



Girls Tech Camp: Librarians inspire adolescents to consider STEM careers

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Abstract

Motivated by a desire to encourage girls to pursue science, technology, engineering and math (STEM) studies, librarians at the Marston Science Library (Marston) at the University of Florida (UF) developed Girls Tech Camp (GTC), a summer camp designed to introduce middle-school girls to creative technologies used in these fields. This week-long summer day camp launched in 2016 and continued in the summers of 2017 and 2018. Each year, the camp brought twenty-two 6th-8th grade girls into an academic science library to build experience with emerging technologies and increase interest in pursuing further studies or a career in STEM. The camp introduced the girls to a range of technologies, including 3D modelling, 3D printing, augmented reality, Arduino microcontrollers, light sensors, digital video production, computer coding, and conductive crafts. Through hands-on activities, guest lectures, and campus field trips, youth interest and confidence in using technology expanded, and participants experienced student and research life at a university. This paper describes the development, operation, and assessment of hosting a camp in an academic library to inspire girls to pursue STEM studies.

Introduction

In the United States, the proportion of educational degrees women have earned in science and engineering has remained steady since 2006, nearly half of all bachelors, 44% of masters, and 41% of doctorate degrees awarded in 2016 ([NSF 2019](#)). However, there is wide variation in gender representation in various disciplines; the proportion of women pursuing degrees in some science, technology, engineering, and math (STEM) fields has been declining since 1997 ([NSF 2019](#)). Some of this is due to reduced interest among female students. As part of a public university, librarians at the University of Florida (UF) seek opportunities for outreach to our local communities, particularly activities that address this imbalance in STEM representation by women. Research has shown that encouraging girls at an early age and exposing them to

technology can generate interest in STEM and increase their confidence ([Watermeyer 2012](#); [Archer et al. 2013](#)). Thus, library staff at the Marston Science Library (Marston) designed Girls Tech Camp (GTC), a week-long technology summer camp for middle school girls.

The GTC was designed to provide a safe space for girls to explore new technology in fun and creative ways. Emerging technologies can create opportunities to blend creative design and interactive art, while also developing foundational STEM skills. Balancing science and math with art encourages a creative approach that minimizes fears and offers a forum for both education and expression. Freed from expectations to “get it right,” participants are excited about learning. In addition, the camaraderie of a creative approach builds a community of young women helping each other learn new STEM skills. Limiting this camp to girls also removes the influence of societal gender role biases, providing a safe space for girls to grow and challenge themselves (e.g., [Archer et al. 2013](#); [Tanner 2009](#)). This paper describes the development and operation of the camp, including recommendations for holding similar camps based on lessons learned. Assessment of the camp is further evaluated through interpretation of responses from camper surveys.

Literature Review

Providing supportive, encouraging, and diverse role models of women scientists can broaden gender perceptions towards science-related career paths ([Archer et al. 2013](#)). The idea that science and math are for boys still persists in the minds of many young people ([Adamuti-Trache and Andre 2008](#)), and changing this perception requires a conscious effort from educators and families. Tanner ([2009](#)) discusses possible ways to more equally distribute resources, attention, and time towards girls in science education, challenging educators to develop an “equal eye.” Watermeyer ([2012](#)) builds on this concept further through the development of software that connects mentors with girls to foster experiences in the different STEM fields. Young girls need to see that careers in the sciences are an attainable goal. This is especially important for girls that show an interest in STEM disciplines ([Blakemore et al. 2009](#)). K-12 girls and boys show no significant difference in their abilities in mathematics and science. They differ, however, in interest and confidence level in STEM subjects ([Peterson & Britsch 2011](#)). Lower levels of girls’ confidence in STEM subjects may result from a multitude of sources, including societal and cultural assumptions, such as a perceived lack of encouragement based on underrepresentation of female role models in the STEM disciplines ([Graff 2013](#); [Yazilits et al. 2013](#)).

Actively cultivating interest in STEM for young girls can play a critical role in engaging and keeping them involved ([Broadley, 2015](#)). Research investigating gender preference and pedagogical approaches show that girls tend to gravitate towards relationship-based careers ([Aeschlimann et al. 2016](#); [Archer et al. 2013](#)). Developing educational programs that capitalize on existing interest in the sciences is one way to increase young girls’ motivation toward the STEM disciplines ([Blakemore et al. 2009](#); [van Langen 2015](#)). Studies show that creative, inquiry-based learning techniques can further engage young minds and increase STEM confidence ([Kim 2016](#); [ERCA 2016](#)).

Marston is in a unique position to combine pedagogical and inquiry-based learning addressed in the literature. Success in encouraging girls to pursue STEM studies requires a multifaceted approach. By using existing makerspace technology at Marston (3D modeling and 3D printing)

and female camp leaders as role models, GTC provided hands-on learning experiences and increased exposure to a university setting to help girls envision themselves studying STEM in college. Similar girls-only programming designed to support and increase girls involvement in STEM include Girls Who Code, a nonprofit developed by Reshma Saujani in 2012 and Girls in Technology, led by the Women in Technology Committee in 2019. Additional organizations serving girls are listed in the National Girls Collaborative Project.

Camp Preparation

Proper planning and preparation was important to the success of the camp. Planning started approximately 6 months prior to the camp with frequent team meetings. Immediately after each camp, a retrospective was held to note what went well and what activities and logistics should be changed for the following year. Since instructor availability was a key factor in determining which technologies to offer, a week in mid-July that did not conflict with major conferences, personal travel, and other popular area camps became the optimal time.

Location

One major decision was planning the venue for the camp with enough space for at least 23 campers and access to the required technology (i.e., 3D equipment, Arduinos, iPad docking station, and computer lab). Marston Science Library was chosen as the camp venue because it provides direct access to most of the technology used in the camp, its conference room could comfortably hold the campers, and it was convenient for Marston staff and faculty who are familiar with the technology to participate as camp volunteers. Marston is one of six libraries on the University of Florida campus. This free-standing, five-story building houses collections in agriculture, earth sciences, engineering, life sciences, mathematics, and physical sciences. This branch library employs 12 library faculty and 12 staff in a highly collaborative environment. Marston offers an array of services, including active makerspaces for 3-D printing and scanning, an augmented/virtual-reality mobile-application development lab, and technology available for circulation, including iPads and Arduinos. In addition to the conference room and adjacent computer lab (40 workstations), GTC also used the staff lounge for food storage and preparation.

Parent/guardian access to Marston is a challenge, because there is no public parking within a five-minute walk of the building. To remedy this situation, camp staff were located outside the building for one hour in the morning (Drop-off) and afternoon (Pick-up), with additional staff members shuttling campers between the outside location and the primary camp room. Drop-off and pick-up were coordinated using two copies of a binder that contained the names of authorized adults, signatures of guardians at arrival and departure, camper allergies and medical issues, emergency contacts, and volunteer schedules. Adults signing out campers were required to present a photo identification each afternoon to ensure they were authorized.

Staffing and Training

GTC was staffed in accordance with the American Camp Association standards ([ACA 2016](#)). To support outreach efforts to the greater community, UF Libraries administration allowed library faculty and staff to spend a portion of their work time as camp volunteers. In 2016, camp staff included nine Marston staff and librarians plus 11 instructors and volunteers from both within

and beyond the UF Libraries. A call was made in early 2017 to request volunteers from beyond the science library. In 2017, 15 UF Libraries staff members and three instructors from outside the libraries participated. Additionally, three girls who attended the 2016 camp returned as Counselors-In-Training (CIT) for the 2017 camp. In 2018, similar numbers of staff participated, including five CITs, furthering our mission to provide role models for the campers as well as providing leadership opportunities in STEM for the CITs.

Staff training was a critical component in preparing for the camp. The UF Department of Youth Conference Services required all camp staff to complete online training on working with youth, submit a background check complete with fingerprinting, and provide the names of all participants for campus-wide insurance coverage. For the 2016 camp no advanced staff training was provided for activities, which meant that camp staff had to quickly learn each activity as it was taught and then turn around and help campers with that activity. To ease this process, advanced training sessions were scheduled for most activities in following years. Training sessions for volunteers were held weekly during the four weeks leading up to camp. They provided an opportunity to troubleshoot potential problems and revise lesson plans when needed.

Registration and Evaluation

A registration application was the primary opportunity to communicate with both campers and their guardians prior to the start of camp. Paper applications were used, due to strict information protection rules of online applications for children under 13 years of age ([U.S. Federal Trade Commission 1998](#)). Application elements included: camper and parent/guardian contact information, grade and name of middle school, emergency contact information, names of those allowed to pick up the camper, food allergies, medical concerns, t-shirt size, how they heard about the camp, behavior rules, photo and video waiver, release of liability, and policy for withdrawing from the camp. In upcoming years the photo release form will include local news outlets to meet media interest. Staff worked with the UF Department of Conference Services to create the registration form, establish a cancellation policy, and manage scholarship applications. Prior to camp, staff received Internal Review Board approval to use anonymized survey data from campers in research or educational projects. We developed an anonymous survey instrument in Qualtrics and solicited campers' responses each year at the end of camp (see [Appendix 1: GTC Evaluation Form](#)). In 2016, 19 campers completed the survey, and 21 completed it in 2017. Unfortunately, in 2018, the survey was distributed one week after the camp concluded, and only 4 responses were received. The survey measured camper self-assessments of their camp experience. It enabled the camp leaders to adapt camp activities from year to year and measure progress on camp goals to promote interest and confidence in STEM among middle school girls.

Budget

A camp budget was developed to include all estimated purchases such as supplies, snacks, and camp insurance. The camp registration fee was set at \$80 for 2016 and increased to \$100 for 2017 and 2018. These rates, lower than other area camps, were possible due to the extent of in-kind support. Registration fees enabled two full scholarships plus purchases of supplies and a small gift certificate as appreciation to non-library instructors. Repurposed library promotional materials were donated to the camp (e.g., pencils, folders, water bottles, staplers, and sunglasses).

Each camper received a bag of supplies on their first day of camp that included a USB drive, camp t-shirt, water bottle, and folder with computer account information. Campers were required to bring their own lunch or money to purchase lunch on campus.

Camper Profile

Girls Tech Camp was open to rising 6th, 7th, and 8th grade girls. Many of the campers in 2016 were children of UF faculty and staff who learned about the camp through word of mouth. To increase diversity in 2017 and 2018, the camp was advertised to local outreach programs, such as Partnership for Strong Families and area middle school science teachers and guidance counselors. Two full scholarships were offered to encourage participation of underrepresented youth. Registration to area outreach programs began one month prior to general registration, since camp spaces filled up quickly in previous years. Table 1 shows the grade distribution and schools represented each year as reported in the camper applications.

Table 1: Campers' Grade levels¹ and Schools Attended

Year	6th grade	7th grade	8th grade	Total # of Campers	# of Unique Schools
2016	8	12	2	22	6
2017	12	5	4	21	8
2018	12	9	2	23	12
¹ Rising grade levels (i.e., forthcoming school year). Note grades for 3 campers in 2016 and 1 camper in 2017 were unconfirmed.					

Managing Technology and Logistics

The management of technology was an important component to the camp. Each camper was assigned an iPad mobile device for the duration of the camp, checking the iPad out in the mornings and back in at the end of each day. Two weeks prior to camp, several mobile applications were installed on the iPads including Adobe Premier Clip, Adobe Spark, Aurasma (renamed HP Reveal in 2018) and SAWBO (Scientific Animations Without Borders). The iPads were used for augmented reality and video production sessions. They were also very popular during Explore Time. Desktop computers in the nearby computer lab were used for 3D modeling and computer coding sessions (with Unity, MIT Scratch, and Arduino scripting) and greenscreen video editing (Adobe Premiere Pro). During the week of camp, all iPads and computers were removed from Library IT update cycles in order to prevent inadvertent removal of software that would impact the flow of instruction.

Account management is one of the greatest challenges of a technology camp. To protect the identity of minors on the Internet, each camper was assigned a female scientist alias for their web and email accounts. Since mobile devices (iPads) were used as the main personal computing device in this camp, transferring files to and from desktop computers through a shared drive (e.g., Google Drive or Dropbox) was necessary. Campers worked in teams of 4-6 girls for several activities, so we created team folders in the shared drive for easier file sharing. Camp counselors also used the shared drive to access material for the final Camp Showcase. Campers were given a flash drive, so they could save copies of their work to take home. Only aliases

assigned to each camper were used in file and folder names, and folders were erased at the end of camp. No content was published online with public access.

Prior to camp, a handout was prepared for the campers listing their login information and a master copy retained in the camp leaders notebook. Login information included:

- Temporary university accounts for access to UF computers and the wireless network
- Email accounts for every camper
- Username and passwords for accounts in software used (e.g., Adobe ID, Tinkercad, Aurasma/HP Reveal)

Camp Activities

Camp activities were scheduled for the campers to learn and create with new technologies. Female instructors were preferred to serve as inspiration and to tell the campers about their experiences as women in STEM fields. Four multi-day activity tracks were developed and revised each year based on camp evaluations. In the initial year, the camp activity tracks were 3D modeling & printing, video production, computer coding, and crafting with technology. The camp schedule in 2017 was modified to include more challenging coding activities and to offer augmented reality instead of Arduino circuitry. In 2018, we employed larger themes to better integrate various tracks (see Figure 1). For instance, activities in both 3D modeling/3D printing and augmented reality were integrated into team projects to design and build enhancements of a children's book for use by visually-impaired readers.

Camp activities were designed for middle school youth age range of 10-14 yrs old. In 2016, camp leaders discovered that prior experience and aptitude of learning new skills varied widely, such that the time allotted for each camp activity was not always adequate. Certain activities would have benefited from additional time for troubleshooting. Therefore, in planning for the 2017 camp, short activities were built in throughout the day that could be easily omitted if other activities took longer than expected due to skill level or technical difficulties. This allowed the campers to have time to learn to troubleshoot their own technology issues, which is an important skill when working with new technologies. Developing resilience and perseverance in the face of failure and frustration is a laudable, though often unrecognized, objective itself.

Other activities included researching a female scientist, designing prosthetics for kids, and fun filler activities such as competitive cup stacking and outdoor corn-hole games. Field trips included visits to the Computer Science and Engineering Robotics Laboratory and the Library's One-Button Studio, where the campers created their own videos.

Each year, the camp concluded with a Camp Showcase celebration, including cake and drinks. Guardians, campers' families, and all camp staff and volunteers were invited to Marston for the final two hours of camp. Each camper displayed products she had created during the week, and guests were welcomed and invited to circulate to view the campers' displays.

	Monday	Tuesday	Wednesday	Thursday	Friday
Time	Video & 3D	AR	Video & Coding	Coding & Crafting	Video & Showcase
8:00	Drop-off Starts/CIT Training				
8:30	Icebreakers	Explore Time/Icebreaker	Explore Time	Explore Time	Explore Time
9:00	Intro	AR/Scavenger hunt	Video/ONE Button	Coding	Video
9:30	iPad distribution / Group picture	AR	Video/ONE Button	Coding	Video
10:00	Morning Snack	Morning Snack	Morning Snack/Paper airplanes	Morning Snack	Morning Snack/Speed stack competition
10:30-11:30 am	Video	AR	Video/ONE Button	Coding	Video
12:00	Lunch				
12:30	Outside time				
1:00-2:30pm	3D	AR	Coding	Crafting	Finish up projects
3:00pm	Afternoon Snack	Afternoon Snack	Afternoon Snack	Afternoon Snack/ Pi Recitation	Finish up projects
3:30pm	3D	Breakout Box	Coding	Crafting	Camp Showcase
4:00pm	Explore Time	Breakout Box	Explore Time	Explore Time	Camp Showcase
4:30pm	Pick-up / Explore Time				
5:00pm	All girls picked up				

Figure 1. GTC Sample Week

Major Themes

3D Technologies

The UF Libraries offer extensive 3D services, and, thus, it was a foundational technology for the camp, using instructors from the Libraries' staff. 3D printing continues to be popular at Marston, since its introduction in 2013 for instruction, research, and pleasure. As manufacturing technology develops, a broader range of 3D printers are available -- including low-cost models, multi-filament heads, and those that print a variety of mediums, including food. Developing knowledge, confidence, and skills with 3D modeling and printing is expected to enhance users' employability.

After a broad overview of 3D technology and demonstrations using portable printers, campers learned basic 3D modeling using Autodesk's Tinkercad software. Each camper made a custom name tag, an activity that incorporated most of the modeling commands and was small enough to

print out by the end of camp. Additional activities included using Structure 3D scanners to scan each other and to design and model new prosthetic hands, an engineering challenge extended by GRiP (Generational Relief in Prosthetics), a university student club developing affordable prosthetics for area youth. The most popular 3D activity in 2017 was the 3D food printer, Pancake Bot™, activity led by Alix Freck, Children's Librarian at the Alachua County Public Library. Campers designed pancake models and enjoyed eating them after they were "printed." In 2018, 3D activities focused on multimodal learning, inspired by Colorado University - Boulder's Tactile Picture Book Project ([Yeh 2016](#)). Teams of 4-6 campers selected a page from "The Very Hungry Caterpillar" ([Carle 1969](#)) and created 3D versions of the page with text in Braille. Instructors from the public library provided the Braille machine and taught the campers how to use it to create their pages. Following the Camp Showcase at the end of the camp week, the 3D printed boards were donated to the Tactile Picture Book Project.

Coding

Computer coding is a fundamental aspect of digital literacy, and coding skills are highly desirable in the job market. In 2016, Shaundra Daily, faculty in the UF Department of Computer & Information Science Engineering, led the coding activities for GTC based on her research in affective computing, creating technologies that understand human emotion ([Radiya-Dixit 2017](#)). Daily introduced computer coding with Virtual Environment Interactions (VEnvI), a "software and curriculum for blending movement and programming, which offers a novel and embodied strategy of engaging 5th and 6th grade girls in computational thinking" ([Daily et al. 2015](#)). During this highly interactive day the campers learned the Cha-cha-slide line dance and then programmed their computer avatars to perform the same dance routine. Dr. Daily's coding activities were popular with the campers; however, some girls wanted to be challenged with a more difficult programming language.

In 2017, a local programmer joined GTC to teach game development using the free Unity software and scripting language C++. Campers were led through basic exercises to introduce Unity's interface and shown how to program a sprite to move around the screen. This activity proved to be quite challenging, since Unity is a professional-level game development software and most of the campers lacked experience with programming structure and syntax. In 2018, a community college librarian with experience teaching coding to youth in summer camps joined the GTC instruction team. Campers gained computer programming skills through a series of increasingly difficult coding challenges using MIT Scratch. This workshop was successful, because campers could either focus on learning the basics or jump to the advanced projects, depending on their interest and experience.

Crafting with Technology

Creativity was a major theme throughout the camp to increase interest in technology activities. Each year, technology-related craft activities were scheduled for one full day to give campers an opportunity to express themselves by mixing art with technology. The two primary activities were creating greeting cards using paper circuitry and sewing bracelets with conductive thread, batteries, and LED lights. During the first year, it became clear that most campers had limited prior sewing experience. The staffing ratio was increased in subsequent years to enable successful project completion by beginning sewers. Campers also used Arduino Uno to craft movable paper models. Arduinos are open-source low-cost microcontrollers that require simple

programming to control diverse sensors and motors. With this activity, campers learned to connect circuits and write basic instructions to make model parts move, such as a making a paper head turn. This activity required a moderate level of knowledge and skill. Paper heads were decorated by hand and then mounted onto microprocessors.

The crafting activities were split over two days after the first year in order to allow more time for campers to catch up during free time, if needed. Observation and camper surveys revealed some frustration with mastering tactile projects. Instructions for the LED circuitry greeting cards were revised to improve clarity, and project items were pre-packaged prior to the camp to save activity time. Erin Winick, a UF alumna with a jewelry business based on 3D printing, SciChic, shared her story via Skype with the campers describing how her interest in crafting with technology evolved into a small business.

Augmented Reality

Augmented reality (AR) was added to the camp in 2017 and 2018. Augmented reality is the practice of overlaying or adding digital content to the real world. The current best-known example of AR is the popular Pokemon Go!, a mobile app that allows players to collect digital creatures overlaid on the user's surroundings. Campers were introduced to AR using the free app, Aurasma, and learned how to overlay images and short videos when viewing a "trigger" image or text using the iPad's camera. Prior to the start of the camp, the augmented reality instructor created a series of AR triggers just outside the main building. During camp, the AR day started with a scavenger hunt activity, where the campers searched in teams for augmented signs in the plaza outside the library. The rest of the day was spent augmenting children's books using either photos or videos. Each team selected a book and then used storyboards to plan out how to augment the book's text. The teams could use images found online or create their own. To help with creating content, participants were provided with a small box of costumes and supplies to create additional props using paper and markers. The day concluded with each team presenting their augmented story to the rest of the camp.

Video Production

Videos are increasingly the most popular format for information. On their first day, campers were thrilled to be assigned an iPad to use on site and encouraged to take lots of pictures and videos throughout the week. Campers were introduced to video production with a challenge to create a "video diary" of their camp experience. At the end of each day, iPads were checked back in and recharged. The campers quickly found camera settings and apps to add artistic flair to their photographs.

Adobe Spark products (Post, Video) and Adobe Premier Clip were featured, since they are free and intuitive programs designed for mobile devices. On the first day of camp, campers learned to create Adobe Spark Posts and save them to their iPad. Adobe Spark Post allows users to create "social graphics," akin to digital posters or postcards, where text and graphic design elements are combined with digital photographs.

Campers visited a professional video production site on a field trip to the UF Libraries' One Button Studio. The dedicated studio space provides high quality lighting, recording-quality acoustics, and is equipped with a greenscreen. Campers were invited to develop either a video

diary of their camp experience, a news story about camp, or an instructional video featuring a new skill learned at camp. Each team of campers were encouraged to develop a script and use storyboards to plan video action prior to visiting the One Button Studio. A box of props and costumes as well as paper, tape, and scissors was popular for video production. At the studio, every camper acted in a video, whether alone, in pairs, or as a team. Each team was allotted 30 minutes of recording time at the One Button Studio. In order to incorporate the videos created at the One Button Studio with images on their tablets, video files were edited in the computer lab using Adobe Premiere Pro. Editing in Adobe Premiere Pro was necessary to replace the greenscreen with a desired image or video and to change the file into a non-proprietary format. Edited video files were transferred through Google Drive onto iPads, where campers used Adobe Premiere Clip to combine different elements into one final video. The file transfer process and number of video-editing programs proved challenging and required extra staff support. Fortunately, software upgrades to the One Button Studio in 2018 resulted in direct file compatibility.

A password-protected folder in Google Drive was created for campers to share photographs and videos for remixing by other campers. Campers saved copies of their final video and favorite images onto their flash drive to take home. Videos and images were displayed during the Camp Showcase at the end of the week.

Additional Activities

Icebreakers and Explore Time

Daily icebreakers are short activities that we used as camp began to increase energy, introduce camp attendees to one another, and set a welcoming, inclusive tone to the camp. We categorized all icebreaker activities into a four-quadrant matrix, depending on the activity level of the game and the number of individuals in the group (see Figure 2). Quadrant 1 contains active icebreakers with a large number of people, akin to a large, energetic block party. Quadrant 2 activities are also active but designed for a small group of people, including, for example, a dance circle. Quadrant 3 consists of low activity for small groups, such as small-group table talk. Quadrant 4 describes low activity for large groups, such as typical at a large professional conference. Quadrant 4 activities were not employed as icebreakers at GTC.

The first camp activity began in Quadrant 1, as high-activity, large-group games create the most fertile opportunity for positive interactions with a large number of individuals. These Quadrant 1 games aid in removing inhibitions and increasing interactions among the campers. The next activity was selected from Quadrant 2 to shrink the group size and focus on establishment of relationships within smaller groups, such as the camp teams. Lastly, Quadrant 3 activities moved small groups into a lower energy game to create intimacy among group members. Quadrant 3 activities create a foundation for relationships that will grow throughout the camp.

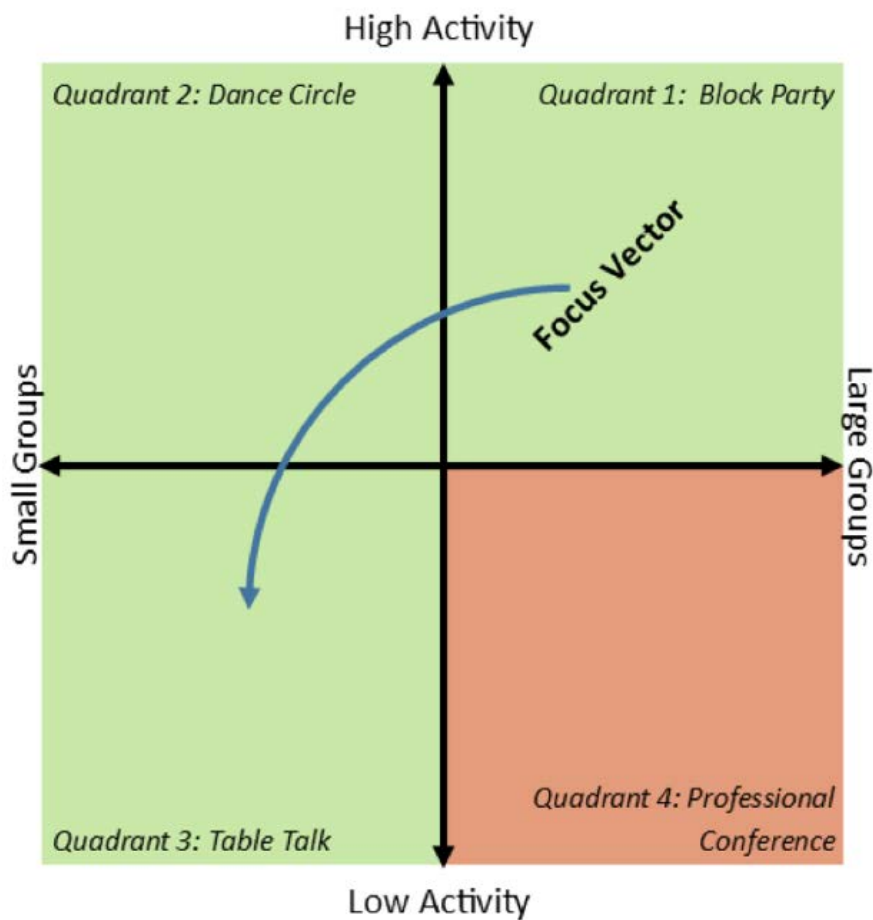


Figure 2. GTC Icebreaker Matrix

Unstructured Explore Time was offered at the beginning and end of each day. Explore Time serves a variety of purposes: time for campers to individually practice and go deeper with previous instruction, opportunities to socialize and build friendships, and quiet time for recharging. No expectations were placed on campers during these times. Explore Time coincided with drop-off and pick-up times by parents, so that campers' staggered arrivals and departures caused minimal disruption to group activities. A variety of activities were offered for Explore Time, including flying miniature drones, origami, coloring pages, and Legos. The most popular pastime was use of the iPads, followed by the competitive Speed Stacks® cup game. Lunchtime outdoors with cornhole and four square were popular in 2016. Explore Time also provided an opportunity to test reactions to proposed activities. In 2017, a group Breakout® box puzzle during Explore Time was well received and incorporated into the 2018 camp schedule. Individual and team contests in Speed Stacks® cup stacking and recitation of the digits of pi, planned for the final day of camp, prompted girls to practice during Explore Time.

Breath of Fresh Air: Field trips and Guest Speakers

Field trips and guest speakers were welcome additions to GTC. Field trips to research labs and the One Button Studio on campus provided fresh air and a change of scenery from the conference room and adjacent computer lab where the camp was hosted. Guest speakers

augmented one of the missions of the camp - to provide role models of women working in STEM fields.

Hosting the camp on the university campus provided convenient field-trip options within walking distance. Girls visited 2-3 labs in the Computer Information Science Engineering department, where graduate students described their research in acoustics and robotics. A short walk to the One Button Studio, a video recording studio in another library branch, was popular each year.

Young, female speakers at different career stages were invited to provide advice and inspiration to campers in person and through video conferencing. Jessica Bergau, the founder of GRiP, ([Generational Relief in Prosthetics n.d.](#)) shared why she started the student club during her sophomore year and how she developed skills and experiences through the club's activities that led to her first post-collegiate employment. Erin Winick described her entrepreneurial path from engineering student to founder of SciChic, an online business of 3D printed jewelry, where "we work hard to develop STEM-inspired fashion and inspire young girls to get involved with science and engineering." In 2017, Erin received the Young Entrepreneur Award from Florida's Governor Rick Scott. Alix Freck, Children's Librarian from the Alachua County Library, taught campers to print their own 3D pancakes with Pancake Bot™. Two graduate students, Emily Brooks and Shannon Butts, were inspirational as instructors of Crafting with Technology, Arduinos, and Augmented Reality. UF Assistant Professor in Entomology Andrea Lucky included campers in a citizen's science project to collect ant species to aid biodiversity research.

By providing role models of women at various stages of STEM careers (undergraduate and graduate students, established research faculty, and non-academic professionals), campers can more easily visualize paths towards developing a career in STEM.

Results and Discussion

Participant Feedback

The camps in 2016, 2017, and 2018 were successful in cultivating campers' interest and confidence in using technology. Feedback from campers and parents was extremely positive, with participants stating they gained new knowledge about technology. Each year, over 80% of the campers strongly agreed or somewhat agreed with the statement, "I learned a lot about technology this week" (Fig. 3a). Nearly 50% of the campers found the new information useful (Fig. 3b). Most importantly, campers indicated increased confidence using new technology as a result of participating in the GTC. Confidence is an important indicator of future success for college women in STEM fields ([Brandt 2015](#)). Over three-quarters of campers in 2016 and 2017 agreed with the statement, "I feel more comfortable with technology after my experience with Girls Tech Camp" (Fig. 3c). Response rates to camp evaluations are highest when evaluations occur during camp; in 2018 only 17% of campers completed surveys distributed one week after camp, whereas response rates were higher in 2016 (86%) and 2017 (91%).

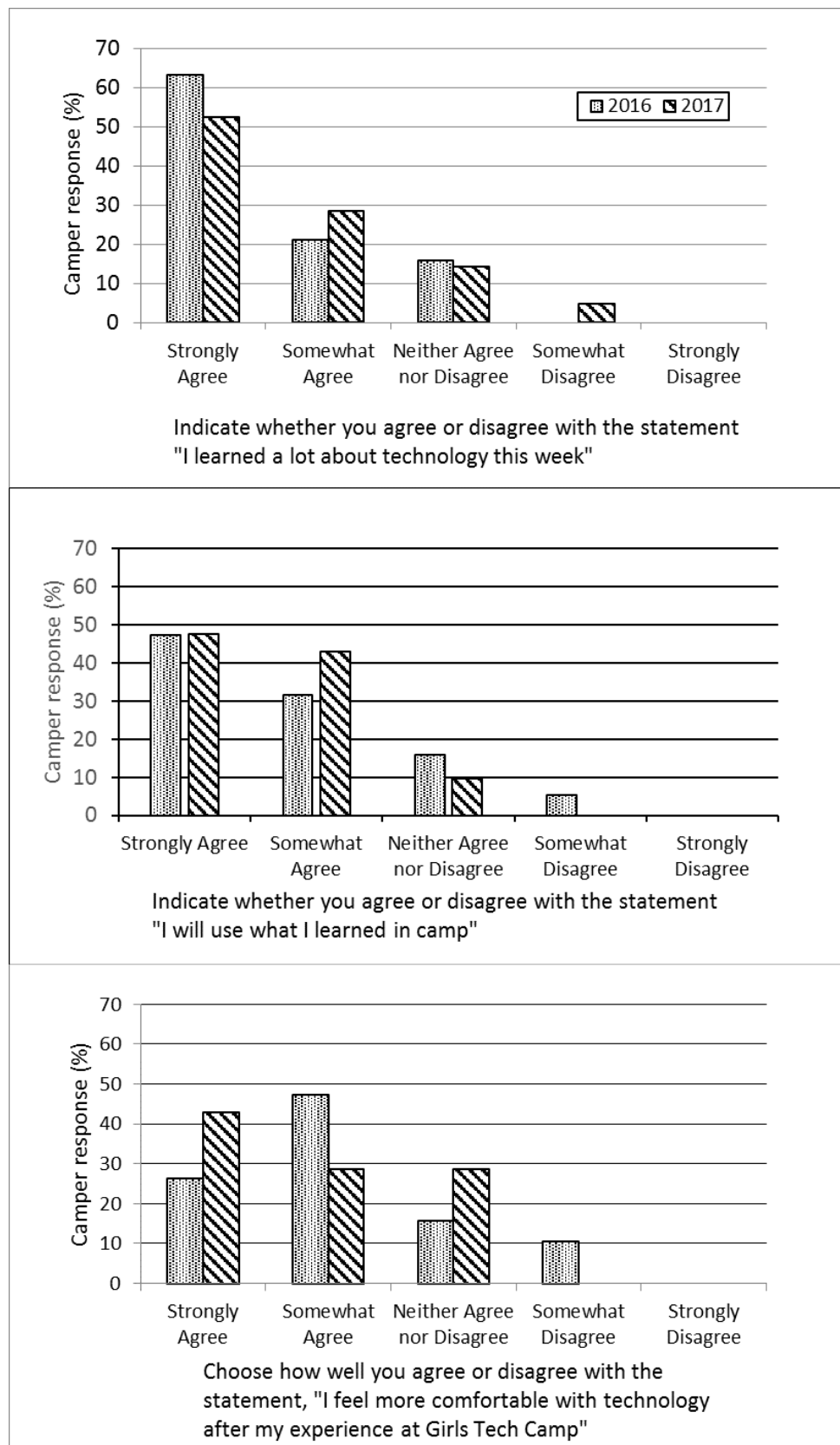


Figure 3. Camper responses in 2016 (grey stippled) and 2017 (diagonal striped) to GTC evaluation questions.

Through the online evaluation, campers listed their favorite camp activities and the best and worst things about camp. In all three years, 3D printing and modeling was the campers' favorite activity, and Augmented Reality was second favorite both years it was offered. Video production varied in popularity each year, perhaps, partly due to the numerous steps and programs necessary for greenscreen editing. Coding activities proved the most challenging to match to the girls' broad range of experience and interest.

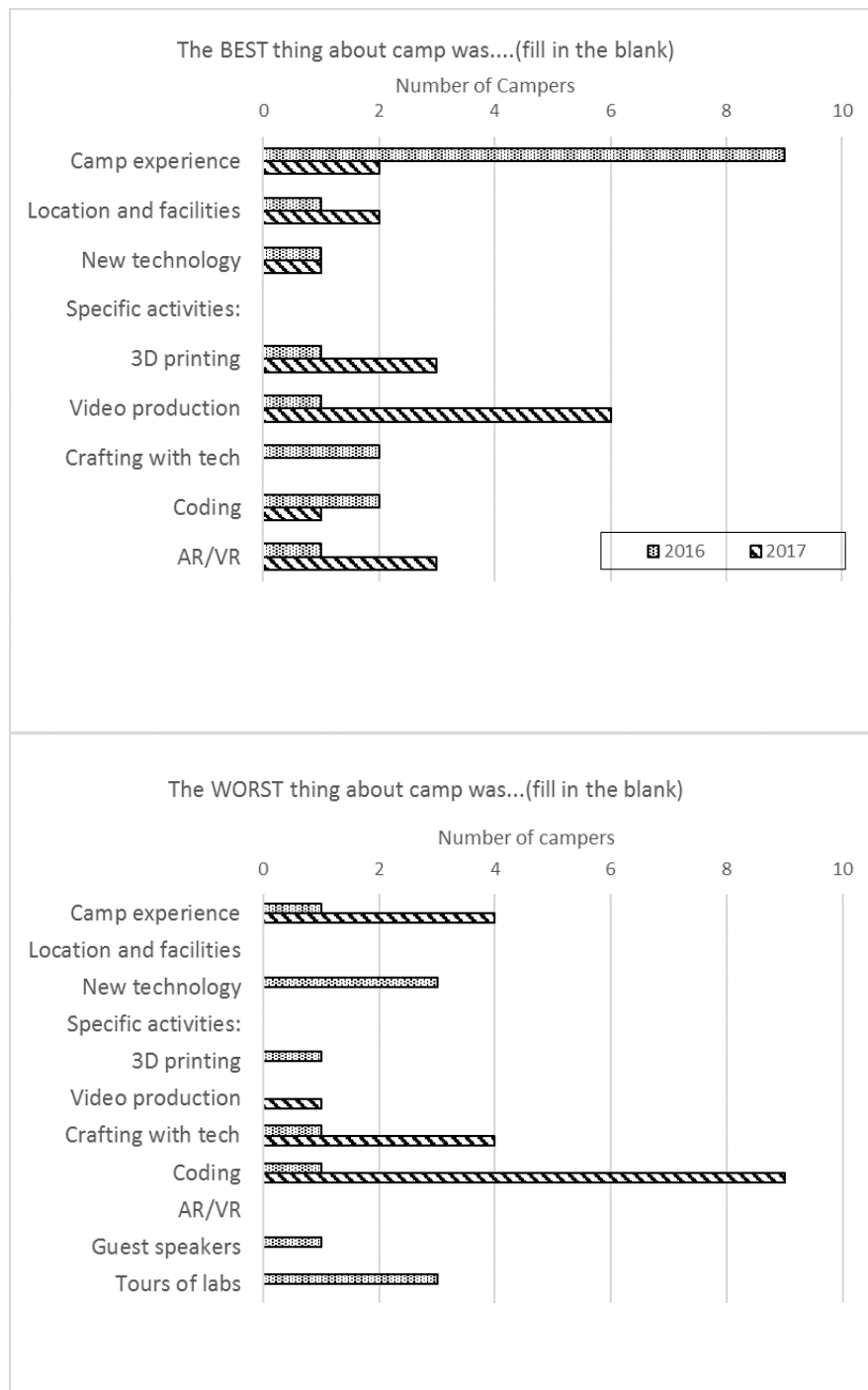


Figure 4. Camper responses in 2016 (grey stippled) and 2017 (diagonal striped) to GTC evaluation open-ended questions.

Four themes emerged from the open-ended responses to the best and worst thing about camp: camp experience, location and facilities, new technology, and specific activities. The “camp experience” theme included comments related to making friends, “being able to design and create things,” the structure of the days, and snacks provided. In 2016, nine campers rated aspects of camp experience as the best thing about camp, especially spending time with friends (Fig. 4a). In 2017, four campers rated aspects of camp experience as the worst thing about camp, listing complicated drop-off/pick-up procedures and too much unstructured time (Fig. 4b). Comments in the “location and facilities” theme highlighted the positive impact of hosting the middle-school camp on a university campus. Specific activities appeared in both best and worst things about camp each year. Offering a range of activities is beneficial to meet diverse preferences of campers. For example, while one camper listed too much unstructured time as the worst thing about camp, several other campers listed it as the best. Similarly, working with new technology appeared as both the best and worst thing about camp, revealing some campers’ excitement and others’ frustration in acquiring new skills. Camper feedback is especially helpful when large proportions of campers share similar opinions. For instance, based on the nine campers who listed coding as the worst thing about camp in 2017 (Fig. 4b), we recruited a new instructor and employed a new coding interface for the 2018 camp. Enlisting dynamic instructors with experience working with youth is important to maintain camper interest in all topics.

Coordinator Reflections

Each year, we attempted to use freely available software when possible, to enable campers to continue to explore their interests and skills after camp ended (see Table 2).

Table 2. GTC Technology Used

Software	Hardware
Adobe Premiere Clip	Arduino Unos
Adobe Premiere Pro	Braille Typewriter
Adobe Spark products (Post, Video)	iPads
Arduino scripts	LilyTiny microcontroller
Aurasma/HP Reveal	Pancake Bot™
Autodesk’s Tinkercad	PC Computers
MIT Scratch	Printrbot Play portable 3D printer
Scientific Animations Without Borders (SAWBO)	Structure 3D scanner
Unity	
VEnvI	

Another point of discussion is the need to respond to the emotional well-being and group dynamics of the campers. Camp leaders stepped in to help restore calm when frustration levels

with activities or other campers occasionally arose. Embedding CITs within each team of campers increased camp leaders' ability to respond to issues. It was helpful to have an adjacent room reserved and used as needed for a quiet space.

Training volunteers to assist in camp activities emerged as a greater need than anticipated. Volunteers included library staff, as well as three to five high school girls who participated as Counselors-in-Training (CITs) in 2017 and 2018. In 2016 camp volunteers were expected to follow the instructors during camp and then immediately assist campers with the hands-on activities or troubleshooting. This didn't lead to efficient time management and may have contributed to some activities taking longer than planned. In 2017, "train the trainer" sessions were held prior to camp to provide time for volunteers to experience each task. This was important, too, because librarians from other branches, less familiar with STEM, became camp volunteers. Volunteers provided valuable feedback to refine instructions for clarity. In 2018, each Counselor-in-Training was assigned to one team of campers to increase their engagement with campers and serve as a resource for campers with questions. This arrangement worked well, and the CITs provided valuable insight into the campers' attitudes, successes, and challenges. Following camp each year, camp leaders met to review camper evaluations and share and record successes and challenges of the camp while details were still fresh.

Conclusion

The Girls Tech Camp hosted by University of Florida Marston Science Library has been successful in meeting the objectives of encouraging middle school girls to improve their interest and confidence in STEM. During the first three years of this week-long summer camp, over 60 middle school girls increased their technology knowledge and skills and had fun doing so, through a variety of interactive activities. In addition, participants developed friendships with peers, experienced a slice of college campus life, and interacted with female role models working in STEM fields in a range of career stages. Campers shared their excitement in the camp evaluations. When prompted to "tell us anything else you want us to know about Girls Tech Camp" in the evaluation, the most common response was to offer the camp again or extend it. One camper expressed this sentiment, "Why was it so short! I wish it could have been longer!" Hosting minors in an academic library required not-insignificant preparation by library staff, who are accustomed to working with young adults. An iterative process to revise and improve the camp is key to its success.

Refining the camp each year was beneficial both to better meet needs of participating youth and to respond to changes in technology used in camp activities. This was, perhaps, most evident in the Coding activities, where finding the best-fit instructor and software required several revisions. Technology upgrades in software required annual revision of educational materials and training of staff. An important lesson learned was to remove technology from nightly software updates during the camp to avoid mid-camp disruptions. On the other hand, technological upgrades from year to year can be beneficial, as we experienced, for instance, with more efficient video editing procedures that resulted from software upgrades to the library's One Button Studio.

In summary, UF Libraries' dedication to the vision of this outreach activity remains strong. However, the extensive amount of dedicated staff time to handle preparation and implementation is significant. One alternative under consideration is to partner with existing local summer camp

programs and focus library efforts on instruction of STEM activities. In 2019, UF Librarians will lead STEM activities for youth attending area summer camps while GTC is on hiatus for one year. Regardless of the format, academic libraries can reach out to middle school girls with interactive technology activities to foster greater interest and confidence of girls in STEM. Hosting a technology camp for middle-school girls on a college campus can encourage participants to pursue further studies in STEM and lead to better female representation in STEM fields in college and beyond.

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