

The primary theme specific to participating cosponsors was consideration of teaching demands and available time. Whether directly referring to it or suggesting, through asides, that it was in the back of their mind, both teachers who service student goals and follow a pacing guide made frequent mention of this.

As earlier noted by the general education teacher, “Doing the experiments and doing the hands-on and providing them with, like, rubrics; things that are usually difficult to put together and take a lot of time to do so, will continue to give these kids a better chance,” calls attention to the up-front demands of this approach. She again referred to this in two other instances: “...The fact that they're so engaged with this science and technology component, I don't think it's something that we have enough time to usually offer them,” and, “We don't have enough time to give him those on-hands opportunities to express, in like different ways, that they do understand what's happening in the classroom.”

The special education teacher also remained cognizant of her demands as a teacher, even while favorably considering the approach used in the club: “I think I'm willing to, I mean obviously I won't say, like, ignore the remediation part, but I think that there are ways to provide equal-looking access to kids.” Although only mentioned as an aside, one of the assistant principals also referred to this point, showing no opposition to infusing this approach to the school day, but giving a caveat: “I think you could [implement a program such as this during the

academic day]. I think as a classroom teacher, you'd just, kind of, have to look at how that works out with all the other demands.”

Program experiences for teachers were frequently viewed through the lens of instructional/preparation time and demands. Given the prevalence and weight of this theme as a potential obstacle to implementation of this educational approach, it will be further investigated in the discussion chapter of this study.

School-Based Educational Leaders

Transformative themes specific to educational leaders focused on: Student equity, building culture regarding an approach such as this within the school community, administrative open-mindedness, and current enrichment practices. I discuss these themes below.

Equity. A strong theme amongst the educational leaders was concerns and reflections on the equity of a club solely for students receiving services. After having supported and experienced the club, though, the principal shared how the club influenced his conception of equity, which is what largely inspired Year Two's shift to adult experiences:

Equity does not mean equal, and so there was, maybe my initial reaction of, “Oh, it should be open to everyone, and that's what equity is,” I'm now questioning my own understanding of equity and access, and what it means to be equitable does not necessarily mean that everyone gets the same thing. It's giving kids what they need, and if there are certain kids that need this, then there's that, and I guess the equity piece is, “What do other students get that's similar.” I still need to think that one through... ..I have to think more about that in my thoughts, and my journey.

While most other mentions of equity have already been discussed in the Perception of Small Groups theme, the assistant principal with a background in special education spoke directly to the equity of this model as a means of delivering enrichment to students who do not traditionally receive it:

I think we have to look at our students and make sure that we're being equitable for enrichment opportunities for all children, I think we have to, when I was talking about the equity lens, we have to provide those opportunities for all students, and I don't, I don't have the data to describe, but my hunch, you know, my internal feelings, is that we don't offer those opportunities for kids, or we do offer it to kids with IEPs, but they're, like, those clearly twice-exceptional students, where we're, like, "Oh, okay, they're brilliant in this," and they're getting enrichment, but what about our special education students who, they struggle in math, and they struggle in science, and they struggle in reading. They still have to have those opportunities for enrichment. I think it will make them feel more efficacious as a learner. I do really believe that, like, we all have talents, and it's our job here, especially here at the elementary level, is to give them that love of learning and to start cultivating those talents, and, you know, we have to find out what kids are passionate about, what they're good at, and when I talk about enrichment opportunities, like soft skills, too, like, I really think there's some value, like, yes, some students, reading's really challenging for them, school's *hard* for them.

Educational leaders framed their experiences around equity in terms of student access to enrichment opportunities, as well as earlier-discussed perspectives on small groups. Through their experiences with the club, they questioned their thinking on equity as framed by attitudes of

student ability, their perceptions of student academic risk-taking, and perceived community-building within the club. These observations also affirmed existent research, through speculation on the limited educational enrichment opportunities currently available for students who receive special education services.

Building culture. Another theme specific to educational leaders was how institutional culture can be improved, whether for students, teachers, administrators, or the larger learning community.

According to the principal:

I think that there's an opportunity to leverage technology to market and communicate what's happening—it's one thing when you tell people about it, but it's another thing when they actually see it, so there'd be some opportunity to use social media, or some other technology to actually get the community to see what's happening, and then for them to give input as well, once they see it.

One assistant principal agreed with this idea of outreach through marketing, stating that:

I think it's a matter of how can we have our students, which we've kind of done, the tech club shared out with the school through the video, and having the school community seeing it, I think that was a great first step, I think, "What are they doing in tech club? What are they making?"

Speaking directly to how administrators can help a program such as this, the principal suggested:

That idea of adding on, seeing an idea and saying, “Well, this is how I’d like to contribute,” or “Oh, so I can do this with my own kid,” or teachers, how they could see it, and getting other students interested.

An assistant principal expanded on this assertion, stressing the novelty of this approach:

I don't think [administrators] even know that [this club] is a possibility. I think this is the first time I've ever really encountered a club solely for students with IEPs, like, and like, “I really just want to, you know, work with students with IEPs, and have the technology piece in here,” so I think it's just, like, here's the possibility, and once people know the possibilities out there, and showing, like, “Here’s the results, and it worked, and look at what the feedback from the kids, look at the feedback from the staff, and how it changed their beliefs,” once people see that, they’re like, “Oh wow, okay, let’s try that here.”

An assistant principal also spoke of the potential transformative power of this club for school staff:

I think the impact from a staff aspect, is it really educated people, like, “Wow, our students can do this.” It may have changed some mindsets, and, you know, really seeing special education students as capable learners, and, you know, finding ways to set the bar high outside of just, like, IEP pupils.

As in the theme about students demonstrating knowledge in alternative means, this assistant principal spoke to this program’s approach as an opportunity for teachers to have latitude to take academic risks with their students:

...Even if it's just, “Hey, you know, you can incorporate this into your small group,” and especially if it’s like, self-contained students, you can, you just have to change your

focus, and be, like, “Okay, this is the content that I’m teaching, but also, how can I build in these enrichment opportunities in these small group sessions.” Even if you’re targeting, like, one or two things, like when you look at the, like, “Here’s the content that I’m teaching, but where can I enrich, or how, what are different elements that I can pull in.” I also think, like, if I were still in the classroom, that I would lean heavily, now, on building more, having, really, incorporating more PBLs into what I was doing with my special education students, because again I think that balance of, I can cover content, they can explore things, they’re developing soft skills, they’re working with others, hitting communication goals with one another, organization, I mean those are all skills that a lot of our students with IEPs are still trying to work on, too. So I would just get a little bit innovative, and I think you have to take risks, because, I think sometimes we’re afraid to take risks with our special education students, because we’re like, “Oh my gosh, what if they don’t do well?” Well what *if* they don’t do well? You adjust it. It’s like any other intervention; you look at the data and say, is it working? What can I tweak about it? If it’s not working, like, let’s go on from there.

Educational leaders reflected on the role that not only I, as a teacher and sponsor of the club, can take in promoting this approach to education, but on their own role, as well. They spoke to utilizing projects made in the club as a means of advertising both it and student success to the larger learning community, as well as utilizing the club as a means of sharing enrichment potential and student ability to staff. They also spoke to the novelty of this approach for administrators, as well as the need to frame it as a positive small group instructional approach for students with special education needs.

Administrative open-mindedness. Although only expressed by one of the interviewed school-based leader, one assistant principal repeatedly stressed open-mindedness to teacher ideas as a point of growth:

I think that's my biggest thing is, I think it's a matter of always continuing to be open-minded about an idea, because, you know, when you do hear about, "Well, we're going to be inviting special ed. students, only," I always am looking with an equity piece, that are we going to make sure that this is the best thing for them, and how would it look to others, and how would it make them feel. So I think if we look at the intentionality of, is this giving them voice, is this giving them more opportunities, is this leveling the playing field for them so they can feel that this is something that will really help these students to be able to even explore a new passion or something that they wouldn't have thought of even trying before... ..Seeing if you have staff who are, I think that really, the key is that you have a staff member, or a teacher who is passionate about it, because when you have that person who is passionate about it, they're going to spread that to the kids, and they're going to be excited about it, and so, looking at that tech piece, you also have to look at, you know, building those relationships with the kids.

She pointed to the success of a group such as this being incumbent on having at least one staff member with the requisite competencies and interest level:

Sometimes our kids with IEPs need that extra push and being able to take those risks in the clubs, and in that smaller group setting, they're going to have that, if you build that relationship, build that comfortable learning environment for them, and so I would say to anybody, if you're going to look into something like this, is making sure you have the

right staff involved, to create the right environment, and then whatever it is, is bringing that passion to students and working with them.

This theme compliments the previously discussed theme of building culture. The principal, as the school's leader, suggested that by explaining the rationale and theory behind a novel and non-traditional approach, administrators challenged initial reservations about allowing implementation of a club such as this. Open-mindedness, therefore was identified as an important administrative factor to testing and identifying new, effective instructional approaches. This open-mindedness, in turn, also pivots on having staff willing and able to implement these creative approaches to educational problems of practice.

Guest Presenters

In addition to pointing out how their perceptions of students who receive services were challenged by interacting with this club, most presenting technical experts connected what they observed of students to relevant skills for the general workforce, as well as potential recruitment practices within their own professional fields.

One engineer spoke to the process over content approach to vocational preparedness in this club, considering the target population:

Whether they had the work ethic to learn the skills, I don't know, but if you tell them why they're doing something and then you go do it, this might appeal to that group, whereas memorization of facts and figures may not appeal to them.

This engineer framed this realization within the context of potential longer-term impacts of this exposure for students:

Understanding the hardware side, understanding the connections between systems, can go a long way, and particularly as more processes and tasks get automated. This club lays the groundwork for some of those skills... They were able to share some stories, themselves, that showed that they had an understanding of, that there were some career paths, already. I don't think that they had connected the skills that they were learning directly to heating and cooling, at least not yet, but it seemed that they were getting it and that they were very curious about the different sensors and elements within the electronics that we were looking at.

On a related note, another presenter shared the benefits that *he* would have felt being provided with this level of outreach at this age:

I think it would have been amazing if I had this kind of outreach when I was younger, so I think I'm overall pretty positive about it. I think it's amazing to get to go learn this stuff, and the fact that 30 years later, people are exposed to so much technology which is just tied to the kind of industry that I'm in, it's amazing that kids are getting to do this stuff, and program computers, and stuff like that at this age. They have Arduinos, they have Raspberry Pis that they can do, people are learning very quickly, very fast.

He tied this personal level of connection and development of general interest back to his industry, drawing a direct line between 6th-grade interests and potential career outcomes:

It was fun, on my side, to be able to put the presentation together, to think back to where I was when I was their age, and basically the things that got me interested in my career, so I could actually tie that in and explain to them how engaging it can be to actually follow up on some of that stuff.

The CEO questioned the benefits of investing in student outreach at this point in students' educational careers, suggesting that it may be more appropriate to provide these experiences at later junctures:

I think you'd want to find ways to be influential at moments where students are making decisions that will put them on a path to actually move into these fields. For example, if a student is deciding whether to take a computer science class in 9th grade, or 10th grade, encouraging them to fill out that bubble might have 100 times more influence than at the point, this part of their career, stage of schooling, where there's not a lot of choices that they have that seem to put them on the path or further develop the technology interest. I think it's possible to contribute to some underlying notion that they like technology, and can envision some career in that field, but I also think that when it comes down to it, it's about some choices about classes you can take, or succeeding, or getting help in those classes, so maybe the more influential moments are when those choices are more clear cut.

He went on to share that although this program may be beneficial in a general sense, he did not see evidence of a direct line to student outcomes, sharing that:

I think it's great to start with aspirations and build dreams, but I also think it's really helpful to have, um, a realistic understanding of how to get to those, the promised land of technology jobs, if that's part of the goals of the students.

He framed this within the context of how, within his work setting, careers require not only college education, but often post-graduate degrees, and so was left wondering, "How are we

going to get [students who receive services] ready for college,” as well as, “How will they take the more advanced classes to get these jobs?”

Although potentially broader than the specific scope of this study, multiple presenters spoke to the larger benefits of vocational awareness training, irrespective of population. One presenter noted this club as an opportunity to demystify and build interest towards career tracks:

Spreading awareness, just the fact that careers exist in these fields, is often lost on people. A lot of people think that electronics and radios and all that are magical devices that come out of the moon; this club helps to make those real life connections to these technologies.

Another presenter tied this into the larger context of workforce realities in the US:

[These fields] have a vast shortage of workers going into engineering, particularly students from the United States needed to work on American infrastructure, whether government or commercial. This is a labor market largely served by immigrants on visas. If you can get people trained and interested in anything engineering-related, it’s far greater than having them go into another service industry, or even software. It’s obvious that our industries need to do more outreach like this.

Following up on this last point, I asked how current employer outreach practices might change to be more effective. He shared that instead of focusing predominantly on high school and college students, “The more personal, sort of one-on-one outreach to specific students and specific schools is probably a good idea.” Another presenter added upon this, suggesting that instead of simply sending resources out to schools and hoping that they indirectly help build student interest in technological fields, “It seems super obvious that what a company like Boeing

should be doing, is sending someone out to see what you're doing with those resources.”

Another presenter hypothesized on the likelihood of this level of outreach, opining that, “Only mega-companies, the government, and kind-hearted individuals like me have the resources and scope of time to invest in growing their workforce in this way.”

In presenting to the tech club, guest presenters had the unique role of being outside of traditional educational structures and ways of thinking. They also showed the most variability in the takeaways from their experiences, which is not entirely surprising, given their differing roles within their respective fields. They noted the program's workforce-relevant emphasis on process over content, as well as perceiving potential positive influences from early industry outreach on an eventual homegrown technology-based workforce. These observations were noted, however, within the context of perceived industry limitations and/or reservations around this form of outreach investment.

Chapter 5

Discussion

Through the interviews analyzed in Chapter 4, data point towards several instances of adults moving through the continuum of transformative learning towards change in practice (Nerstrom, 2014). This chapter explores supporting evidence by first summarizing findings, then exploring their implications in further depth, as related to the stated research questions. After considering the level of impact on participating adults across stakeholder group, I lay out future research recommendations to delve further into this promising topic of study. The chapter closes with a reflection of my own experiences as a participant and researcher in this study, followed by my final conclusions.

Summary of Findings

In the original phase of this study (Year One), I set out to explore how exposure to STEAM-based enrichment opportunities and vocational skills impacted self-confidence and/or cross-curricular self-efficacy for students receiving special education services. Over the course of the year, experiencing the club alongside students, it appeared that student participants experienced growth in the anticipated manner, which was largely consistent with general research on technical education. Through this experience, however, it became apparent that adult participants were also impacted, challenging their own perspectives and attitudes about students who receive services. The second phase year of this study (Year Two) focused on multiple stakeholders' experiences (i.e. cosponsor teachers, school-based educational leaders, and guest presenters representing technological fields) with this club, searching for 1) evidence of challenges to attitudes and perceptions regarding students and/or the program and 2) evidence

that this transformative thinking can lead to changes in practice. After analyzing the adult interviews, I found supporting evidence for both questions, both between and within stakeholder groups.

Several common themes emerged across multiple participant groups. The major academic themes included recognizing the enrichment club's potential to allow students to demonstrate their knowledge and learning in alternate ways and utilizing this approach to address identified academic needs. Extending upon these findings, several themes related to the perceived potential of this approach beyond core academics also emerged. Furthermore, I found evidence of evolving adult perceptions regarding students who receive special education services, as well as small group education.

I also analyzed emergent themes within participant groups. Cosponsors noted the potential of this approach, while considering time/resource investment as they relate to current teaching expectations and demands. Educational leaders suggested that their definition of equity in education evolved as a result of experiences with the club, spoke to their role and the role of the teacher participants in building support for this approach to education, and stressed the importance of open-mindedness to novel approaches suggested by teachers. Guest presenters generally stressed the need for increased outreach to schools, starting at a younger student age, as well as speaking to the benefit of developing process-level skills in education, rather than solely content skills.

Implications of Findings Overview

In order to interpret the findings from participant interviews, I analyzed emergent themes for evidence of transformative learning. I conducted this analysis following the framework of the

Nerstrom Transformative Learning Model (2014; see Appendix B) of: “(a) having experiences, (b) making assumptions, (c) challenging perspectives, and (d) experiencing transformative learning” (p. 327). For the purposes of this study, I interpreted and applied this model as follows: (a) All adult participants have had previous educational training and experiences, which (b) helped to shape their established perspectives and assumptions about students and education. (c) New educational experiences force these participants to balance them against their established assumptions and attitudes, causing them to either affirm their previously held beliefs or to challenge these perspectives. (d) Based on the level to which the new experiences challenge their perspectives and assumptions, transformative learning can occur, in the form of new educational beliefs and/or subsequent new educational practices.

None of the interviewed stakeholders at Mid-Atlantic Elementary had participated or heard of an after school STEAM-based enrichment program targeting upper elementary students who received special education. As such, this novel experience necessarily challenged their established perspectives. Data analysis, therefore, focused on which previously held perspectives were affirmed or challenged and whether the data showed evidence for true transformative learning, defined as “adopting and acting upon new perspectives” (Nerstrom, 2014, p.328).

Major themes in the data mirrored and complemented the research on adult attitudes and perspectives explored in the literature review. Additionally, these themes also suggested directions for future research, to continue filling in some of the holes in the current literature. Adult experiences with the club challenged assumptions about students’ ability level, as well as inclusion always being the most equitable educational setting for special education learners (Hopper & McLeskey, 2013; Lynch, 2012). Additionally, interview data suggested the power of

adults learning alongside students (Liu, 2011), as well as the necessity of adults either directly or indirectly experiencing and participating in this form of technology-based education, rather than simply hearing about it, in order to build culture across the learning community.

Data were analyzed within the context of the research questions. I balanced evidence of true transformative learning against stated and speculated-upon obstacles to changing established attitudes and/or practices.

RQ1: What are the Impacts of a STEAM Enrichment Program for Students Receiving Special Education Services on the Attitudes and Perceptions of Adults Involved with the Program?

Amongst the themes that emerged over the course of the post-participation interviews, several reached the level of actively challenging previously held beliefs and assumptions. These themes were varied, with some held by multiple participant groups and some having more specificity. Although participants generally did not speak to direct changes in practice through the themes identified in this section, they indicated at least some potential towards eventual change.

Alternative manners of students demonstrating knowledge and learning

Most school-based participants spoke to students showing academic strengths through this club in ways that had not been previously observed in the classroom. This theme challenged their perspectives on special education learners' ability-levels. Some teachers spoke in general terms, speaking to general strengths-based education: "We're not looking at what they can do, we're looking at what they can't do, and we need to see what they can do—what they're capable of doing." Some were more specific in their reflections: "...They can do more than we think they

can do when we see them in the classroom, or [when we] are only expecting written or read work—this is a more hands on, but still complex, thinking process...” As noted in the previous chapter, the special education teacher contrasted this approach directly against remediation-based and traditional integration models:

Like, if all the kids do all day is sit in math and science and reading in a GenEd environment, and they don't really have any, that's what their peers are talking about, and they don't necessarily have the same background to participate in those conversations. But if they are doing STEM activities, too, and their peers are engaged in it, then that's something that they're successful in and they can also have a discussion about, a sense of belonging, I guess.

School leaders also found benefits to this approach, tying their experiences in the club to practical applications, such as addressing identified IEP academic and socioemotional needs.

These observations and realizations, that students achieve more when they have more strengths, have obvious implications on engagement and self-efficacy levels for students who receive services. It transforms school from a place that students struggle to a place in which to demonstrate and build upon proficiencies.

Perceptions about students who receive services

Although a rather simple point, multiple stakeholders commented on how participation in this club either changed or had the potential to change adult understanding of students who receive special education services but access the general curriculum, again challenging perceptions of student ability. Multiple guest presenters reacted with surprise after presenting to the group, with one stating that he “would not have been able to tell that they had special

learning need,” and the other that he was “under the impression that they had some sort of learning issues, but they all seemed bright enough to me to get what we were doing.” The school-based resource participants (i.e. librarian and gifted education teacher), who do not work as closely with individual students over the course of the school-day, also suggested that sharing student-created projects from this club to the larger community could be a useful tool for understanding student participants, serving to:

Educate staff, and maybe even for parents to learn, not just parents of students in special education, but those who aren’t, so they can learn that just because these kids are in [their child’s] classroom, doesn’t mean that they can’t contribute.

Although not directly within the scope of this study, the group of visiting government officials immediately assumed (and opined) that they must be observing a group of “gifted” students. This short, anecdotal experience challenged two assumptions: Only identified advanced learners should receive enrichment education, and students who receive special education services cannot access enrichment opportunities.

Building realistic and individualized perceptions of students who receive services is a requisite component of designing strengths-based academic support (Geltner & Leibforth, 2008), rather than solely focusing on reducing deficits (Yell, 2016). This finding, therefore, suggests a manner in which to remove perceptions of student ability as an obstacle to changes in practice towards enrichment approaches.

Perceptions of small groups

Another commonly observed challenge to established perspectives was adult views on small group education as a potentially beneficial learning environment for students who receive

services. Cosponsors spoke to student confidence levels within the club setting, increased academic risk-taking, and observed community-building amongst student peers. They felt that students viewed the club as a safe space, demonstrating “a confidence that they don’t always have in the classroom, because I think they’re always comparing themselves to their peers, and feel somewhat intimidated by that.” Students who are quiet and reluctant to share in class or engage with classroom content participated openly in the group:

Some of them tend to be kids that kind of fly under the radar in the class during the day, don't usually share a lot, don't usually participate in lessons a lot, some of them didn't even typically interact with peers a lot during the school day, and that was not true to this club at all; they were very engaged, they interacted with each other, they shared and spoke and enjoyed their time more than during the day.

Educational leaders’ views on small groups, with reference to this approach, were largely tied to their evolving understanding of equity, as already discussed in Chapter 4 and this chapter. One assistant principal observed that the context of this small group felt different for participating students than intervention groups, sharing that “by giving them the opportunities to then work on some of those challenges in a fun environment after school, it might not necessarily be a stigma.” She further evidenced this evolution by stating that, “Even if we build an environment where students feel comfortable to express themselves or take those risks, it’s sometimes really and truly in the small group setting that we really see them flourish.”

This perspective shift regarding small groups is critically important to the success of an approach such as this one. Building a sense of safety for academic risk-taking and an opportunity for students to collaborate on equal ground is part of what led student participants to feel

confident enough in the club to opine statements such as, “This club showed me that I’m the smart kid” (See Appendix A).

Building culture

One theme that appeared in all educational leaders’ interviews was how the school community’s collective culture regarding this approach can be improved. These administrators questioned attitudes about their own role to building culture, both in terms of their own learning community and in terms of other potentially reluctant administrators.

The principal suggested using technology to market it:

It’s one thing when you tell people about it, but it’s another thing when they actually see it, so there’d be some opportunity to use social media, or some other technology to actually get the community to see what’s happening, and then for them to give input as well, once they see it.

An assistant principal agreed with this approach, sharing that a club-created video presented on the morning announcements, showing an Arduino microcontroller device that student participants had built, was a good way to get the larger community to ask, “What are they doing in tech club? What are they making?” She spoke to the power of exposing other participating staff to this approach, suggesting that “...It really educated people, like, ‘Wow, our students can do this.’ It may have changed some mindsets, and, you know, really seeing special education students as capable learners.” This, combined with administrative reacculturation, could, in turn, lead to changes in practice:

...Even if it's just, “Hey, you know, you can incorporate this into your small group,” and especially if it’s like, self-contained students, you can, you just have to change your

focus, and be, like, “Okay, this is the content that I’m teaching, but also, how can I build in these enrichment opportunities in these small group sessions.” Even if you’re targeting, like, one or two things, like when you look at the, like, “Here’s the content that I’m teaching, but where can I enrich, or how, what are different elements that I can pull in.”

Building culture is of critical importance to any novel educational initiative—attempting to do so without administrative support, and even active engagement, is virtually impossible. This ties back in with the importance of open-mindedness in educational leaders. As one assistant principal stated:

I don't think [administrators] even know that [this club] is a possibility. I think this is the first time I've ever really encountered a club solely for students with IEPs, like, and like, “I really just want to, you know, work with students with IEPs, and have the technology piece in here,” so I think it's just, like, here's the possibility, and once people know the possibilities out there, and showing, like, “Here’s the results, and it worked, and look at what the feedback from the kids, look at the feedback from the staff, and how it changed their beliefs,” once people see that, they’re like, “Oh wow, okay, let’s try that here.”

Club foci beyond core academics

Several stakeholders spoke to the club’s stress on executive function skills such as planning, organizing, self-regulation, and self-awareness (Reber & Reber, 2001), which one assistant principal repeatedly referred to as “soft skill” development. This challenged perspectives on the breadth of skills that an approach like this can address, including but also extending beyond standards-based academics. The other assistant principal further stated that

developing these skills at a young age is critical: “It’s not something that just, just happens in middle school and high school; we’re starting in kindergarten.”

Another important finding is the adult-reported perception of student-acquired skills transferring beyond the club, both in terms of academics and socioemotional growth. According to the librarian:

There has to be some transference of confidence, of ability to help others, because I think that’s one of the biggest, you know this isn’t just a club for fun, this is a club that is teaching them a skill, but yet they were very into it. You varied the activities; they were doing the coding, and they were doing the circuits, there were some things that you could see they were more comfortable with, and they could problem solve, so every one of these skills will transfer to any, especially math, science, tech, as they go further.

In terms of social growth, the general education teacher shared:

I think it [transfers]; some of our friends that are a little bit more quiet, when we have, like, free time, and break, and things like that, I do notice that they are interacting a little bit more and hanging out together, whereas, in the past, they weren't necessarily students I had seen mingling...

This was further supported by one of the assistant principal’s observations:

I know it's been exciting to build some of that camaraderie within that small group, be able to ask questions and investigate things, things that they might not have even had any information on or knew about, and it was a safe environment that was created for them so that they could take those risks.

Vocational awareness and career planning in education

Another frequently noted observation was the obvious career path exposure that students were given as suggestive of building specific technology-related skills, potential vocational awareness, and potential pathways to attain employment in various fields. This realization challenged participant perspectives on the role and potential of vocational awareness training at the primary level.

The special education teacher shared that, “This [program] really opens up some idea about, obviously, career paths, and, certainly, what certain careers require, and not only require, but just involve, and what some of the options out there might be,” which students this age are not often exposed to. One assistant principal reinforced the importance of this, stating that, “I think of our students, we’re preparing them for jobs we don’t even know,” which is consistent with the research-supported concepts of embedding career planning within the curriculum (Mourshed, Farrell, & Barton, 2013).

Teacher time and demands

Although only mentioned as a qualifier to other thoughts and assertions, both classroom teachers mentioned the time constraints and demands of their jobs, as they relate to implementing programs of this nature, stating, “Things like [hands-on experiences] are usually difficult to put together and take a lot of time to do,” and, “I think I’m willing to, I mean obviously I won’t say, like, ignore the remediation part, but I think that there are ways to provide equal-looking access to kids.” This was also noted by an assistant principal, who stated that, “I think you could [implement a program such as this during the academic day]. I think as a classroom teacher, you’d just, kind of, have to look at how that works out with all the other

demands.” While these musings all suggest obstacles to implementation, they did show openness to try, so I consider them as evidence of challenging held beliefs and attitudes.

By bringing up these constraints within the context of favorable opinions regarding this approach to education, teachers were revealing an internal cost-benefit analysis of personal participation or implementation. This investment of time, both in terms of preparation and instructional delivery, viewed within the scope of teacher demands, is a meaningful obstacle to acting on perception shifts.

RQ2: What Direct and/or Indirect Impacts can Transformations in Adult Thinking have on School-Based Special Education Practices?

Although themes in RQ1 suggested evidence of transformations in perspective, they did not necessarily suggest changes in participant practices. This last point, about time/demands as an obstacle to implementation, led me to consider attainment of true transformative learning as a function of balancing new perspectives against true or perceived obstacles to change. For example, if a challenged perspective addresses the only attitude/obstacle to implementation, change in practice is likely to occur; conversely, if a challenged perspective addresses only one of, for example, three attitudes/obstacles, change is far less likely to take place. As such, themes discussed in this section are discussed as either: Likely leading to changes in practice, possibly leading to changes in practice, or unlikely to lead to a change in practice.

Addressing academic needs through authentic learning and/or enrichment

The predominant student-related theme, with potential towards changes in practice, was the idea of addressing certain IEP goals through programs such as this club. Both the special education teacher and educational leaders spoke to the limitations rising from a remediation-only

approach to servicing goals, as measured by student outcomes on goals and summative assessments. This is consistent with national special education attainment gaps on formal assessments (National Center for Education Statistics 2015a; National Center for Education Statistics 2015b). Since participating stakeholders do not have identical roles in student education, they will be explored individually.

Cosponsors. The general education teacher noted the potential of the hands-on approach to this club on several occasions, stating that, “I think it really just shows, like, what they can handle,” but also repeatedly contrasted this to her demands in the classroom, sharing thoughts such as, “We have to prove what they can do, and usually the only way that we can prove that to people is by providing them passing test scores,” and the challenges around “...doing the experiments and doing the hands-on and providing them with, like, rubrics; things that are usually difficult to put together.” These shared thoughts suggest that although perspectives of ability, a chief underlying attitude, have been shifted, obstacles remain for teacher accountability (e.g. student demonstration of proficiency on state standards), as well as for time required for preparation and instructional delivery. Until these other obstacles have been addressed, change in practice is unlikely.

The special education cosponsor spoke to shifting from sole reliance on a proscribed remediation program for her small group students to a program that provides more “equal-looking access for kids.” She shared that her participation in the tech club, as well as its student outcomes helped to solidify her belief that “...kids, with special needs in particular, benefit from authentic and self-directed learning experiences.” While the described guided reading program is not explicitly enrichment, it does share in the same philosophy of allowing

students to engage with materials in a meaningful manner, followed by collaborative discourse, as a means of holistic learning. To contrast this stakeholder against the general education teacher, her interview also suggested a shift in perspective on ability, but her accountability measures are dependent on student IEP goals, rather than a pacing guide, removing an additional obstacle to change in practice. Although time is still an obstacle to change, the approach she shared actually more closely mirrors classroom best-practices, and any other small group implementation would already necessitate tailoring to meet individualized student needs. Longer-term change in practice resulting from transformative learning, therefore, is likely.

Similarly to the special education teacher, the two resource teachers also had fewer obstacles to changing practices than the general education teacher. They do not have set, standards-driven curricula, and so do not have the same accountability obstacle, and have flexibility in designing their lessons, addressing the obstacle of time. According to the gifted education teacher, in response to observing ability levels in the club, he now strives to “offer complex thinking activities to all students and to withhold judgement. See if the student will rise to the occasion as many will if the activity is engaging and catches their interest...” The librarian, in turn, shared that, “The more we challenge and create opportunities that stretch our student’s minds, the greater the long-term influence we will have on their long-term success.” Based on the interview data, both of these stakeholders seem likely to instruct special education learners differently after this experience.

Educational leaders. The assistant principals were more direct in promoting enrichment as a means of servicing student needs, having experienced this program. One assistant principal

spoke to the accountability obstacles that teachers face, speculating that when considering their approach, teachers would reach as follows:

“Oh my gosh, what if they don’t do well?” Well what *if* they don’t do well? You adjust it.

It’s like any other intervention; you look at the data and say, is it working? What can I tweak about it? If it's not working, like, let's go on from there.

The other assistant principal considered tying development and implementation of approaches such as this to student goals, spoke to the ability to tailor instruction to individual needs:

We’re always looking at how can we leverage angles with trying to help further with their goals that they're working on, whether it's, you know, they have struggles in math, you incorporate that in the tech club, or if it’s a matter of they have no language skills, that you're working on it, too. We’re always looking at how can we leverage their strength and how can we then help an area that they still need to continue to work on and grow in, so I think that’s something to always keep in mind, too.

Through these shared positions, the administrative obstacles to change in promoting this enrichment approach to education appeared to be instructional appropriateness and accountability. Both of these obstacles appear to be addressed: The program can be adjusted to facilitate student success, and even if it is not curriculum-aligned, instruction is curriculum-relevant. Similarly to the special education teacher’s experience, instruction can also be tailored to address specific student IEP goals. As such, instructional leaders’ transformative learning in promoting this approach as a means of meeting student needs seems somewhat likely.

Administrative open-mindedness

Initial implementation for this study would not have been possible without the open-mindedness that administrators exhibited in welcoming this enrichment approach into their school. Only one directly addressed it, stating that one of her “biggest takeaways is that I'm always willing to have an open door, open mind to trying new things for our kids, especially if it's going to help to further them.” Given the principal’s original reluctance to implement the program in its proposed form, it would have been easy to decline. Instead, the administration was open to discussion, and once they heard the rationale behind the selected audience and delivery, they were very willing to try it out, both as a club and as a research opportunity. Without the willingness to take reasoned risks within education, it is not possible to push the field forward, and so this openness to staff ideas, followed by student gains, can only inspire future openness, as well as an attitude of supporting fellow educational leaders to take a similar approach.

In this theme, the only observed obstacle to change in practice is administrative perspective on appropriate scope of extracurricular clubs. Through willingness to discuss and better understand the science behind and reasoning for the club, this obstacle was adequately addressed, change in practice was evidenced, increasingly likelihood of future openness. In addition to this open-mindedness component, administrative perspectives on equity were also present in this theme, which warrants closer inspection.

Equity in special education

One of the strongest transformative themes to emerge from interview data was educational leaders’ evolving views on equity. Initial resistance to a small group model of delivery for this enrichment opportunity gave way once leaders were able to witness the safe

space that this format afforded for participants. Synthesizing what was pointed out by multiple stakeholders, when integrated to a general education setting, many students who receive services do not willingly participate, whether due to louder voices in the classroom or their own insecurity. In order to facilitate student participation, maximize opportunities for creative problem-solving and collaboration, build “...that comfort level to have that exchange and discourse with each other,” and allow for adequate direct adult interaction, this club’s setting is not at all restrictive to students’ learning. As was shrewdly observed by the participating principal, “Equity does not mean equal,” reiterated by an assistant principal that in some instances, this form of equity gives students “what is best for them.”

The primary obstacle to change in this case is an established attitude of small group instruction as a restrictive learning setting, which appears to have been addressed through the club’s approach and outcomes. This change in perspective and possible change in practice from equity as pure integration to comply with LRE requirements (Yell, 2016), to equity as a means of meeting student needs and providing educational enrichment, has wide-reaching implications. According to the principal, equity has “...definitely influenced my decision making and approach. I can say I am more and more thinking about the individual needs of students,” which is relevant because educational leaders have many indirect impacts on students: They help set instructional priorities, they select continuing education for staff and faculty, and they can seek out staff members to lead instructional initiatives. Although there are no other openly stated obstacles, there were also no specifically stated changes in practice in the interviews, but these strong changes in perspective lead me to believe that changes in practice on this theme seem possible.

Industry outreach

One unanticipated potential change in practice was the assertion that current prospective employers need to expand the scope of their recruitment practices. Presenters shared what was suggested by the literature, with one sharing: “[These fields] have a vast shortage of workers going into engineering, particularly students from the United States needed to work on American infrastructure, whether government or commercial.” Multiple presenters suggested that the current predominant methods of recruitment, high school and college job fairs, are overly narrow in scope. Although some larger companies are attempting to court younger students by providing schools with materials for STEAM-based projects, this experience, meeting and working directly with 6th grade students, was meaningful in both allowing students to interact directly with professionals and allowing the professionals to directly see student interests and capabilities. Presenter observations about younger outreach align with industry calls to work more closely with schools, at a younger age, to help develop prospective candidates (Mourshed, Farrell, & Barton, 2013). To add upon this with my own observations, I think it was uniquely meaningful for students to hear technical experts from technology fields explain their interests from when they were in 6th grade, as well as their educational journeys through secondary and post-secondary school. Student feedback following presentations included statements of high school electives of interest, as well as self-reflections of educational priorities (e.g. math and science), moving forward.

Three presenters commented on this level of investment in early and diverse outreach, as related to eventual employment opportunities for students participating in the program. The mechanical engineer’s perspectives on ability were challenged, stating that he was “...under the

impression that [these students] had some sort of learning issues, but they all seemed bright enough to me to get what we were doing.” He further suggested that, “Only mega-companies, the government, and kind-hearted individuals like me have the resources and scope of time to invest in growing their workforce in this way,” suggesting a sizeable extra obstacle, with suggestion of possible personal change, but variable industry change. The CEO suggested that due to the relative high number of applicants to tech job openings, paired with the fact that student participants are “not top of their class in school,” he wondered, “What are the technology jobs that are attainable and realistic and part of what they could set their sights on, because I think large swaths of them are just inaccessible.” The obstacles of ability and investment were not successfully addressed for this participant, with change in practice rather unlikely. He contextualized this perspective by sharing that within his own company, “For every hundred people that go out into the workforce, there may be one that is possibly in the realm of our area of work.” In contrast, the software developer presenter observed the engagement and interest of participating students, and shared that, “I don’t hire the rock-stars for my team, I hire people who are interested and work well in a group,” suggesting that the ability obstacle was addressed. This presenter went further in endorsing this form of outreach, sharing that:

I’m a big proponent of an education system that actually gives people hands-on, and thinking about real problems, and so, to me, one of the biggest things that I can do is actually encourage other people to think of all the opportunities they might have to have a positive educational impact on other people. That’s why I would be, that’s why I would talk it up, I would encourage other people to look for other opportunities, right, because it

feels very enriching to be able to come in and share experiences and get students interested in this kind of stuff, long-term.

These conflicting opinions lent further credibility to the mechanical engineer's suggestion that openness to early outreach may relate to company size. For a large technology company, many roles and worker skill-sets are required, ranging from conceptual through rote; for these companies, the student participants in this group may have been viewed as potential and heretofore overlooked eventual recruits. By contrast, for a specialized company with a specific focus, a small and flexible team of employees is required, capable of many simultaneous or demand-specific skill-sets; in this setting, student participants were perceived as less likely eventual candidates for recruitment, at least after one exposure.

Varied Levels of Impact

One final point of note about analyzed data is the somewhat expected finding that not all adult participants went through the same level of transformation. For some adults, participation caused them to challenge major beliefs, as in the educational leaders' perspectives on equity, or the presenters' assumptions about student participants. In other instances, experiences predominantly affirmed hunches or deeper held beliefs about students and their learning, as in the special education teacher and the assistant principal with a special education background. In the case of the guest presenters, company size and workforce needs affected participant impact levels, depending on perceived investment benefits to participating in a program of this nature. Irrespective of background or prior experiences, members of each stakeholder group did exhibit some evidence for transformative thinking through their interview reflections, as well as at least some evidence that their experience would affect their practices.

Recommendations for Future Research

As an exploratory case study designed to probe at a holes in existing literature around both technology-based enrichment in special education and adult transformative learning in education, it is somewhat natural that the current research has generated more questions than answers. As such, I have several suggestions for future research.

Replication

Although this study's generalizability is somewhat improved through its inclusion of two years of data, collected with two sets of 6th grade club participants, it took place in only one school. Data collected from other schools would be helpful, both in terms of further testing this general approach and in beginning to refine strategies for more formal implementation. These views are supported and inspired by both the interview-based data from adult participants and my own experiences with the tech club.

Outcomes for Students Participating in Enrichment Programs

In order to better assess the value of this approach for student participants, follow-up or related studies would benefit from more easily quantifiable data, collected over several years. As a between-subjects example, comparing student sample data against groups who did not participate, with regards to standardized testing results, graduation rates, and vocational outcomes; as a within-subjects example, analysis utilizing pre/post metrics of vocational awareness, career aspirations, and/or self-confidence could provide a deeper understanding of student outcomes.

Longitudinal, Mixed Methods Data

Follow-up studies on adults and their transformative thinking can also include pre/post assessments of attitudes about participation, as well as longitudinal data regarding commitments to and follow-through with proposed changes in educational practices.

Delivery Method

In addition to an after-school format, innovative teachers and educational leaders could pilot research around targeted STEAM-based opportunities for students who receive services during the school day, as a means of servicing identified needs. Where applicable, this approach could be delivered in conjunction with or in place of targeted remediation, depending on the extent to which identified areas of student need can be addressed.

Expanded Scope

The current study revolved around students who receive special education services but access the general education curriculum. In order to expand on this approach and further test its generalizability, I propose that targeted, small group STEAM opportunities be provided to other academically and socioemotionally at-risk student populations that do not generally get access to enrichment, such as English Speakers of Other Languages and minority groups.

Theme-Specific Research

Participation in this program challenged the attitudes and perceptions of adult stakeholders, both within and beyond the direct scope of this study. For example, initial perceptions on small group rationale and practices were challenged, resulting in participants questioning whether homogenous small groups can have educational benefits over general

education inclusion. Similar themes on teacher time/demands, industry outreach, administrative open-mindedness, and so on warrant more targeted investigation.

Transformative Learning and Obstacles to Change

Future transformative learning research could more fully explore the foundation of initial perspectives, as well as the related obstacles to changing attitudes and/or practices. Consideration of these obstacles, in conjunction with the existent Nerstrom (2014) model's emphasis on new experiences challenging preconceptions, may contribute to a more powerful predictive and actionable model of transformative learning.

Personal Reflections

As an active participant in this research, I shared experiences with all participating members, and to some extent, have had many outcomes in common with them. My own perspectives on technology education, special education learners, and the direct/indirect educational impact that all stakeholders have on students were all challenged by this experience. Having participated so deeply, I have undergone my own transformative learning with regards to student ability, enrichment as an alternative means of meeting student needs, the benefits of small group education, and more—I have already implemented some of these changes in my practices as an educator, and will further pursue these shifts in thinking to guide not only my own future practices, but to affect the practices of those around me.

I served as the primary sponsor of this technology club, working closely with and learning from student members and adult participants. At the program's start, I was not proficient with the technologies used, despite my strong interest and background in science, nor did I fully appreciate my passion for building upon special education best practices, despite my history of

working as a special education teacher. As a former quantitative researcher, I stepped far outside of my comfort zone in conducting an action-based, solely qualitative study. I have thoroughly enjoyed this experience and am pleased with the way in which it adds to the overall body of literature. I look forward to personally pursuing the topic further and hopefully generating interest for both researchers and practitioners to push it in new directions.

On a personal level, participating in this two year study has had definite, demonstrable impacts on my practices as a teacher, as already mentioned. Last year as a primary science resource teacher, and this year as a primary STEAM resource teacher, I have worked with all elementary age groups, K-6. Regardless of student group or ability level, I have transformed my instruction to follow an enrichment-based PBL model. I work hard to establish my classroom as a safe learning environment in which to take academic risks. I give my students wait-time, which they are not used to and leads to considerable friction before fruition, and I incorporate grade-level standards and curricular concepts to demonstrate to students, teachers, and administrators the multidisciplinary potential of this approach to education. I fully admit that in my role, I have the latitude through which to experiment and implement without specific accountability measures, but I firmly believe that our gains in the classroom extend far beyond our lessons, and can be used to shape future, large-scale instructional best practices.

Conclusion

This study identified a major hole in educational approaches to students who receive special educational services. Although technical disciplines have been expanding quickly into education, with increasingly well-documented outcomes for student development in both

academic and essential skills, students who receive services are not suggested to be given equitable access to these resources.

All school-based study participants made some note of the fact that the current model of special education delivery is not yielding desirable goals. Educational approaches reliant on remediation are not closing educational gaps, and so a new approach is needed. Participating school-based adults viewed the reasoning behind and outcomes from this enrichment club favorably. One assistant principal correctly hypothesized that enrichment is not currently considered as an instructional delivery for the majority of students who receive services, and is utilized primarily for students who are identified as twice exceptional (Baum, 1988; Foley-Nicpon, Assouline, & Colangelo, 2013). In her opinion:

My hunch, you know, my internal feelings, is that we don't offer those opportunities for kids, or we do offer it to kids with IEPs, but they're, like, those clearly twice-exceptional students, where we're, like, "Oh, okay, they're brilliant in this," and they're getting enrichment, but what about our special education students who, they struggle in math, and they struggle in science, and they struggle in reading. They still have to have those opportunities for enrichment.

In the earlier noted words of one of the cosponsors, "Right now, we're losing those kids, you know. We're not looking at what they can do, we're looking at what they can't do, and we need to see what they can do." Throughout my experiences with this club, I seldom heard an adult or student use the word "can't," even when engaging in high-level activities. Students never expressed self-doubt or outward negativity. Obstacles to learning weren't seen as reasons to stop or for adults to make tasks simplistic; they were seen as opportunities to troubleshoot and

discuss, generally with adults as equals to student participants. There is no reason *not* to pursue this enrichment approach as one means of addressing special education needs, which I view as a concrete step towards enrichment-based educational opportunities for *all* learners.

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Appendix A

Results from Proof-of-Concept Study (Year One)

A pilot after-school group was implemented at the lead researcher's base school during the 2017-2018 academic year. The club was run within the researcher's capacity as a science resource teacher at the school. The researcher selected a group of six students who receive Special Education services but access the general curriculum, based on conversations with homeroom teachers and special education case-managers. These students participated in this "Tech Club" with the stated purpose of finding technological means of promoting environmental stewardship, which is a stated focus at their school. The discussed computer/electronic technologies and vocational career paths, attended presentations by field engineers, and explored provided microcontrollers and related coding software. Along with the researcher, the students built and coded for a variety of Arduino-based projects, including simulated stop-lights, servo-controlled motors, and a temperature/humidity sensor. Students presented their projects to the larger school community. At the conclusion of the program and school-year, short, conversational interviews were conducted with the various participants (students, cosponsors, school-based leadership, and guest presenters) to obtain insight as to program experiences and to help inform the study's future direction. Consent was obtained for all participating interviewees, but no identifying information was recorded during the interviews.

Researcher impressions

All student participants were able to fully participate in all aspects of the program. With decreasing support, they built and coded for increasingly complex microcontroller devices (etc. simulated traffic lights, servo motors, temperature/humidity sensors). They engaged with each

other, cosponsor staff, and guest presenters, conducted research on various vocations and their requisite educational/experiential components, and presented what they created to members of the larger school community.

Anecdotally, outside observers were unaware that participants had any specific learning need. Quite to the contrary, a visiting delegation from a governmental group, after speaking with the students and observing their work, quietly asserted to me, “These must be your GT kids;” they were very interested when the demographics of the participants and purpose of the program were revealed.

Rather than share the totality of my observations and perceptions as Lead Researcher, I have included a selection of representative comments from the various stakeholder groups.

Student impressions

Students universally stated that they enjoyed the program. They shared that: “This club showed me that I’m the smart kid.” “I thought the tech club was fun, you know, a great way to do things that you like to do.” “I liked that we did all those things, like engineering, programming, designing buildings, anything about science.” “I learned a lot about the (guest speakers’) jobs, because before I didn’t know much, but I started learning what they do and how they got there.” “I’d like to meet more than one day a week.” “I learned that I like technology.” “We did a lot of cool things like when we were making the thing that would read the temperatures of the rooms. I thought that the science behind it was cool.” “The guests were amazing; their jobs sound pretty cool, and how they use technology in the things that they have to do.” “I learned that I can do amazing things if I work hard and I learned a lot of new things

that I never knew about science and tech.” “When I grow up, I want to become a successful businessman, advancing technology to make life easier and giving jobs to people.”

Cosponsors. Two specialists served as cosponsors over the course of the year. They shared that:

Adult one (cosponsor October-December). “Originally, I found the whole concept interesting, an interesting way to get kids into coding and engineering.” “Even in the hallways, sometimes, when I would see [students], they seemed less confident than they did when they were in the club.” “Keep the way you’re presenting it; I liked how you tried to keep it positive and keep the class moving so that there wasn’t a lot of downtime; at the same time if there could be more wait-time built in, that may be helpful.” “Videos of instruction, with a list of things to review, may help you work with more students at once and then review the various projects that they are working on.” “This [program] showed kids that they can be successful and do something that’s complex that not everyone else can do, and in some ways, to show teachers that they can do more than we think they can do when we see them in the classroom or are only expecting written or read work—this is a more hands on, but still complex, thinking process that incorporates a lot of skills.” “Maybe this club could be recorded and sent out [to the division], having a video showing what [students] are doing and explaining it, and how it’s something that can be used to educate staff, and maybe even for parents to learn, not just parents of students in special education, but those who aren’t, so they can learn that just because these kids are in [their child’s] classroom, doesn’t mean that they can’t contribute.”

Adult two (Cosponsor February-May). “I found the fact that kids, they were working on a level that sometimes I was looking at them, and the fact that they knew how to do some of these things, it was old hat to them. I watched them problem-solve; like it didn’t work, and they

went back and tried to figure out why before they asked, and for that group of kids, it's amazing." "I think it gave them, they had a confidence that they don't always have in the classroom, because I think they're always comparing themselves to their peers, and feel somewhat intimidated by that. Like I was so happy to see [student] in there; she was one of those students that I've watched her since 1st grade, Headsttrt, really, and watched her struggle... ..I watched her succeed in this group." "Some of the behavior things that you would see in a classroom, they weren't there. They took it seriously, and they were very good about helping one another, and I don't look at those kids as, they don't get the chance to do that very often, so you could see it was good for them to help another student figure something out." "It would be great if you could include more kids, but with more sponsors so you could give individualized attention... maybe look to the high schools and see if any of the high schoolers would be able to help who are doing similar things, because they would look up to them." "I can imagine that the confidence that [these students] gained from being in there *has* to transfer into the classroom, and their teachers have got to see some bit of a change, because I'm trying to think, there has to be some transference of confidence, of ability to help others, because I think that's one of the biggest, you know this isn't just a club for fun, this is a club that is teaching them a skill, but yet they were very into it. You varied the activities, they were doing the coding, and they were doing the circuits, there were some things that you could see they were more comfortable with, and they could problem-solve, so every one of these skills will transfer to any, especially math, science, tech, as they go further." "Right now, we're losing those kids, you know. We're not looking at what they can do, we're looking at what they can't do, and we need to see what they

can do—what they’re capable of doing.” “When you have our [students], you know, they drop out, because they think, ‘I’m not succeeding.’”

School-based leader impressions

One administrator was interviewed at the program’s conclusion for the 2017-2018 school-year. The administrator shared that:

“One of the benefits is not limiting the expectations of our students, by setting a high bar for them, and then making sure that they have the scaffolds to achieve them; when you focus on enrichment, then you go in with a belief that all kids can do it, as opposed to an intervention, which addresses the deficit model.” “I think that there’s an opportunity to leverage technology to market and communicate what’s happening—it’s one thing when you tell people about it, but it’s another thing when they actually see it, so there’d be some opportunity to use social media, or some other technology to actually get the community to see what’s happening, and then for them to give input as well, once they see it. That idea of adding on—seeing an idea and saying, ‘Well, this is how I’d like to contribute,’ or ‘Oh, so I can do this with my own kid,’ or teachers, how they could see it, and getting other students interested.” *In response to question about equitable use of enrichment club (school-wide vs. targeted)* “Equity does not mean equal, and so there was, maybe my initial reaction of ‘Oh, it should be open to everyone, and that’s what equity is,’ I’m now questioning my own understanding of equity and access, and what it means to be equitable does not necessarily mean that everyone gets the same thing. It’s giving kids what they need, and if there are certain kids that need this, then there’s that, and I guess the equity piece is, ‘What do other students get that’s similar.’ I still need to think that one through... ..I have to think more about that in my thoughts, and my journey.”

Guest presenter impressions

Both guest presenters (field engineers) visited and shared information about their professions, schooling backgrounds, and applications of their work to projects students were working on. They shared that (collapsed):

“I thought the kids all seemed bright and had good questions; they all had some connection to the examples provided—they’d seen air conditioning, they’d seen building and cars, so they quickly connected to the examples. They were able to share some stories, themselves, that showed that they had an understanding of, that there were some career paths, already. I don’t think that they had connected the skills that they were learning directly to heating and cooling, at least not yet, but it seemed that they were getting it and that they were very curious about the different sensors and elements within the electronics that we were looking at.” “I was under the impression that [these students] had some sort of learning issues, but they all seemed bright enough to me to get what we were doing... ..Whether they had the work ethic to learn the skills, I don’t know, but if you tell them why they’re doing something and then you go do it, this might appeal to that group, whereas memorization of facts and figures may not appeal to them. They seemed very capable of learning skills, and I didn’t have any problem communicating with them.” “[These Fields] have a vast shortage of workers going into engineering, particularly students from the United States needed to work on American infrastructure, whether government or commercial. This is a labor market largely served by immigrants on visas... ..If you can get people trained and interested in anything engineering-related, it’s far greater than having them go into another service industry, or even software. Understanding the hardware side, understanding the connections between systems, can go a long way, and particularly as more processes and tasks get automated. This

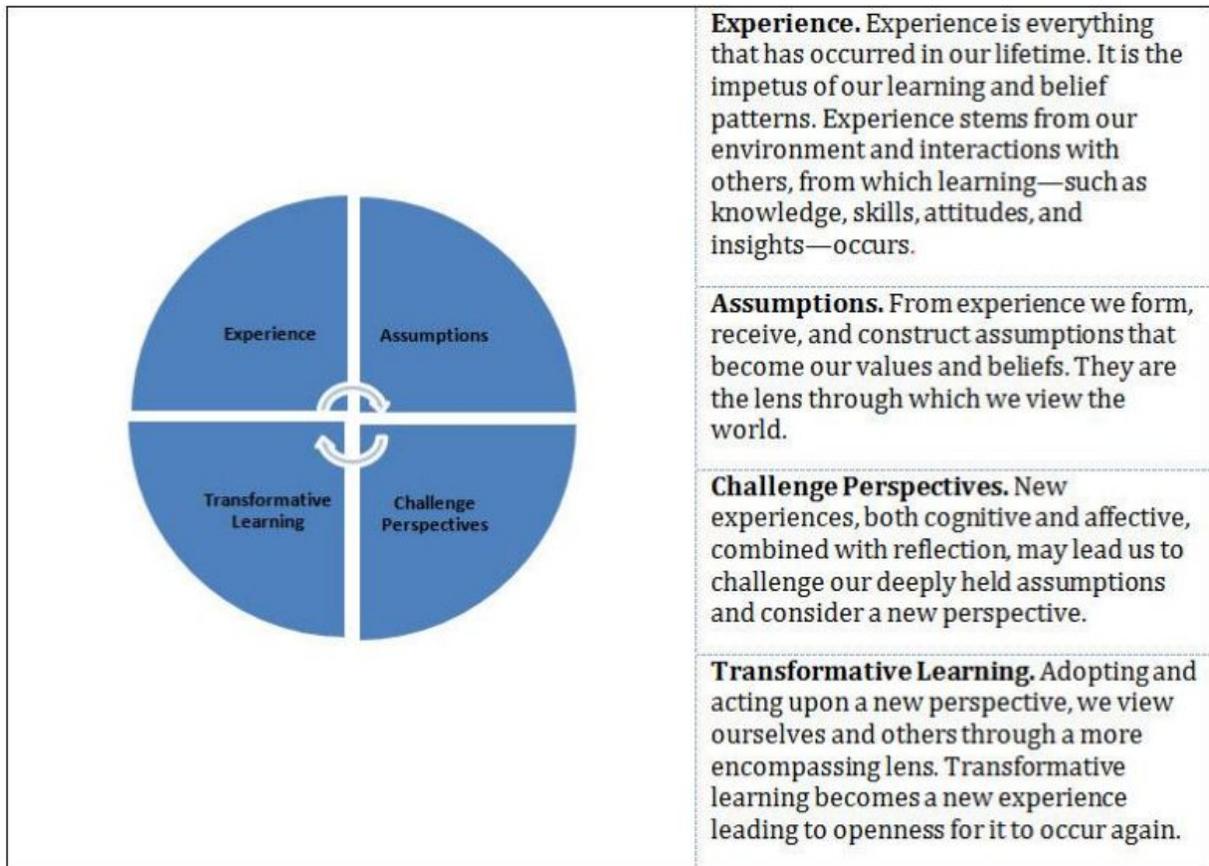
club lays the groundwork for some of those skills.” “The kids seemed really engaged, which I liked, and I think we all had a good time... ..They had a lot of really good questions.” “I would not have been able to tell that [students] had special learning need—if anything I was surprised by how engaged they were.” “Spreading awareness, just the fact that careers exist in these fields, is often lost on people. A lot of people think that electronics and radios and all that are magical devices that come out of the moon; this club helps to make those real life connections to these technologies.”

Implications of Proof-of-Concept Study

From this proof-of-concept study, a commonly emergent theme, between stakeholders, is the transformative effect that the club had on adult perspectives of participating students. While there is undoubtedly evidence for continuing the enrichment program for a targeted group of students, the researchers identify potential for focusing the research efforts on the transformative effect of such enrichment opportunities on the *adult*-stakeholders in students’ lives (attitudes, direct/indirect support of students, potential expansion of implementation efforts beyond a single school, etc.). In order to refine the research question, a secondary literature review was conducted.

Appendix B

Nerstrom Transformative Learning Model



Appendix C

Student Participant Recruitment Letter (Year One)

Date,

As part of your child's participation in the STEAM tech after-school club, I would like to invite you to participate in a related research study. As an Educational Leadership doctoral student at Virginia Tech, I am studying whether enrichment opportunities can help teach students new skills and career paths, improve student confidence, and improve performance in other classes. The results of my research will be used in my dissertation work, and possibly in publication.

If you give permission for your child to participate in this study, I will make observations and take notes on their experiences during the club; I will also access their student records, but I will not use or share any identifying information about them in any written work. Students will not be required to meet outside of club times, their participation in this study is voluntary, and their decision to participate will not affect their grades or their ability to be in the club. They have the right to stop participating at any time, and you have a right to withdraw them at any time.

If you would like your child to participate in this doctoral research study, please read and sign the **attached** permission form, and have your child write their name at the bottom. I would be happy to answer any questions you may have.

Sincerely,

Yannos Misitzis

STEAM Resource Teacher

Carta de Introducción para los Padres

Date,

Como parte de la participación de su niño en el programa del club STEAM después de clases, me gustaría invitarlos a que participen en un estudio e investigación relacionado con lo que hicimos en el club. Como estudiante del doctorado de “Educational Leadership” en la Universidad Virginia Tech, Yo estoy estudiando si las oportunidades de enriquecimiento, pueden ayudar a enseñar a las estudiantes nuevas habilidades y vocaciones, mejorar la confianza en sí mismos, y mejorar el desempeño en otras clases. El resultado de mi investigación será usado en mi tesis y posiblemente en una publicación.

Si usted le da permiso a su niño para participar en este estudio, yo hare observaciones y tomare notas de sus experiencias durante el club; yo también usare sus records, pero no usare su identificación en ninguno de los reporte. Los estudiantes no necesitaran reunirse fuera del tiempo del club. Ellos tienen el derecho de dejar de participar en cualquier momento y usted tiene el derecho de sacarlo del programa cuando quiera.

Si a usted le gustaría que su niño participe en esta investigación, por favor lea y firme el permiso adjunto, y haga que su niño escribe su nombre en la parte inferior. Yo estaré muy feliz de contestar cualquier pregunta que usted tenga.

Sinceramente,

Yannos Misitzis

STEAM Resource Teacher

Appendix D

Student Participant Informed Consent (Year One)

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent for Participants

in Research Projects Involving Human Subjects

Title of Project: Enriching Students through Technology Education

Investigator(s): **Yannos Misitzis**
Caitlyn Saxton
William Glenn
Jim Egenrieder

I. Purpose of this Research Project

The purpose of this project is to study and learn more about the process of teaching students computer and engineering skills. The activities done through this program will hopefully motivate students in other subject areas in school, and will give them the chance to learn more about job opportunities to pursue after graduation. The results of this research study will be used in dissertation work and possible publication.

II. Procedures

Should you choose for your child to participate in the study, the researchers will take informal notes about student and adult experiences in the STEAM tech club to help improve similar clubs for students in the future. The project will involve a small group of students (approximately six). No identifying or specific information will be collected or recorded about your child in the current project and only researchers will have access to school records or demographic information. Notes will be collected **during the club's regular meeting time** and the researcher on site will act in his capacity as a teacher while working with students. Students will not be audio- or video-recorded. Students will not be asked to participate in research outside of the regular club meeting times.

III. Risks

There is little to no known risk to your child in this study. Informally collected notes are being used to explore how effective this enrichment opportunity is for students, and will help the researchers study and improve similar opportunities for students in the future. Notes on student experiences will not contain any identifying information, and will be taken during the course of their regular club meetings.

IV. Benefits

The anticipated benefits to students include learning technology-based skills, potential motivation for students in other subject areas in school, and opportunities to learn more about job opportunities to pursue after graduation. The anticipated benefits to the researchers include learning about and improving enrichment opportunities for students in the future.

No promise or guarantee of benefits has been made to encourage you to participate.

V. Extent of Anonymity and Confidentiality

The identity of your child will only be known to researchers. No names or identifying information will be recorded with the notes, and notes will be maintained by participating researchers. At no time will the researchers release identifiable results of the study to anyone other than individuals working on the project without your written consent. In the unlikely event that a researcher suspects that a participating student is in danger, Virginia State law requires that appropriate authorities be notified.

The Virginia Tech (VT) Institutional Review Board (IRB) may view the study's data for auditing purposes.

The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. Compensation

There is no compensation for your child beyond potential academic gains from participation in the club.

VII. Freedom to Withdraw

It is important for you to know that you are free to withdraw your child from this study at any time without penalty. You and your child are free to not answer any questions that you choose, or not to respond to what is being asked of you, without penalty.

Please note that there may be circumstances under which the researchers may determine that your child should not continue in the study.

VIII. Questions or Concerns

Should you have any questions about this study, you may contact one of the researchers whose contact information is included at the beginning of this document.

Should you have any questions or concerns about the study’s conduct or your rights as a research subject, or need to report a research-related injury or event, you may contact the Virginia Tech Institutional Review Board at irb@vt.edu or (540) 231-3732.

IX. Parental Permission

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary permission:

_____ Date _____

Parent signature

Parent printed name

X. Student’s Assent

Please discuss the following with your child: A) The purpose of this study (studying the effects of enrichment opportunities on academic performance and motivation/self-esteem); B) The potential benefits (technology-based skills, potential motivation for students in other subject areas in school, and opportunities to learn more about job opportunities to pursue after graduation); C) The fact that data collected will be utilized in a dissertation study.

If your child agrees to participate in the study, please have them write their name, below:

_____ Date _____

Participant Name

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent for Participants

in Research Projects Involving Human Subjects

Title of Project: Enriching Students through Technology Education

Investigator(s): Yannos Misitzis

Caitlyn Saxton

William Glenn

Jim Egenrieder

I. Propósito del proyecto

El propósito es enseñarles computadora y habilidades de ingeniería, esperando que este programa pueda motivar a los estudiantes en todas las materias en la escuela, y les dará la oportunidad de tener una mejor idea de que carrera quieren hacer en el futuro. Estos resultados serán usados en mi tesis y posiblemente publicado

II. Procedimiento

Si usted desea que su niño participe en esta investigación, los maestros tomaran notas acerca de las experiencias de los estudiantes y los adultos en el club STEAM, que ayudaran a mejorar la participación de los estudiantes en clubes similares en el futuro. Este proyecto incluye un pequeño grupo de niños (aproximadamente seis). No se identificara ninguno, ni se usara información específica de cada uno. Notas serán tomadas **durante las clases regulares del club, y** los que trabajan en el Proyecto lo harán en capacidad de maestros. Los estudiantes que participen en este programa no lo harán fuera de las horas del club

III. Riesgos

No Habrá ningún riesgo. La información obtenida será usada para explorar que efectivo es esta oportunidad de enriquecimiento para los estudiantes, y nos ayudara a mejorar semejantes oportunidades para estudiantes en el futuro. Estas notas no incluirán ninguna información personal

IV. Beneficios

Los beneficios para los estudiantes incluyen en aprender habilidades basadas en ingeniería, motivar los estudiantes en las otras materias en la escuela, la oportunidad de saber que estudiar y las oportunidades de trabajos en el futuro. El beneficio anticipado es mejorar las oportunidades en el futuro para los estudiantes. La participación es libre no obligada.

V. Anónimo y confidencial

La identidad de su niño solo lo sabrá el maestro. No Habrá notas con el nombre de su niño. En ningún momento habrá información privada compartida, en caso de que exista algún peligro las autoridades serán notificadas, como lo exige la ley en Virginia

El grupo institucional (IRB) de Virginia Tech (VT) puede revisar la investigación con el propósito de auditoria. El IRB es responsable por la protección de los humanos envueltos en este proyecto.

VI. Compensación

No habrá compensación, solo lo que gana su hijo en la parte académica por participar en este Proyecto..

VII. Libertad para dejar el programa

Es muy importante que usted sepa que su niño se puede salir del programa en cualquier momento, sin ningún problema. Usted y su niño tienen el derecho de preguntar cualquier cosa relacionada con el proyecto y al mismo tiempo el derecho de no contestar algo que no desean contestar.

Por favor note que puede haber circunstancias en las cuales se puede tomar la decisión de que su niño no deba continuar en este Proyecto

VIII. Preguntas y Preocupaciones

Si usted tiene alguna pregunta, usted puede llamar a cualquiera de los nombres que están en la parte superior de este documento. Si usted tiene alguna pregunta o preocupación acerca de este estudio o necesita reportar algo relacionado con el programa, usted puede llamar al Virginia Tech Institutional Review Board a irb@vt.edu o (540) 231-3732.

IX. Permiso de los Padres

Yo he leído este formulario y las condiciones de este Proyecto. Y tengo todas las respuestas contestadas. Yo entiendo la información provista y doy mi permiso:

_____ Fecha _____

Firma del Padre

Nombre del padre en imprenta

X. Estudiante aceptación

Por favor explíquelo a su niño: A) El propósito del estudio B) El beneficio de participar en este programa;
C) Como será usada la información obtenida.

Si su niño está de acuerdo en participar en este estudio, por favor que escriba su nombre en la parte inferior.

_____ Fecha _____

Nombre del participante

Appendix E

Adult Participant Recruitment Letter

Date,

As a participant in the STEAM tech after-school club, I would like to invite you to participate in a related research study. As an Educational Leadership doctoral student at Virginia Tech, I am studying whether enrichment opportunities can lead to transformational experiences in the participants. The results of my research will be used in my dissertation work, and possibly in publication.

If you give permission to participate in this study, I will make observations and take notes of your experiences during the club, culminating in an audio-recorded interview. You will not be required to meet outside of club times with the exception of the reflective interview, your participation is voluntary, and you have the right to stop participating at any time.

If you give consent to participation within the scope of this study, please sign below. I would be happy to answer any questions you may have.

Sincerely,

Yannos Misitzis

_____ Date: _____

Participant Name

Appendix F

Adult Informed Consent

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent for Participants

in Research Projects Involving Human Subjects

Title of Project: Enriching Students through Technology Education

Investigator(s): Yannos Misitzis

Caitlyn Saxton

William Glenn

Jim Egenrieder

I. Purpose of this Research Project

The purpose of this project is to study and learn more about the process of teaching students computer and engineering skills, as well whether these enrichment opportunities can lead to transformational experiences in the participants. The activities done through this program will hopefully motivate students in other subject areas in school, and will give them the chance to learn more about job opportunities to pursue after graduation. The results of this research study will be used in dissertation work and possible publication.

II. Procedures

Should you choose to participate in the study, the researchers will take informal notes about your experiences participating in and/or supporting the STEAM tech club, to help improve similar clubs for students in the future. The project will involve a small group of students (approximately six) and supporting educators. No identifying information will be collected or recorded about you in the current project. Notes about your experiences will be collected **during the club's regular meeting time**. You will not be audio- or video-recorded during meeting times. During or after your involvement with the club, you

will be invited to participate in an audio-recorded interview to reflect on your experiences and thinking about the club.

III. Risks

There is little to no known risk to you in this study. Collected notes and interview data will be used to explore how effective this enrichment opportunity is for students, as well as its impact on participating adults, and will help the researchers study and improve similar opportunities for students in the future. Notes on your experiences will not contain any identifying information.

IV. Benefits

The anticipated benefits to the researchers and adult participants include contributing to the body of literature through learning about and improving enrichment opportunities for students in the future.

No promise or guarantee of benefits has been made to encourage you to participate.

V. Extent of Anonymity and Confidentiality

Your identity will only be known to researchers. No names or identifying information will be recorded with the notes or interviews, and data will be maintained by participating researchers. At no time will the researchers release identifiable results of the study to anyone other than individuals working on the project without your written consent. In the unlikely event that a researcher suspects that a participant is in danger, Virginia State law requires that appropriate authorities be notified.

The Virginia Tech (VT) Institutional Review Board (IRB) may view the study's data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. Compensation

There is no compensation beyond the stated potential benefits from participation in the club.

VII. Freedom to Withdraw

It is important for you to know that you are free to withdraw from this study at any time without penalty. You are free to not answer any questions that you choose, or not to respond to what is being asked of you, without penalty.

Please note that there may be circumstances under which the researchers may determine that you should not continue in the study.

VIII. Questions or Concerns

Should you have any questions about this study, you may contact one of the researchers whose contact information is included at the beginning of this document.

Should you have any questions or concerns about the study’s conduct or your rights as a research subject, or need to report a research-related injury or event, you may contact the Virginia Tech Institutional Review Board at irb@vt.edu or (540) 231-3732.

IX. Permission

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary permission:

_____ Date _____

Signature

Printed name

Appendix G

Cosponsors Interview Protocol

1. Describe your role in the tech club.
2. What did you find interesting about the club?
3. What surprised you about student participants?
4. How does a club like this impact students?
5. How has this experience made you challenge your own perspectives about students who receive special services?
6. How will this experience change how you practice, as a teacher?
7. What would you like other educators, who did not participate in this program, to know about technology-based enrichments for students receiving services?
8. What else would you like to share?

Probes:

- Tell me more about that
- What do you mean by that?
- Why do you think that?
- How does that make you feel?
- How does that relate back to (earlier response)?
- Did your perspectives change in any way based on your participation? (q.3, q.5)
- Will this experience transform your practices? (q.6)

Appendix H

Educational Leader Interview Protocol

1. How does enrichment impact students?
2. How can enrichment impact students who receive services, specifically?
3. How has your experience with this club challenged your perspectives about students receiving services?
4. How will this experience affect your practice, as a school leader?
5. What would you like other administrators, who were not exposed to this program, to know about technology-based enrichments for students receiving services?
6. How can educational leaders be incorporated into future growth of this approach?
7. What impact can a club like this have on the school community?
8. What else would you like to share?

Probes:

- Tell me more about that
- What do you mean by that?
- Why do you think that?
- How does that make you feel?
- How does that relate back to (earlier response)?
- Did your perspectives change in any way based on your participation? (q.3)
- Will this experience transform your practices? (q.4)

Appendix I

Guest Presenter Protocol

1. Describe your experience presenting to this club.
2. What did you find interesting about the club?
3. What surprised you about the participating students?
4. How has your experience with this club challenged your perspectives about special education?
5. How could enrichment opportunities like this be impact your industry?
6. What would you like other working professionals, who did not participate in this program, to know about technology-based enrichments for students receiving special education services?
7. What else would you like to share?

Probes:

- Tell me more about that
- What do you mean by that?
- Why do you think that?
- How does that make you feel?
- How does that relate back to (earlier response)?
- Did your perspectives change in any way based on your participation? (q.4)
- Can experiences like this impact industry practices? (q.5)