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Intervention and Self-Efficacy in Computing

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By

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Abstract:

While STEM fields have been traditionally male dominated, the last few years have seen a greater push to recruit more females into these majors. While this unbalance has been partially corrected, science, technology, engineering, and mathematics still seem to favor male participants. A relatively new approach to female recruitment is the use of STEM intervention practices to raise self-efficacy and counteract stereotype threat. This technique has successfully positively influenced attitudes of both male and female students as well as the teaching attitudes of early education teachers. The Bulldog Bytes camp serves as an intervention practice for raising the computer literacy of elementary age girls in the state of Mississippi. While the research on the effects of the camp is still preliminary, the results of multiple surveys conducted at the 2018 camps point toward a positive shift in these girls' computing self-efficacy as a result of the camp.

Introduction:

Every child holds a different view of himself, influenced by many factors. This view is reflected in each child's self-efficacy, or the confidence one has that one can perform a given task well, within every aspect of their life. Self-efficacy can be affected by many factors. From stereotype threat, or being so scared to prove a negative stereotype right that one underperforms and thus falls into the stereotype, to personal experience, children across America face any number of challenges daily that shape and influence their goals and dreams. For many young girls out there, this unfortunately means they are steered away from traditionally male dominated fields, especially science, technology, engineering, and mathematics. Over the course of many recent years, efforts have been made to counteract this push to encourage more females to enter these fields.

While great strides have been taken to reduce the gender gap in science, technology, engineering, and mathematics fields, it still exists and remains prevalent through the university system. A new trend in recruitment is various forms of intervention in an attempt to raise self-efficacy. The target of these intervention practices is often girls, ranging in age from late elementary school to high school. During the summer of 2018, the Mississippi State Computer Science department helped conduct a series of camps across the state called Bulldog Bytes.

The Bulldog Bytes camp series was a sequence of computing camps that focused on teaching elementary age girls about cyber security and introductory robotics. The camp tried to target a wide range of girls with various socioeconomic backgrounds. By targeting a diverse demographic, a survey conducted at these camps would create a decent cross section of self-efficacy of school age girls in the state. Thus, a survey was conducted twice, once at the beginning and once end of the camp in an attempt to gauge the girls' interest and self-efficacy within computing, and if the camp had an effect on it as a mode of intervention.

While many variables play a role in a child's self-efficacy, there is no set theory on how to improve someone's confidence within a specific field. This makes recruiting underrepresented demographics to science, technology, engineering, and mathematics hard, and allows for the majority to remain a majority. Something is dissuading females in particular from entering these fields, stagnating the size of the gender gap in computing fields in particular. An investigation into self-efficacy and intervention is thus needed to gain insight into what influences self-efficacy of children in relation to science, technology, engineering, and mathematics, and the potential effects of interventions on self-efficacy. This investigation includes a short analysis of various interventions conducted by other researchers to establish a pattern of effectiveness. The results of this investigation will then be applied to the Bulldog Bytes camp to try to determine the effectiveness of the camp as an intervention on self-efficacy.

Establishing a Need:

In 2012, the United Nations Educational Scientific and Cultural Organization published an in-depth study on gender equality within education. The study covered everything from gender-based dropout rates to religious influences on both genders' education. One aspect explored in this study is gender differences in various fields of studies. This study not only sites that women only make up 40% of higher education graduates in science in North America and Western Europe, but also that they only account for 21% of computing graduates. This is the lowest percentage of every region looked at. Surprisingly however, it does cite that women make up 60% of life science graduates in North America and Western Europe. Comparatively, they make up 57% of graduates in social sciences, business, and law in North America and Western Europe. Since women only make up 21% of computing graduates, that means males make up 79% of these graduates. Conversely, in the most female dominated field on the chart, social and behavioral science, women make up 64% of graduates, which is well below the 79% (UNESCO 81). This suggest at least some level of gender bias within most fields, toward both genders. However, even the female dominated fields have a significant number of males in it. This data demonstrates that students are somehow being pushed into certain fields, and a greater diversity across all fields is needed. The state of Mississippi is no exception to this trend. An analysis of the enrollment rates of both genders within the Mississippi State Computer Science department demonstrates the gravity of the gender bias in computing in the state. While female enrollment has increased from 44 students in fall of 2011 to 110 students in fall of 2018, these numbers are nothing compared to the 613 male students enrolled in fall of 2018. This is a 6:1 male to female ratio within the department, numbers that are much lower than the ones laid out by UNESCO's report.

Gender differences in achievement in STEM fields is also very common. Some studies claim these differences can be found as early as pre-k. Interestingly though, these gender differences often do not support male dominated STEM fields. While there is "limited consensus" on which gender is better at math, and how big the gap is, "gender differences, generally [favoring] males, in participation in mathematics and related areas continue to be considerable" (Forgasz et al. 371). However, while studies have also shown that at a young age, there is no difference in science performance, as students age "the trends in performance by science content area appear to align with gender stereotypes," that is females perform slightly better in life sciences, and males perform slightly better in physical science (371). While many sources cite these gender differences in STEM achievement, there is always an implicit bias due to stereotype threat and other influences. Through high school, many students take the same compulsory science and mathematics classes, and thus, no real participation or achievement difference should be seen until the university level.

Studies have been conducted to try to gain an understanding of what drives women to participate in STEM fields. The findings often offer "a complex model" that combines a number of various factors (McCarthy et al. 68). It is not a simple solution because this problem runs deep. There are complex associations ingrained into society that tie the "inquisitive, active, hands-on learners" typically associated with STEM fields with "tomboys" (68). Society has created these gender and stereotypical ties to activities and professions that limit interest to specific groups of people. Studies on stereotypes relating to science, technology, engineering, and mathematical fields indicate that children as young as six hold strong stereotypes that boys are better than girls in these fields. Not only that, but these stereotypes are stronger when they are about ability within robotics as compared to other STEM fields (Master et al. 100). These views have a great ability to influence a young students self-efficacy belief. By establishing intervention practices, the effects of stereotypes and other negative influential forces can be counteracted to bring more women into STEM.

Self-Efficacy, Potential Influences and Effects:

There exist countless pieces of literature relating to why women do not participate in science, technology, engineering, and mathematics in as high of numbers as men, as well as potential ways to recruit women to these fields. While many ideas have been put forth, one of the most valuable concepts proposed is self-efficacy. Not only does the concept of self-efficacy do a good job of helping researchers understand why STEM fields potentially lacks women, but it also explains why negative influences such as stereotypes have a strong impact on female students, and what steps can be taken to change that. Understanding self-efficacy helps explain many factors that could potentially get more women into traditionally male dominated fields.

The concept of self-efficacy is fairly straightforward. Self-efficacy is one's own belief about one's ability to succeed within a specific field. Self-efficacy does not directly reflect one’s actual ability. Albert Bandura posits that self-efficacy has a number of expectations, all laid out by performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal. Efficacy expectations are defined by Bandura et al. as “the conviction that one can successfully execute the behavior required to produce the outcomes” (Bandura 193). The idea is that efficacy expectations influence the action taken by every individual and are the expectations one has based on personal self-efficacy beliefs. Meaning, if a student believes she is strong in computing, she will be more likely to pursue computing related fields. The four categories that

Bandura lays out to represent different kinds of efficacy expectations try to explain how outside forces can influence personal self-efficacy. Performance accomplishments describe the expectations one has based on previous actions. If one makes a good grade on a test in a subject, one has positive expectations about one's performance in that subject. Vicarious experience would be expectations based on the actions of others. If one sees a similar student perform well, one expects that one also has the ability to perform well. Verbal persuasion is the expectations based on what someone outside of one's self tells them. If one's parent tells one that one is smart, one expects to perform well academically. Finally, emotional arousal describes any emotion-based expectations. That is, if one is stressed about a test, one expects to do poorly as the material appears so hard, it warrants stress. Bandura does a good job of laying out a groundwork for any proposed aspect of self-efficacy, as these categories are broad but descriptive. However, calling them expectations has the potential to be misleading as expectation implies that these are potential outcomes, not influences, while their definitions imply these categories are both influences of beliefs, as well as the potential outcomes. Bandura would have done better to call these categories more simply the four aspects of self-efficacy.

Researcher Guan-Yu Lin agrees with Bandura's assertion that self-efficacy is influenced by mastery experiences, vicarious experiences, social persuasion, and physiological states, obviously renaming the pillars Bandura laid out. Lin also expands Bandura's influences to more explicitly include personal physiological states. This gives credence to Bandura's hypothesis about the nature of efficacy expectations, without calling them expectations, which is appreciated. Lin asserts that mastery experiences influence self-efficacy the most. This seems logical as personal victories and confidence building activities add a level of comfort and achievement that only these hands-on experiences can build. Lin does a good job of clarifying

Bandura's expectations and connecting them to their meaning and how these expectations build self-efficacy. These four categories are incredibly important as they can help teachers give their students a wider range of self-efficacy building experiences, from support to mastery activities. Other concepts related to self-efficacy can define and defend their relatedness to self-efficacy based on these four categories as well.

These four categories point to stereotype threat as an important negative influence on self-efficacy. Jenessa Shapiro and Amy Williams define stereotype threat as the "concern or anxiety that one's performance or actions can be seen through the lens of a negative stereotype" (Shapiro et al. 175). They also assert that this threat impacts an individual's ability to perform well in the field which is targeted by the threat. The two researchers conducted a number of studies that tentatively determined that stereotypes about gender and race in relation to science, technology, engineering, and mathematics do in fact influence an individual's ability to perform well in STEM. For example, they cite that if a female student was asked about her gender prior to taking an exam, her score was reduced by 33% compared to a female student who was asked about her gender after taking the exam (176). Stereotype threat is a very interesting force that has the potential to greatly influence a young student's self-efficacy. The fact that this fear leads to reduced performance, thus confirming the fear, can convince a young girl that she is not capable of performing to the same standards as their male peers in STEM fields. If a young girl is exposed to these negative stereotypes, it has the power of completely changing her self-efficacy. A number of studies have correlated strong stereotypical beliefs about male dominance in STEM fields with lower female self-efficacy, one such study is outlined below in one of the case studies. One clear outcome from this particular study however demonstrated "that girls who held stronger stereotypes that boys were better than girls at programming and robotics had lower motivation, particularly lower self-efficacy" (Master et al. 100). Thus, stereotype threat holds an important influence on self-efficacy from performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal.

The most obvious way that stereotype threat relates to Bandura's four categories of expectations is its relation to verbal persuasion. These students are aware of stereotypes because of the words of someone else, whether it be a teacher, another student, or even a parent. They also are reminded of the threat at some point close to the activity to which the threat pertains. The example noted above where female performance was decreased if asked what her gender was prior to the test is an example of this type of verbal persuasion. By asking the student her gender, the test creators may be sending a subliminal message to the student that her gender is somehow linked to her performance. This message coupled with any negative stereotypes a student has heard create a self-efficacy expectation based on the words of someone outside the student. Statistics given to a student that support any negative stereotypes would indicate vicarious experience. The student's strong urge to disprove a stereotype would constitute her emotional arousal. The mastery experiences would then come on the tail end of a stereotype threat experience, as every time the student fulfills the stereotype, the more likely said student is to believe it. This then demonstrates the inherent connection between stereotype threat and motivation and self-efficacy. Additionally, these feelings start earlier than teachers may have anticipated, furthering the need for early STEM exposure and intervention practices.

Shapiro and Williams also describe two different types of stereotype threats, self-as-source and other-as-source. A self-as-source stereotype threat is a fear in one's own mind of confirming that one falls into the stereotype. Similarly, another-as-source stereotype is a fear of confirming to someone else, whether it be a peer, a teacher, a role model, etc. that one supports the stereotype. Shapiro and Williams outline some possible implications of the two different types. The authors cite that the internalization of the threat in a self-as-source case could lead to additional burdens or pressure on a young student about performance on an individual test. Similarly, a student who experiences other-as-source stereotype threat may "fear being a bad ambassador for women" if they fulfill a negative stereotype about women. (Shapiro et al. 179). While the difference in the consequences between self-as-source and other-as-source may seem subtle, if the type of stereotype threat present in a young girl's mind, knowing what her beliefs are may help to reverse it. The only way to reduce stereotype threat in self efficacy is to help an understand that the outcome of one test does not dictate their ability. Other-as-source stereotype threat is a good example of the effects of social persuasion on self-efficacy that Bandura and Lin outlined, while self-as-source is a good example of the effects of physiological states. This again, links stereotype threat and self-efficacy by definition. By connecting stereotype threat directly to self-efficacy via Bandura and Lin's proposed groups, a clear line of how stereotype threat becomes an efficacy expectation can be drawn. If one believes they must break the norm and thus stresses, the outcome will thus be affected. Shapiro et al. do a good job of outlining what stereotype is and how it could potentially influence students.

An interesting approach to understanding how to recruit females to STEM and raise their self-efficacy within these fields has been laid out by Raymond McCarthy and Joseph Berger in their paper "Moving Beyond Cultural Barriers: Successful Strategies of Female Technology Education Teachers." By interviewing a number of technology teachers, the pair attempted to determine what factors influenced a female's desire to go into STEM. They divided factors into four categories, "situation," "self," "support," and "strategies" (McCarthy et al. 67). The factors and their subfactors McCarthy et al. laid out are as follows: parental engagement/support and institutional support made up the support category; challenges and advantages formed the situation category; the self-category is comprised of conflicted gender identity, “tomboy” identity, active activity based learning, and inquisitive nature; the strategies category was formed by male role models, identity with roles associated with males, hands on, technology, and working toward over achieving (McCarthy et al. 69). McCarthy et al. assert that these factors, when integrated into technology education, will aid in recruitment of females to STEM fields. The team also suggested five steps to take to increase the frequency of these factors: increase diversity and diversity education in the classroom, educate boys and men on how to be positive role models and peers to everyone, increase familiarity and comfort for teachers with incorporating STEM fields into the classroom, incorporating more technology and engineering activities into early education curriculum, and finally, encouraging more males to become early educators to increase positive male role models (75-76). McCarthy and Berger believe that these factors and steps could increase female participation in STEM fields, and thus their self-efficacy.

McCarthy et al. have clearly done the work and have established a strong list of factors and steps that will help recruit females to STEM. Additionally, every step or proposed influence falls into one aspect of Lin and Bandura’s four efficacy expectations, giving their proposed solutions more credibility as there appears to be a clear pattern of influences. The steps about educating men on inclusivity and being a strong peer and recruiting more men to the early education field are particularly important. All fields need greater inclusivity, and boys need to build their peers up. However, there are some inherent problems with their model. A number of their proposed factors are stereotype based, and thus can have negative consequences on self-efficacy if not properly addressed. The major issue is that it ties female success with positive leadership from men, and by acting less feminine. There is no attempt to break stereotypical pattern or to educate women on how to be an actual woman within these fields. If these sorts of ideals were coupled with the outlined steps, not only would women feel more included, but the steps would work better. By recruiting men to early education, McCarthy et al. attempt to shatter male targeted stereotypes, but by associating female success in STEM fields with male leadership and acting more like a boy, they further female targeted stereotypes. These factors placed through the lense of the four self-efficacy expectations could be rewritten in a way that promoted more equality and gender performance differentiating. If this model extended to include educating young students about positive female role models, or that being in STEM and being feminine were not mutually exclusive, it would be an amazing example of various targets of potential interventions that could actually recruit young girls to STEM.

By exploring the impact an intervention practice has on self-efficacy, similar to how stereotype threat and recruitment changes can change self-efficacy, the potential effectiveness can be determined. Using the four self-efficacy expectations and examining how influences like stereotype threat are counteracted, a researcher can design and execute an intervention practice that holds the potential to greatly impact a young student's self-efficacy.

Intervention:

As any number of things can affect an individual's desire to go into a particular field, many types of intervention practices have been tried to recruit young girls to science, technology, engineering, and mathematics fields. While a common target of most interventions has been self-efficacy, researchers aim to affect various aspects of the four different self-efficacy expectations. Additionally, researchers have designed interventions that have targeted anything from teachers' teaching styles, the attitude of males to their female peers, and finally, the attitudes and skills of the young girls they are aiming to recruit. While the style and target of these interventions appear to be a mixed bag, the results vary in effectiveness just as much. For the purpose of this paper, intervention practices with a performance achievement target will be examined, as the Bulldog Bytes camp focused heavily on giving students STEM mastery experiences, and thus, a strong parallel can be drawn between each of these intervention cases and the camp. However, the first case mentioned targets a less expected demographic and targets verbal persuasion for variety. This paper will take a closer look at four relatively successful cases to help understand what makes an individual intervention practice successful.

In the first and perhaps the most interesting case of intervention, Catherine Riegle-Crumb, Jenny Buontempo, and Chelsea Moore investigate stereotype intervention on male students and how increasing their views of their female peers can improve female self-efficacy. This method specifically targeted verbal persuasion by increasing support in peers, but touches on each of the expectation categories as it is inherently linked to stereotype threat. This is a very interesting technique as the lack of females in STEM fields is very much a ‘female issue’ and addressing the men seems counterintuitive. However, outside influences have a unique influence on self-efficacy, and men need to view women as equal for them to feel equal. The researchers produced a paper on their male focused study called “Shifting STEM stereotypes? Considering the Role of Peer and Teacher Gender”. Riegle-Crumb and her team have found that “men are generally more likely to endorse” the negative stereotypes associated with females in science, technology, engineering, and mathematics fields than the women in those fields are (Riegle-Crumb et al. 493). They also noted that men working within STEM fields are the most likely to believe such stereotypes as they have the most to gain from believing men are naturally better at these fields. The study outlined in their paper targets high school engineering classes as science and mathematics classes are taken at equal rates by both genders. Since engineering classes are electives, this will not necessarily be the case. Additionally, the researchers found that engineering classes focused more on cooperative learning and projects than the mathematics and science classes did, allowing for more peer interactions.

The team trained teachers from 19 schools to create a standardized engineering class implementation. The class was project based, designed to encourage the students to work together and solve problems. Only seven of the nineteen teachers were female, and a significant number of students participating, in fact 262 out of 357 of them, were male. That means that less than thirty percent of the participating students were female. Since the class was an elective, 90% of students indicated a desire to go into STEM fields in college, however only 75% of female students wanted to pursue STEM. There was also "a modest correlation between percent [females] in the classroom and the presence of a female teacher" indicating that female students felt more comfortable signing up for an engineering elective when it was taught by someone of their same gender (Riegle-Crumb et al. 498). The students were given a survey to measure their belief in stereotypes supporting male superiority in STEM fields once at the beginning of the intervention, and once upon completion. The study found that if a high percent of females is present in the classroom, the male students who already generally disagreed with the stereotypes were even more likely to reject the negative stereotypes by the end of the course. The students who agreed with the negative stereotype remained unaffected. However, if the teacher was female, the male students who accepted the negative stereotypes at the beginning of the class were more likely to reject them at the end but teacher gender had little to no effect on the male students who already rejected the negative stereotypes. Thus, this intervention shows that male stereotype views can be adjusted via intervention, but the best way to do so is unknown, as different things work for students who hold different initial beliefs. This method of intervention, while effective, is clearly ambiguous in what set up creates the best results, and the effect on female students over all self-efficacy is unknown.

In their intervention study, Dr. Donna Cady and Dr. Steven R. Terrell introduced technology practices into elementary school science classes. The goal, like many of these interventions, was to see if more exposure to technology could improve the self-efficacy of the female students who partake in the intervention. At one elementary school, two classes were chosen, one to be the experimental group, and one to be the control group. Prior to the start of class, the students were asked to take *The Young Children's Computer Inventory (YCCI),* an established and relatively well-known survey, to gauge their self-efficacy. The control group taught science and technology classes as separate while the experimental group used technology to convey scientific concepts. Dr. Cady and Dr. Terrell's paper "The Effect of the Integration of Computing Technology in a Science Curriculum on Female Students' Self-Efficacy Attitudes" goes into a more specific breakdown of the week-by-week curriculum of the intervention.

The researchers choose to look specifically at questions pertaining to computer importance and computer enjoyment as they viewed those categories as being the most important to self-efficacy. This model of intervention holds a target expectation of both emotional arousal and performance accomplishments as the researchers aim to create positive and learning based exposure to these fields. Through their research, the researchers determined that "females in particular, understand the importance of using computer they are apt to want to use it, enjoy it, and invariably become more confident in their abilities" (Cady et al. 280). Their results found that the experimental group did in fact believe that the use of computers is more important. Alarmingly, the control group's survey answers indicated that their view of the importance of computers actually went down over the course of the eight weeks. The two scientists thus make the claim that not only did the experimental group's self-efficacy increase as a result of their deeper understanding of the importance of computers, but the control group's self-efficacy decreased. However, neither group's computer enjoyment changed. The team suggests that a longer study with more participants is needed to determine the true implications of their findings, but that it is obvious that for many young girls, traditional computing education is not enough. Because of the small scale of this study, a true impact of the intervention method cannot be measured, but the results are quite encouraging, as the intervention students appear to have both a greater mastery and more positive emotional connection to the computing material than the control group.

Some researchers, such as Allison Master, Sapna Cheryan, Adriana Moscatelli, and Andrew Meltzoff, aim to understand how motivation and stereotypes influence self-efficacy together and how intervention on both at once can change self-efficacy. They outline their intervention in their paper "Programming Experience Promotes Higher STEM Motivation among First-Grade Girls". By dividing just under 100 six-year-old students into 3 groups, the first group participating in a robotics exercise, the second in a storytelling exercise, and the third participating in no activity at all, the research team hoped to spark interest in some of the students. This model of intervention targets just performance accomplishments, as the goal is to measure the importance of exposure. After the intervention, the proctors measured technology motivation and STEM-gender stereotypes. The results were what the researchers predicted, with the young boys who participating in the robot activity scoring higher in interest and self-efficacy categories than the girls who also participated in the same activity. This suggests that the boys naturally had a higher computing self-efficacy as the results showed the robotics activity "did not significantly affect boys' motivation" as it did the young girls (Master et al. 99). Similarly, the girls who participated in the robot activity scored higher than the girls who participated in one of the other two activities. The results also indicated that at this age, the students believed that boys are better at programing and computing activities than girls, but did not hold these stereotypical views in relation to math and science. In fact, as mentioned above, both groups held significant stereotypes about boys being better than girls at robotics related activity. Because most of the stereotype data was collected post intervention, the researchers found it “unclear whether a brief experience of higher motivation for girls can translate into behavioral changes such as seeking out future opportunities in robotics and programming” (102). While the team found the impact of their intervention unclear, they did find that these strong stereotypes exists at a young age, which is a major problem, and that their results suggest “malleability” when these children are exposed to intervention practices (102). The fact that the team found that the students had the potential to be shaped by this type of intervention practice suggests that performance accomplishment targeted intervention alone may not be enough to correct the trend of lower female self-efficacy, but is a strong start.

The final case study investigated comes from a short paper entitled “Addressing Gender Gaps in Teens’ Cybersecurity Engagement and Self-Efficacy”, written by Laura Amo. This intervention practice is particularly important as it implements the GenCyber program, which is an important aspect of the Bulldog Bytes camp. This program is geared to help encourage and prepare students for cyber security fields. More specifics of the program will be discussed with the outline of the Bulldog Bytes camp. This particular intervention had thirty-four participants, roughly 30% of whom were female, aged 13-17 years old. The intervention focused solely on cyber security practices and took the form of a five-day camp, culminating in a defense simulation. Part of the mission of the camp was to get these students to participate in “hands on cybersecurity-related activities" (Amo 74), so the self-efficacy scores were measured prior to the camp and post simulation. The main focus of this camp is again, performance accomplishments. The results showed that the average self-efficacy scores of both males and females increased throughout the week. Not only that, but to begin, the male scores were higher, but poststimulation, the scores were roughly even. This seems to indicate that with proper exposure, there is no significant difference in self-efficacy between the genders, and that self-efficacy can be positively impacted by intervention practices. More importantly, this study shows that the GenCyber initiative can be effective, rendering the Bulldog Bytes a valid case for further investigation. This study is important because the researcher did not just focus on females, because it is just as important to nurture a young boy's self-efficacy. It also showed again that performance accomplishments remain to be effective self-efficacy intervention targets.

These specific case studies were selected as they were all relatively successful and focused on varying aspects of an overall STEM self-efficacy. They all however did target some aspect of performance accomplishments. Whether or not this is because that is the most effective, or because a lot of STEM requires hands on learning is undeterminable. That being said, all of these practices showed encouraging results because they fostered positive attitudes of the participants and showed a general trend of interventions being effective when targeting exposure to mastery experiences.

The Camp:

Established in 2013, the Bulldog Bytes camp series aims to educate young girls about computing. Educating participants in a wide range of computing topics, the camps were designed to serve as an intervention practice geared toward raising young girls' self-efficacy in computing related fields. A survey conducted in 2011, found that high school aged girls were already aware of gender inequalities in STEM fields (Lee et al. 1). Thus, the Bulldog Bytes camp series hopes to intervene in young girls computing self-efficacy “before adolescent opinions are formed that may discourage girls from” exploring computing fields and activities (Lineberry et al. 1). By integrating the National Security Agency’s Inspiring the Next Generation of Cyber Stars (GenCyber) program into these camps, the organizers of Bulldog Bytes hope to improve computing literacy in young girls. GenCyber allows K-12 teachers and students the opportunity to interact with cybersecurity topics in an attempt to raise interest and diversity in this field. GenCyber also hopes to promote safe online practices to create “good digital citizens,” as well as “improve teaching methods for delivery of cybersecurity content” (GenCyber). To achieve their goals, GenCyber is a no cost program open to any interested student. This camp was specifically designed to be an intervention practice used in a state with low female enrollment in computing fields, making it an ideal camp to study the effects of intervention.

The curriculum for the elementary ed camps, which are the focus of this study and paper, covers topics in computer programming, cybersecurity, and cryptography. For the programing aspect, the girls were taught how to use tools such as Finch robots and Snap!’s drag-and-drop interface. The girls were encouraged to progress through four levels in Snap!. In partnerships, the students used Caesar cipher to send messages to each other to understand cryptography. The campers were taught how to use Autopsy to recover deleted files to help them gain an understanding of file recovery and cybercrime. The students were also taught about email phishing, and then the students participated in an activity that demonstrated how phishing works. The girls also played two video games, SpaceScams and BruteForce, to learn about fake and phishing emails as a more relatable cyber security topic. The campers also learned about passwords and how to enhance their strength through these video games. The girls also created posters and papers on internet safety to close out the camps, as well as learned how to use "howsecureismypassword.net" to check their password strength. The girls also were tasked with creating a design programming project. On the final afternoon, the girls were able to show family and friends their programming projects to demonstrate the completeness of their intervention education. As the curriculum demonstrates, this camp specifically targets performance accomplishments.

Qualitative surveys conducted in past years suggests that the camp has the potential to be an effective intervention option. During the 2013 camp, some campers were asked if the program "increased your confidence in" the computing topics covered or if the program "changed your ideas about your future" (Lee et al. 3). While the results were obviously highly qualitative and thus open to individual interpretation, a few notable answers were given. While the majority of the answers to the first questions appear to be very superficial answers about general computing skills, one girl answered that her "social skills had increased." Not only were social skills one of the skills mentioned in the question, but it is not the clear target of the camp. However, this is an important thing to note as the "non-technical activities during the camp provided an environment where the girls could interact socially in a safe girls-only environment" (Lee et al. 3). The emotional arousal expectations of self-efficacy can be strongly impacted by environment and, if this camp creates a safe place for these girls to grow and learn together, it can help negate the negative forces acting on their self-efficacy in other aspects of their life.

The answers to the second question were encouraging as well. Out of the answers published, a strong majority suggest that the camp impacted their self-efficacy in a positive way as one response suggested the girl is "more open minded [about a] major in technology now" (Lee et al. 3). However, some answers were vaguer as to whether or not their experience was positive. One camper simply stated that the camp gave her “a better grasp on what [she wants] to major in” (Lee et al. 3). From her statement alone, no conclusion can be drawn about if her computing self-efficacy is stronger or weaker, only that it changed. This confusion underlines the weakness of qualitative and open-ended survey questions. Thus, a more in depth look at the effect of the camp on self-efficacy is needed, something quantitatively based, and thus measurable.

In past years, the camp has been held in only a few locations. However, in 2018, the year this data is from, the camp was able to expand to six communities across the state of Mississippi. With the expansion also came the shift from being a residential camp to a day camp. This change in structure holds a potential influence over the participants as well, as some of the girls may be more or less interested in participating, and a day camp structure may be more financially feasible for a larger number of families. The scale and structure of the camp now, coupled with the design of the curriculum and past survey results make it an ideal intervention practice during which to study the effects of intervention on self-efficacy.

The Surveys and Methods:

To try and gain an accurate gauge of self-efficacy and how it changed due to the Bulldog Bytes camp, two surveys were conducted. The first survey was conducted twice, once at the beginning of the camp, and once on the final day. The second survey was conducted via mail a few months into the girls fall semester of school. The surveys conducted in camp served as a gauge of the girl’s self-efficacy during the camp. In order to get an accurate account of the change in self-efficacy, only the results of girls who completed both pre and post surveys in entirety were used. The follow up survey served to gauge whether or not the girls felt as though the camp helped them succeed in the classroom as well as whether or not they enjoyed the camp enough to want to go back. Since the post survey was sent via mail, the parents not only had to consent to giving the girls an additional survey, but also email in their mailing addresses. As a result, the girls whose data was included in the results from the first two surveys are not necessarily the same as the girls whose data was used in the follow up survey, allowing a wider cross section of girls to be examined.

For the first survey, we wanted to make sure that the questions had been tested and served as a valuable tool to gauge student's feelings and motivations. We chose to use variations on the survey laid out by Brenda Capobianco, Brian French, and Heidi Diefes-Dux in their paper "Engineering Identity Development Among Pre-Adolescent Learners". With approval by the Institutional Review Board, the campers were given one of two surveys based on the survey laid out in the aforementioned paper, based on age. The questions came directly from the paper by Capobianco et al., with the only differences being a modified length for the younger kids, and how the age groups selected their answers. The younger kids were given a shorter survey and asked to bubble in a face that represented how they felt about each statement, either a neutral face, a sad face, or a smiley face. Each face was assigned a point value, 1 for the sad face, 2 for the neutral face, and 3 for the happy face for a total of 15 points. The older group of kids were given the complete survey laid out by Capobianco, French, and Diefes-Dux and asked to circle "yes" if they agreed with the statement, "no" if they disagreed, or "maybe" if they were unsure. The answers were assigned the same point value for a total of 60 points. The points for each student were then summed for each individual. At the end of the camp, this process was repeated.

Forty-six of students completely filled out both the pre and post survey, and their scored were compiled. A difference in score was then calculated for each of those forty-six girls. The average difference in score was also computed. This survey was chosen because it not only measures each student's self-efficacy relating to computing and STEM fields, but also her understanding of the role of engineers, these questions acting as a measure of vicarious experiences. The other statements mainly target performance accomplishment expectations, which was the focus of the camp, however some statements reflect emotional arousal as well. The statements are noted in the chart below. Statements one through five were for the younger students, who comprised of thirty one of the forty-six collected surveys.

Survey One Statements
1. I do my school work as well as my classmates
2. I am good at solving problems in mathematics
3. I am good at solving problems in science
4. I use computers as well as my classmates
5. I am good at working with others in small groups
6. I like being a student at my school
7. Being a student at my school is important to me
8. I make friends easy at my school
9. The teachers at my school want me to do well in my school work
10. Engineers solve problems that help people
11. Engineers work in teams
12. Engineers design everything around us
13. There is more than one type of engineer
14. Engineers use mathematics
15. Engineers use science
16. Engineers are creative
17. When I grow up, I want to be an engineer
18. When I grow up, I want to solve problems that help people
19. When I grow up, I want to design different things

20. When I grow up, I want to work on a team with engineers

For the follow up survey, a new survey was drafted so that questions specifically targeted the girls' feelings about the Bulldog Bytes camp. While the initial goal of the original two surveys was to gauge the girls' self-efficacy, this survey attempted to gain insight into the long-term effects of the camp on self-efficacy. The statements aim to reflect both self-efficacy of the girls in science, technology, engineering, and mathematics as well as the girls' feelings about the camp. It serves more to understand the effectiveness of the camp as an intervention practice on self-efficacy by determining if the girls still hold a high self-efficacy score and positive attitude about the camp. The target of this survey is a mix of emotional arousal and performance accomplishments because the team wanted a more complete understanding of the student's self-efficacy beliefs. A total of twenty campers participated in this survey. The girls' who participated had the option to say how they felt about each statement by circling "no", "yes", or "maybe". Answers were scored as follows: two points for "yes", one point for "maybe", and zero points for "no", for a high total of twenty possible points. The statements are listed in the chart below.

Follow Up Survey Statements
1. I like school this year
2. My math class is fun
3. My science class is fun
4. We use computers in school
5. I want to be computer scientist when I grow up
6. I want to do a Bulldog Bytes camp again
7. I am safe on the internet
8. I want to work with robots again
9. I enjoyed the cybersecurity camp
10. The things I learned at the camp are helping me with school this year

The Results of the Surveys:

After collecting the surveys, each score was calculated. The table below lists each individual's pre and post test score, along with the difference between the two.

Student Number	Pre-Test Score	Difference	Post Test Score
1	48	2	50
2	14	0	14
3	46	6	52
4	59	0	59
5	60	0	60
6	56	-3	53
7	54	2	56
8	53	0	53
9	58	-38	20
10	15	-3	12
11	45	0	45
12	11	0	11
13	11	2	13
14	14	1	15
15	54	4	58
16	50	-1	49
17	51	1	52
18	13	-2	11
19	13	0	13
20	13	2	15
21	14	0	14

22	15	0	15
23	13	0	13
24	15	0	15
25	14	1	15
26	14	-5	9
27	48	9	57
28	52	0	52
29	51	-1	50
30	13	0	13
31	13	1	14
32	14	0	14
33	15	-1	14
34	15	-3	12
35	11	0	11
36	13	1	14
37	15	0	15
38	11	2	13
39	10	3	13
40	15	0	15
41	12	1	13
42	15	0	15
43	14	1	15
44	14	-1	13
45	14	1	15
46	14	1	15

As the table shows, the pre-test scores and post-test scores are both high. While the average difference between the two indicates that self-efficacy scores went down over the course of the computing camp, the average difference, at -.37, is not even half a point. However, looking at the individual scores, the camp had a clear impact on some of the individuals. The highest positive score difference was a jump up of nine points, and the highest negative score difference was a jump down of thirty-eight points. Because of this, a more in-depth look at the individual self-efficacy scores is needed. A select few of the students' answers will be looked at in an attempt to understand the implications of the results.

Students 3, 9, and 13 all had very interesting score breakdowns. Camper 3 experienced a six-point score increase from pre-survey to post survey. This camper changed her answer from "no" to "yes" on statements 7, 18, 19, and 20. This is an important change as these statements are "being a student at my school is important to me," "when I grow up I want to solve problems that help people," "when I grow up I want to design different things," "when I grow up I want to work on a team with engineers" respectively. All of these statements are important to the student's STEM self-efficacy. The camper's change in answer to these four questions indicates that her enjoyment of STEM fields increased throughout the course of the camp, and thus her self-efficacy increased as well. Her posttest answer of "yes" to statement 20 in particular indicates she values her own work and ability enough to work with engineers. Unfortunately, she also changed her answer from "yes" to "maybe" on 4 and 13. Her change in answer for statement 13, "There is more than one type of engineer" is most likely the result of slight confusion about engineers since the camp focused on computing relating fields. However, the change in question 4, "I use computers as well as my classmates" is slightly alarming as one goal of the camp was to improve computer literacy. That all being said, her self-efficacy score did increase, and she showed an overall more positive attitude toward STEM fields in her post survey. A discouraging case from this camp was student 9. Her answers changed from all “yes” or “maybe” to all “no,” resulting in a drop-in score pre to post of 38 points. It is impossible to tell why the camp had such a negative impact on the student, but it obviously did. She had one of the highest scores of 58 in the pre-survey, indicating she went into Bulldog Bytes with a relatively high STEM self-efficacy. If the average difference in self-efficacy score excludes this outlier, the difference is actually a positive change of .47 points. This means that student 9’s strong negative reaction had a large impact on the overall self-efficacy score. Not only is this an unfortunate result, but it is also incredibly discouraging. It also reflects the fact that one child’s negative reaction can bring down the moods and attitudes of those around her. The camp clearly had the potential to be both beneficial or harmful.

Student 13 is the only one out of this list who took the shorter version of the survey. The only one of her answers that changed was her answer to statement 4 “I use computers as well as my classmates,” indicated the camp increased her comfort in her ability to use computers. She selected the sad face on the pretest, and the smiley face on the post test. Interestingly, she chose the smiley face for statements 1, 2, and 5 on both surveys, but chose the sad face for question 3, “I am good at solving problems in science” on both. This student clearly benefited from the camp as her computing self-efficacy increased, reflected by her change in answer on statement 4. This young camper gained enough computer literacy skills to give her the courage and confidence to think that she is now as good on the computer as her peers. This change in and of itself is what the camp was about, to help girls gain confidence with computers.

It is also important to consider that students 2, 4, 5, 8, 11, 12, 19, 21, 22, 23, 24, 28, 30, 32, 35, 37, 40, 24 all experienced no change in score from the pre to the post test. That means that the intervention had no effect on almost 40% of students. However, a number of students from this list, students 5, 22, 24, 37, 40, 42 all achieved perfect scores for their versions of the test on the pre and posttest both. Student 11's score breakdown was very interesting. While she achieved the same relatively low score of 45 on the pre and posttests, her answer to six questions changed pre to post. Her answers on statements 3, 11, and 19 all changed from "yes" to "maybe". Statements 3 and 19 both regard the student's personal feelings, and statement 11 regards the student's understanding of engineers, so the changes here indicate that the camp did negatively impact her self-efficacy in some ways, as this relates to her vicarious experiences expectations as well as performance accomplishments and emotional arousal. On statement 9, she jumped from "maybe" to "yes", and on statements 1 and 4 the camper adjusted her answer from "no" to "maybe". The change on statement 9, "The teachers at my school want me to do well in my school work" would seem to indicate the camp experience positively changed the way student 11 views the actions of her teachers, a verbal persuasion expectation. Statements 1 and 4 both relate to the student's view of her own ability, so the increase in score indicates a slightly higher self-efficacy as this fall into the category of performance accomplishment expectations. At the end of the day, while her self-efficacy appeared not to be influenced by the camp, student 11 was changed by the experience. She is more confident in some aspects of STEM learning, and less confident in others. Whether or not these two things balance each other out can only be determined by the student herself.

In fact, the small difference in the average measured self-efficacy between the pre and post test scores are why the third survey was mailed out. These results were not compared against anything but still held valuable results. With an average score of 17.68 out of twenty, a high score of 19, median score of 18, and a low score of 15, the positive attitude of the girls toward the camp, their strong self-efficacy in computing, and the need for these girls to be competent at an early age in computing skills is evident. The exact results, including the scores for each individual statement, are shown in the table below.

Child	1	2	3	4	5	6	7	8	9	10	Total
A	2	2	2	2	1	2	2	2	2	2	19
B	2	2	2	2	1	2	2	2	2	2	19
C	2	2	2	2	1	2	2	2	2	2	19
D	2	2	2	2	1	2	2	2	2	2	19
E	2	2	1	2	0	2	2	2	2	1	16
F	2	2	1	2	0	2	2	2	2	2	17
G	2	2	2	2	0	2	2	2	2	2	18
H	2	2	2	2	0	2	2	2	2	2	18
I	2	1	2	2	1	2	2	2	2	2	18
J	2	2	1	2	0	2	2	2	2	1	16
K	2	2	2	2	1	2	1	2	2	2	18
L	2	2	2	2	0	2	2	2	2	2	18
M	2	2	2	2	1	2	2	2	2	2	19
N	2	2	2	2	1	2	1	2	2	2	18
O	2	2	2	2	1	1	2	2	2	2	18
P	0	0	2	2	1	2	2	2	2	2	15
Q	2	0	1	2	1	2	2	2	2	2	16
R	2	1	2	2	1	2	1	2	2	2	17
S	2	2	2	2	1	2	2	2	2	1	18

To get a deeper understanding of the results presented, the statements were then grouped by type as follows: feelings about the camp, 6, 8, 9, 10; feelings about self, 1, 2, 3, 4, 5, 7; and need for computer knowledge, 4. Notice however, that some of the statements can fit into multiple groups, specifically statement 7, “I am safe on the internet” can also be grouped into “need for computer knowledge” and statement 8, “I want to work with robots again” could also fall under the “feelings about the camp” group. It is also important to look at the individual results of student “P”, who holds the lowest score, to see if her lower self-efficacy is connected to one of these specific groups of statements. By looking at this, it may become clear as to why this particular student has a lower score than her peers.

Generally speaking, it appears as though students hold positive feelings about the camp. Every single survey participant indicated they agreed with statement 8, “I want to work with robots again,” and statement 9, “I enjoyed the cybersecurity camp,” by selecting the “yes” answer choice. Similarly, only 1 participant, student “O” did not choose the “yes” answer on statement 6, “I want to do Bulldog Bytes camp again” and student “O” did select “maybe” and not the “no” choice. A couple more students selected “maybe” on statement 10 “the things I learned at camp are helping me with school this year”, but again no one selected “no”. These results seem to indicate that the girls hold highly positive feelings about the Bulldog Bytes camp.

The lowest scoring camper was camper “P” with 7 “yes” answers, 2 “no” answers on statements 1 and 2, and a “maybe” on statement 5. Statements 1 “I like school this year” and 2 “my math class is fun” tell more about the student’s enjoyment of class currently, and less about the impact of the camp on her self-efficacy, however, are still important to consider when looking at her STEM self-efficacy. Despite having the lowest score, student “P” answered “yes” to every question about her feelings about the camp and had a high over all. Five of the girls tied for a high score of 19. All of the girls selected “yes” for every statement except statement 5, “I want to be a computer scientist when I grow up,” to which they selected “maybe”. The fact that the highest and lowest scores were only four points apart also speaks to the strength of these girls overall self-efficacy.

Discussion Implications of Results:

While the small difference in score seems to indicate that the camp was ineffective as an intervention practice, a closer look at the individual scores contradicts that conclusion. Self-efficacy by definition is an incredibly personal thing and a number of girls were directly influenced by the camp. The small difference can be attributed from a number of things from the fact that the vast majority of the students took the shorter version of the survey, to differences in the individual camps. However, the individual responses hold important insights. Student 13 for example, only changed one of her answers from the shorter pretest to the shorter posttest. Student 13 indicated that before the camp, she associated the sad face with statement 4, but after the camp, she chose the happy face. This highlights the camp's ability to give the students more confidence with computers through performance accomplishments since statement four is "I use computers as well as my classmates". This question is directly related to performance accomplishment, the expectation category that Bandura and Lin identified as the most important expectation on self-efficacy. Thus, even though this student had only a 2-point difference between the two surveys, her self-efficacy in computing notably increased. As stated in the results section, student 13 is a prime example of the potential benefits of a camp such as Bulldog Bytes. These forms of intervention practices are just supposed to raise young students' confidence in science, engineering, and technological fields so that a wider cross section of student's choses to go into one of these fields. Student 13 may not necessarily become a computer scientist when she grows up, but now she believes she has the computing skills to succeed in her classes.

Student 9 not only had the biggest change in score, but her outlier difference caused the average difference to be almost a whole point lower. This student had a bad time at the camp for whatever reason, and it is reflected in one of the most critical numbers pulled from this study. The goal of the camp was to help students realize their potential in computing, whether that be simply raising their computing literacy or spark a love for technology. It is unknown as to why this young lady's score was affected in such a discouraging way, but it can be said that the camp failed her. A number of actions can be taken to make sure that no other student reacts in this way, as it is clear that the camp has the potential to do better than bad. Further data would be needed however to determine more specifically how and why this student was affected in the way she was. If more information were pulled on this particular student's experiences at Bulldog Bytes, a plan could be taken to help prevent such a negative response from happening again. The results of this outlier need to be considered, however the surveys conducted and the results indicated by the student cannot tell the whole story.

In cases like student 11, the camp had both positive and negative impacts on the student's self-efficacy. While this is not ideal, the camp most likely will help the student make an informed decision about her future when the time comes. Intervention practices like these should not aim to recruit all students, but instead, the intervention instances should help educate the student on the possibilities that STEM fields hold as well as help the student understand what her strengths are. Students like student 11, whose scores appear to not have changed at first glance, are impacted in this way. Student 11's feelings toward her ability in certain fields changed throughout the course of the camp, indicating that she did gain a better understanding of her abilities, even if part of that means some of her overall score decreased.

Looking back to the results from the follow-up survey, the questions pertaining to feelings about the camp hold valuable insights. The scores are generally high, suggesting that all the girls who participated in this survey hold positive self-efficacy feelings about computing, school, and the camp. These results may be slightly skewed, as this survey was open only to those girls whose parents responded to the team's request for participants. The generally positive attitude of the young ladies toward the camp would indicate that the camp had a positive impact on the girls' emotional arousal expectations. Enjoyment is a major part of this self-efficacy expectation category, as it often lends to the student's motivation to participate in the field. The majority of the girls indicated they want to participate in the camp again, suggesting again a high self-efficacy in relationship to the material presented in the camp. This is why it was important to look at the emotional arousal expectations, as these girls clearly held positive emotional responses to the camp as well as the material. Since that is a major aspect of self-efficacy, it can be concluded that the young students' positive emotional responses indicate a higher level of self-efficacy as a result of their Bulldog Bytes experience.

The camp appears to be an effective intervention on these young girls' self-efficacy. The group had a strong mix of various different self-efficacy scores going in, and a lot of girls showed growth in their scores. Every single girl who submitted a follow up survey submitted a high scoring survey, and many girls had scores that reflected amazing self-efficacy. While some of the scores in the initial two surveys did decrease, it is important to keep in mind that not every child's path is to go into a science, technology, engineering, or mathematics field. Similar to the interventions mentioned in the literature review sections of this essay, a focus on developing better performance accomplishment expectations appears to aid in the camp's potential as an effective tool. With only one score decreasing alarmingly, it can be concluded that the camp was overall an effective self-efficacy intervention practice.

Hopeful Future Research:

The structure of the camp seems to be well set up for an inclusive self-efficacy intervention. These girls enter into a community that allows for them to grow and learn together. Because of this, every aspect of the self-efficacy expectations can be influenced. A more extensive survey can be conducted to measure the impact this camp has on all of these expectations individually. The survey used for the pre and post survey does a better job of gaining a better understanding of the girls' self-efficacy, but the follow up survey focuses mostly on performance accomplishment expectations. A new survey that mixes these strengths can be created to help gain a better understanding of the girls' self-efficacy expectations. The first survey can be slightly tweaked so each of the four self-efficacy expectations can be clearly seen, then grouping the survey into categories based on which expectation they reflect, as well as rewording them to be clearer, will help. Statements such as statement 1, "I do my school work as well as my classmates," may hold conflicting results as some girls may be comparing their work to their school classmates, and others may be comparing their work to the other campers. Further experiences can be created from there to help these girls look to the camp leaders and each other to gain better self-efficacy. As the results demonstrate, these camps have the power to impact individual students. However, to truly understand the potential the camp has, the same instrument must be used to be able to draw strong, consistent conclusions. By gaining an understanding all aspects of the four expectations of self-efficacy that it impacts now, the Bulldog Bytes camp series can grow and build on this and thus fulfill all of the potential it has.

Another aspect that needs to be studying is how the girls who attend these camps interact with stereotypes. One of the biggest downfalls of this study is the lack of information on prevailing stereotype threat in the camp. Bulldog Bytes is a female only camp, which is going to have an interesting impact on the influence of negative stereotypes. Not only does the camp target girls, but it also attracts a number of girls of various ethnic backgrounds. The proximity of some of the camps to the university allows for increased diversity. Some of the camps also take place in predominantly minority communities. A large cross section of demographics attends these camps, and there are a number of stereotypes relating to ethnic minorities in STEM fields as well. It is unclear as to whether or not these girls are aware of the negative stereotypes that surround females in STEM fields, and that makes it unclear as to how these girls interact with those stereotypes and how they react to the threat. These girls have to notice the lack of male participants in this day camp, and have to wonder why. A good extension if these surveys continue would be to determine the effects of stereotype threat on these girls and how that impacts their self-efficacy. While a strong number of the girls start with a strong score, a number of them start with a more mid-range score, and it would be interesting to see how those girls are impacted by some of these more negative views of girls in science, technology, engineering, and mathematics.

The results from the follow up survey indicate that a number of the girls have confidence in the classroom. It would be interesting to gain a measure of how much of this confidence can be attributed to the Bulldog Bytes camp experience. One of the survey statements was "the things I learned at the camp are helping me with school this year" which does start to touch on this. However, that too can be expanded. Surveys that include statements such as "I am more confident with technology because of the camp" and other simple things like that can help researchers more fully measure the impact of the camp. Confidence in skills is a part of self-efficacy that falls under the expectation of performance achievement, as confidence in skill often comes from an established pattern of success.

A large amount of work has been done to make this camp series as impactful as it already is. It has not only expanded across the state, but also grown in size. The results already conducted have not only shown what the camp is, but what it could be. By gaining an understanding of every expectation category, the influence of stereotypes, and the amount of confidence each girl gets, the camp can grow more than it already has to reach its full potential as an intervention source.

Conclusion:

At first glance, self-efficacy seems to be an amorphous and quite intimidating topic. By dividing self-efficacy influences into the four self-efficacy expectations, a clear path of investigation can be derived. These expectations make things like stereotype threat more understandable and approachable as well as improve proposed intervention strategies. Overall, a pattern of success can be seen throughout self-efficacy interventions, specifically ones that target improving performance accomplishment expectations. Not only that, but negative stereotypes can be changed. These results indicate a potentially strong tool to recruit more females to STEM fields as well as prepare everyone for a more technologically plugged in future.

Created to increase computing literacy, self-efficacy, and technology interest of elementary school age girls in Mississippi, the Bulldog Bytes camp has a carefully crafted curriculum built around the NSA's GenCyber program. Surveys conducted at the beginning and end of the camps, as well as a few months prior aimed to gain a better understanding of the participants' self-efficacy. The results were mostly encouraging, suggesting that the camps are an effective intervention strategy. Many things could be done to improve the camps, including further studies on the affect the camp has on self-efficacy, or even stereotype threat. The Bulldog Bytes camp has the potential to be an incredibly powerful intervention and recruitment tool in the state.

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