Introduction: Mitch Resnick said it best, “the ability to code, like the ability to read and write, is becoming essential for full participation in today's society”[1]. Historically, computing fields have suffered from underrepresentation of women and minorities despite over 50% of students entering college are minorities and women [2]. Many research, educational, and corporate outreach efforts have focused on addressing these issues by creating opportunities for students engage in computing activities and preparing them to enter computing careers. Despite these efforts, there are still too few underrepresented students pursuing a computer science degree because they do not personally identify themselves as being a computer scientist [3]. Since students begin exploring their personal identity and career interests in middle school, it is crucial to help female and minority middle school students begin identifying and developing computer science skills so that the will be motivated to take courses in high school and choose computer science as a major in college.

Intellectual Merit: The results of this work will contribute to the efforts of broadening participation within computer science by providing a resource to give students an intrinsic motivation to pursue a computer science career through targeted CS skill development based on personalized student needs. This work will advance knowledge by providing valuable insight by identifying internal skills that a student possess and match them with specific skills within the computer science field. This research could also be applied to address the misconceptions they have of themselves of not having the adequate skill set to be a computer scientist. Figure 1 outlines the research objectives for this study.

Methods: For this study, I propose to develop a framework for aligning students’ existing skill, abilities, and disposition to computer science skills and disposition so that the student can realize the value they personally can bring to the computer science field. This system will use two youth development theories as a foundation, Zone of Proximal Development (ZPD) and Positive Psychology through StrengthQuest (SQ) an evidenced-based assessment used by 1,985,135 students to date [4]. ZPD is defined as the skills and concepts that are not yet fully developed but are on the edge of emergence, emerging only if the child is given appropriate support. ZPD is often used as a framework for designing scaffolding in learning environments [5]. Positive Psychology is the scientific study of the strengths that enable individuals to thrive [6]. I will use SQ an as a foundation for developing a framework for aligning students’ existing skill, abilities, and disposition to computer science skills and computational thinking disposition. To align CS skills and disposition to the SQ assessment, I will have experts in various CS sub-disciplines take the assessment and align their results to various learning modules. The learning modules will be selected from existing middle school computer science curriculum modules that focus on the basic skills required to function as a computer scientist (such as Code.org’s Hour of Code and middle school curriculum or Google CS-First). The training modules will provide students with personalized instructional scaffolding through allowing students to interact with a virtual human. This environment will challenge the

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<tr>
<th>Objective 1</th>
<th>To what extent can existing general skills and disposition inventories be aligned to specific computing skills and dispositions to accurately measure students' abilities?</th>
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<tbody>
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<td>Objective 2</td>
<td>To what extent can computing activities for each of the sub disciplines be developed to foster computer science conceptual understanding, a realistic picture of the careers and skills needed?</td>
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<td>Objective 3</td>
<td>To what extent can a system designed to connect students strengths to a computing discipline and provide related activities to increase students’ perceptions of computing and their own self-efficacy?</td>
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<td>Objective 4</td>
<td>To what extent can a system provide the types of personalized feedback that will increase student persistence, tolerance for ambiguity?</td>
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Figure 1: Outline of Research Objectives
student with reasonable tasks that stimulate thinking and motivate efforts to continue to learn as the tasks will increase in difficulty over time as the student gains mastery.

I will use this framework to inform the design of an expert learning system that is web-based to generate a personalized computing strengths profile and learning progression for each student. The web-based system will utilize existing resources in Human Computer Interaction (HCI), Databases, Expert Learning Systems, and Virtual Humans under the supervision of Dr. Christina Gardner-McCune at the University of Florida. HCI will be leveraged to focus on design, development and implementation of an interactive computing experience centered on eighth grade students’ usability requirements and needs. A database management system will store information on computer science skills and run queries that will map the students skill set to a specific computer science skill set. Expert Learning System will use the results from SQ assessment and artificial intelligence to create a personal assisted program that will continuously improve by interacting with the student and provide immediate feedback based on performance. The Expert Learning System will integrate with the virtual human to provide context-sensitive hints and instruction to guide students through the modules. The Virtual Human will provide personalized feedback to increase students’ persistence, ability to deal with complexity, and tolerance for ambiguity. Virtual humans will not replace the teachers or volunteers but are used to provide a more independent learning experience through ZPD theory.

**Research Plan:** The first phase in proposed work is to develop the database and Expert Learning System based on students’ needs and requirements. The second phase will be to run a pilot study. In the third phase I will conduct the study. The fourth phase I will focus on evaluating and reporting results. To evaluate the effectiveness of the project, pre and post surveys will be administered and compared to determine changes in attitudes, progression in development and competence in computer science principles. A mixed methods research evaluation will be used to gain insight on qualitative impact and quantitative measures.

**Broader Impacts:** This system will give female and minority students the confidence and new knowledge that they can contribute to the computer science field and society based on their personal strengths. Students who have great success with the system will be recruited and trained as mentors for future generations and serve as advocates of STEM education. Further implications of this study will promote higher quality differentiated instruction for tailored learning experiences at the individual level. Resources for teachers can be developed based on the analysis and results to easily identify learning gaps. In addition, the system will provide unlimited usage across various organizations as an added component to their existing curriculum. Results will be published in peer reviewed journals, such as International Journal of Computer Supported Collaborative Learning (IJCSC), The ACM Journal on Educational Resources in Computing (JERIC) and presented at conferences such as Association for Computing Machinery's Special Interest Group on Computer Science Education (SIGSCE), Interaction Design and Children (IDC), International Computing Education Research (ICER), and Conference on Human Factors in Computing (CHI).

**References:**
When I told my mother that I wanted to go to college her reply was, “I don’t know honey, I don’t have the money for that.” I now realize her response came from a place that reflected her reality. As a survivor of being a battered wife, her newest battle as a single parent was fighting for survival by ensuring she had enough money for food and shelter. She could not see having money beyond a week, nevertheless having money for college. That was not practical. When I heard those words, I did not hear her reality; I heard that I had to do all that I can to get a scholarship. The meaning of scholarship became real to me in seventh grade. My mother received news that I earned a scholarship to a Christian academy as a result of my academic achievements. I remember as she enthusiastically explained, “a scholarship is when someone will pay for your school and you have to keep your grades up.” At that moment I knew the meaning of responsibility and the meaning of possibility. It was at the Christian academy where I was first exposed to computers. I remember being fascinated by the activities I did on the computer and I thought that computers were the way of the future. It was then that my interest in computers and technology began. Since then I have worked really hard to “keep my grades up.” In high school I graduated in the top ten percent of my class. This led to a dual academic/athletic scholarship that I received for my undergraduate studies at the University of Texas El Paso where I majored in Computer Information Systems. When I received my degree I knew I was on a path to beat the stereotype of a computer scientist as a minority and a woman pursing a career in computer science.

Not only have I been successful in the classroom, I have excelled in sports as well. I was nominated on behalf of my academic achievements and athletic abilities to represent the United States of America as I played basketball in Belgium, Amsterdam, and Paris. Throughout my years playing sports I have cultivated life skills that have carried me through many successes and taught me how to learn from failures. Those skills have honed leadership qualities in discipline, teamwork, sacrifice and service. My successes in the classroom and on the court have allowed me to serve as a role model for younger students and younger student athletes. I value the importance of mentorship, and I have had some amazing people who have invested their time, energy, and support in me. I feel that it is my responsibility to pay it forward by mentoring students. I do this through my service to youth serving organizations such as Girl Scouts, Boys and Girls club and various outreach programs. I also started my own non-profit organization, See the Vision (SEEVI), where I work with juniors and seniors in high school to help them prepare for college. I have worked with over 500 students in a seven-year timespan, teaching leadership development, building their self-esteem, and assisting with college prep and career guidance. Over seventy-five percent of the students I worked with improved their standardized test scores by an average of 200 points on the SAT and 3 points on the ACT, which led to many of them securing college acceptance and scholarships.

While working with youth through SEEVI and youth organizations I volunteered for, I noticed that many of the students lacked enthusiasm for college, and more so lacked interest in my own career field, computer science. I saw this most prominently within minority communities, in youth who come from similar background as myself. When I was in their shoes, I knew that if I did not maximize on the opportunities presented to me, I would remain in a state of survival and not have thrived to beat the odds. Therefore, after ten years of working in industry, six years for America Online (AOL) and 4 years for an IT Consulting firm, RobbinsGioa, I decided to refocus my career on developing the next generation. I pursued a Masters of Science Degree in Youth Development Leadership from Clemson University where I maintained a 4.0 GPA. I graduated in the top ten percent of graduate students and was inducted
in Phi Kappa Phi Honors Society I also received an Outstanding Student Award for my master’s project in which I did research on the impact of individualized test preparation on students’ performance on standardized test. Through my research the gap of underrepresentation of minorities and women in STEM fields became clear to me. This observation mirrored the experiences of the youth with whom I was working, and this experience ignited my passion for research in order to address this challenge.

I am now embarking on my journey as a PhD student at University of Florida (UF) in the Computer Science and Information and Engineering department with a research focus in Human Centered Computing in the area of computer science education. Through my PhD work, I aim to create innovative educational technologies and opportunities to increase computer science participation among youth from all backgrounds and ethnicities. To accomplish this goal I will use the skills I developed from working in industry such as team leadership, project management, strategic thinking and planning, and organizational development, and the passion I have for technology and working with youth.

As a new researcher, my advisor, Dr. Christina Gardner-McCune has independently funded me and trusted me to lead studies in her research lab on computer science education research. My responsibilities were to design studies, conduct studies, and analyze data. I was co-leader of two different computing outreach projects. The first program was an after-school program, which exposed middle and high school students to computer science by teaching them how to code in programs such as Hour of Code and Scratch. In addition, I conducted a participatory design study to gain their insight on educational technologies developed by graduate student at Clemson University. The second was a summer program that introduced computer science concepts to students in the context of game design by exploring hardware and software design and programming. In addition, I had the opportunity to work on another project with a team of researchers who provided resources for teachers and students to integrate computer science middle school curriculum. The curriculum focused on a cross-disciplinary project aligning computational thinking and historical thinking through on the context of mobile app design and development. I conducted in-depth interviews with local middle school students about their first experiences programming Working on these projects pulled on my heart strings again as I was able to see a gap of female and minority success in computer science. This research experience motivated me to continue my research focus in underrepresented groups in computer science.

Thus far as a researcher for one semester I have already gained significant experiences doing research in computer science education. I have used a mixture of qualitative and quantitative research methods to evaluate and analyze data from four studies. I have learned about research studies, research paper writing, research methodologies and identifying gaps for further research. I know the importance of having research objectives and analyzing results to measure outcomes that can provide conclusions or recommendations. I have written three papers, two in the computer science education field and one in the National Youth At Risk forum. One paper has been submitted to Association for Computing Machinery (ACM) Special Interest Group in Computer Science Education (SIGSCE) and another published at E-Learn. I have also presented three posters at local and national conferences about my research. I was a featured speaker at the MIT App Inventor Summit in 2014, where I presented data on the cross-disciplinary project that measured student’s perception of computer science. In addition, I was one of the 400 students out of 8,000 attendees to be awarded a scholarship to the Anita Borg
Institute Women Transforming Technology Grace Hopper Conference in 2014. There I met and developed mentoring relationships with some of the top women in computer science.

One aspect of my research focuses on measuring students’ interest in computer science. My analysis revealed that majority of the minority students in the programs lacked experience, competence and ambition in computer science. I also noticed that female and minority students had a skewed view of the skills required to be a computer scientist and these did not see themselves as possessing those computer science skills. Research shows the reason for a lack of diversity in computer science is due to inaccurate perceptions of the study of computer science, limited representation and modeling of diverse persons of those established in the computer science field, and in most cases limited access [1]. Therefore, my research focus is to improve access to and quality of computing programs for middle school and high school students to dispel the myths of computer science. With the guidance and leadership from my mentors at UF, Dr. Christina Gardner-McCune, and Dr. Juan Gilbert I am exploring the impact of human computer interaction approaches and computer science education technologies with an individual strength-based approach to learning and education. I will develop educational technologies grounded in youth development theories to teach youth computer science principles and computational thinking through individualized culturally relevant technologies. I want to help students understand the importance of computer science and the critical need to develop computer science skills.

With my commitment to organizations such as Women in Science and Engineering (WISE), National Society of Black Engineers (NSBE) and SEEVI, I am compelled to invest my total self to impact and help minority students who want to go to college, specifically those who want to major in STEM fields. One particular organization that I am really proud of recently partnering with Aces In Motion (AIM) in Gainesville, FL. AIM provides a safe and positive place where the youth of a community can attend an after-school program and learn skills and receive assistance to lead healthy productive lives with a solid education and a fulfilling career. Within our first month we have grown from two students to fifteen students. This partnership is a prime example of a program that will counteract stereotype threats for underrepresented youth in STEM fields.

Receiving the NSF Graduate Student Research Fellowship will pave the way for me to continue to make significant impacts on the future of computer science participation among youth. It will provide the funding needed to continue doing research that would address the broadening participation in computer science. The funding will support research projects and publications in highly ranked conference proceedings and journals, and will allow me to produce more programs that will increase participation in STEM related fields among under-represented youth. As a woman, a minority, a first generation college graduate, a first generation graduate to hold a PhD., and a NSF fellow I will inspire future generations through Computing and STEM education and impact the field of study through my continued research area. My ultimate goal as a distinguished professor is to continue this research to communicate the message of responsibility and possibility of education through my research contributions and to all those I will have the opportunity to mentor.