

University Library Services to Engineering Summer Campers

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Abstract

Over the summer, Virginia Commonwealth University's School of Engineering and a local youth center host an engineering day camp for rising sixth, seventh, and eighth graders to explore engineering and innovation. Students in this 5-day program develop an idea for an invention, explore the science behind it and existing products relevant to the idea, develop a budget for building the invention, build it, and present their ideas at an end-of-camp pitch session. On day two, students come to the library. They use both library and open web resources to find information about the science, about related products on the market, and (as time permits) to gather prices for parts of their inventions.

The library's involvement has evolved as the librarians have learned about what information and activities are effective for a middle school audience. Some of these lessons apply to any teaching situation – e.g. active learning is generally more effective than pure lecture. Other lessons learned are specific to this context and age group. Because middle schoolers are developmentally different from older children and young adults and because camp is different from school, simply adapting classroom activities did not fully address the needs of the campers.

Other challenges to the library's participation in this summer program related to sometimes conflicting aims within the missions and visions of the university and the library. While both the university and its libraries consider the community in their goals and plans, they are designed as organizations for higher education. Given limited resources, service to primary and secondary students, even in a university-affiliated program, could come into conflict with the core needs of university students, faculty, and staff.

Introduction

Children learn about science and engineering in a variety of contexts, both in and out of school. Participation in informal science, technology, engineering, and mathematics (STEM) activities, along with interest in STEM subjects, is associated with interest in STEM careers when students reach the university level [1]. Out-of-school, informal learning can occur at a variety of sites, including everyday experiences; designed sites such as museums, nature preserves, and libraries; and structured programs such as after-school activities and summer camps [2]. This paper describes the programming provided at one academic library to a STEM summer camp for

middle schoolers [3] and explores the opportunities and challenges of this kind of programming in an academic library.

STEM summer camps can increase STEM literacy beyond what is provided in school. For example, African American and Hispanic students who attended a two-week summer robotics camp for eleventh graders showed increased science literacy after participating in the camp [4]. Beyond increasing content knowledge, STEM camps have a goal of encouraging interest in STEM, with the long-term goal of students going on to enter STEM careers.

Engineering-oriented STEM camps can introduce students to the variety of careers available within engineering [5] and to concepts in engineering design [3], [5]. Many engineering camps are designed for high school students, and increasingly in the last two decades, engineering camps are offered to middle school students as well [6]–[8]. Many STEM camps are hosted by universities [3], [5], [6], [8]–[11].

Libraries also are involved in informal STEM education, including STEM camps. Public libraries, traditionally seen as a home for informal literacy development, have also included STEM as one of their areas for promoting learning and career exploration. In addition to book displays, libraries have incorporated science speakers, in-library experiments, and other STEM activities for children and adults [12], [13]. Makerspaces in libraries are an increasingly popular site for informal STEM learning [14]. Summer programming for children with STEM activities is another avenue that public libraries have used. St. Paul Public Library System, for example, partnered with the University of St. Thomas for a 13-hour day camp co-hosted by a branch of the library and by the university [9].

Academic libraries, with their research and student clienteles, generally include STEM resources to meet the curricular and research needs of their institutions. In-depth programming may extend to high school students, especially those in dual-enrollment programs [15], [16]. Academic libraries vary in their level of support for summer programs for young people, including summer programs in STEM. North Carolina State University, for example, offers a mini-tour of Hunt Library to K-12 groups and summer camps [17]. Even such relatively brief visits can have a positive impact on campers' experiences. One participant in a STEM camp for rising ninth and tenth graders, for example, described the visit to Hunt Library as their favorite part of the camp and "really cool" [10, p. 43].

Some university libraries have been able to offer more in-depth experiences than a tour or other short visit. Temple University has hosted a program where high school students used geospatial tools to map locations within Philadelphia that are significant in African American history, and then used library resources to study those sites [18]. Some academic libraries have developed ways to include library services and information literacy into STEM summer camps for younger

students. For example, librarians at Carnegie Mellon worked with junior high girls as part of a two-week engineering summer camp that included a substantial library research component [11].

At Virginia Commonwealth University (VCU), Cabell Library hosts camp-integrated library instruction for the university-affiliated Everyday Engineering summer camp for middle schoolers. This session includes some elements of a simple tour and some elements of course-integrated instruction that the library provides for undergraduate engineering design students.

Program Description

VCU hosts Everyday Engineering, a one-week all-day camp for middle schoolers (grades 6-8) to foster their motivation, interest, and awareness in STEM. An additional goal of the camp is to encourage campers' career exploration, interest, and commitment to engineering as a possible career. Details about the camp are described in Hargraves and Waller's 2015 paper [3].

In the Everyday Engineering camp at VCU, campers devise inventions, produce prototypes, and present their prototypes to camp staff and to their families at the end of the week [3]. A typical day at the camp includes three components: a prescribed hands-on activity to introduce campers to an area of science or engineering; an innovation and design session where campers learn about engineering design processes, work on mock-ups or prototypes, or prepare for their presentations; and a time for physical activity to promote healthy living [3].

The School of Education, School of Engineering, and College of Humanities and Sciences at VCU work together on the camp. Like many summer camps at VCU, Everyday Engineering is hosted in partnership with the Mary and Francis Youth Center, a university affiliated, donor-supported, sport-focused center that offers year-round programs on campus [3].

The Everyday Engineering charges \$250 per camper, and the camp has about 16 campers per summer. A limited number of first-come, first-served, need-based scholarships are available. These scholarships reduce the price to \$125 or to \$25, depending on the type of scholarship [3]. Although the camp is not explicitly targeted toward students from groups underrepresented in STEM fields, it draws a racially diverse group of campers. In 2014, eight of the campers were African American; six were White; one was Asian, and one was mixed race [3].

VCU Libraries' involvement in Everyday Engineering grew out of its involvement in other programs with the School of Engineering. In the summer of 2014, science and engineering research librarians were asked to participate in a summer bridge program for incoming freshmen interested in STEM majors. For this program, students were introduced to a variety of

undergraduate-level STEM resources available at the library, such as Web of Science and AccessScience, and were taken on a tour of the library, focusing on the science, engineering and study skills collections likely to be useful to freshmen.

Shortly after the bridge program session in the library, a leader active in both the bridge program and the Everyday Engineering camp asked the librarians to provide something like the bridge program's library experience to the summer campers. With little time to prepare and no experience teaching middle schoolers, librarians provided a simplified version of the activities for incoming freshmen, with several key differences. As scholarly articles were inappropriate for a middle school audience, librarians did not demonstrate Web of Science or article databases. The campers had access to library resources only while on campus, so even the age-appropriate library-supplied STEM resources were deemphasized. Instead, session time with the campers focused on free, online resources for a younger audience, including: *How Stuff Works*, *Encyclopedia of Earth*, and *Spark Magazine*. Unlike the incoming freshmen in the bridge program, campers were unlikely to use the library again soon, so they did not take a tour of the library. Instead, after the brief lecture on finding information, they were given time on the computers to work on their projects.

During this first implementation, it became clear that simply scaling back the materials used for incoming college students to more appropriate materials did not adequately address the differences between the bridge students and the campers. In retrospect, it is not surprising that the librarians were poorly prepared for the developmental differences between college students and middle schoolers, as their jobs focused on serving college students and faculty as science and engineering librarians. The campers did not have the same level of basic familiarity with using the web that the incoming freshmen had. The incoming freshmen knew that the program was, in part, there to improve their academic skills and were attentive throughout the session. Middle school campers were not as attentive in the lecture portion of the presentation as the incoming freshmen. Although engineering camp may sound like "nerd camp," the campers nevertheless did not have the same expectations for the camp to have academic content or atmosphere as the incoming freshmen.

Similarly, the content that librarians provided was not fully in line with the needs of the camp as a whole. At the end of the camp, the campers were to have ideated, investigated, and developed invention ideas. More appropriate goals for this research time at the library was for campers to understand the science behind their invention, explore similar inventions, and generate a list of materials necessary to build their prototype. Some of the resources provided were appropriate for the first of these objectives, but none would help campers complete the second and third goals.

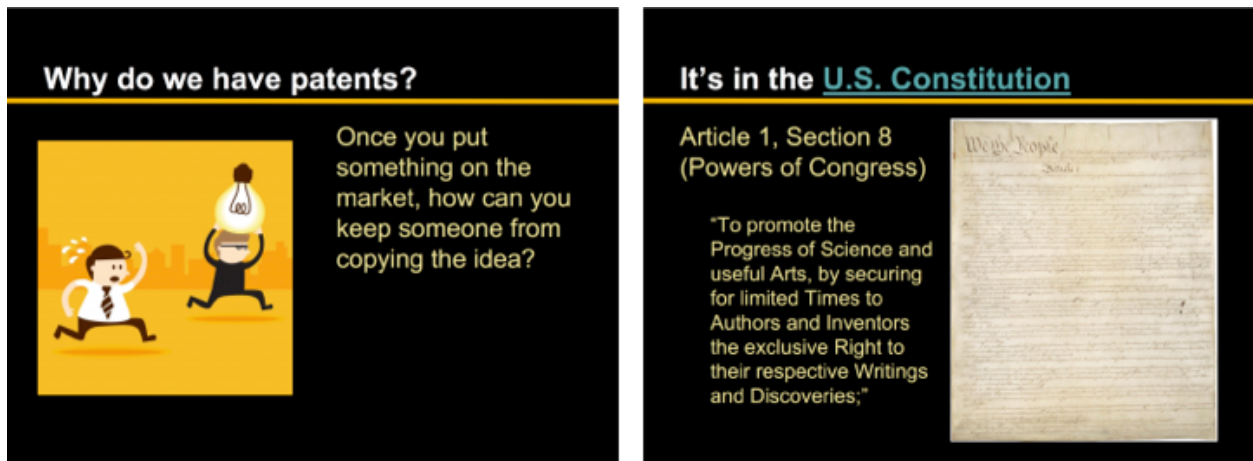


Figure 1: Example slides from lecture on patents.

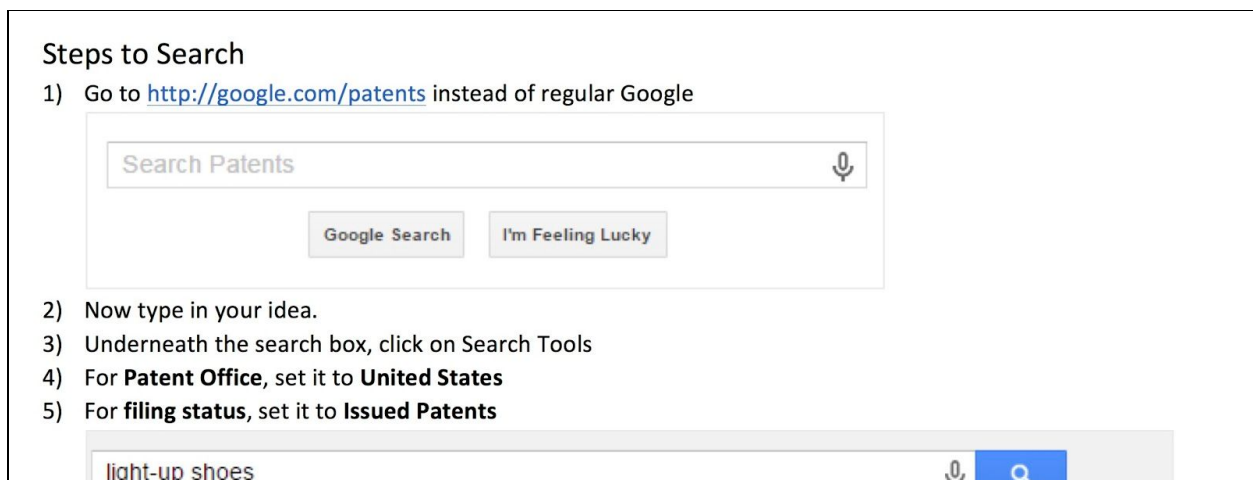


Figure 2: Instructions for using Google Patents to search for patents, from the Everyday Engineering worksheet.

After making these observations, the librarians changed the program for the 2015 and 2016 camps. A short, age-appropriate, lecture on patents and the patent process was added, Figure 1. Most of the lecture on research resources was cut, keeping only a very brief demonstration of a few online resources, such as *How Stuff Works* and *Instructables*, to help campers research the science behind their inventions and discover how to build their prototypes. With less lecture overall, a worksheet was added, Figure 2, to guide campers through the process of searching for similar inventions using Google Patents. In the new session, a large part of the program was still active learning time for campers to search on their own, or with assistance from librarians and camp instructors and counselors, and create budgets for their prototypes.

The library session has not been formally assessed, but it was possible to informally observe what the campers did during their active learning time, what they wrote on their early design

sketches, and what they provided to the camp instructor for supply requests. This informal observation has given information about how much campers were able to do in the time available and of how well their searches uncovered existing products similar to their ideas.

Adapting to Younger Learners

The librarians continue to develop the session to better match the other activities in the Everyday Engineering program by adapting and simplifying the content to match the intellectual development of the campers. For example, regardless of the resources presented to the campers to explore existing inventions and patents, they gravitate to Google Images, a tool that they are already familiar with, for these searches. The librarians are discussing the merits of continuing with the patent searching. Is it better to introduce the campers to patents as part of the invention process or to teach search techniques with a tool the campers already use, such as Google Images?

Adapting the session to the developmental differences between middle school campers and college students also is a challenge that the librarians are working on. Simplifying activities used with college students and making sure there is enough variety in the activities to hold campers' attention is not enough to fit the campers' needs. Ideally, the session would be responsive to both cognitive and non-cognitive development of the campers [19].

This age group has developmental needs that make working with them different from working with high schoolers or young adults. In the middle school age group, these developmental needs include diversity, competence and achievement, structure and clear limits, physical activity, positive social interaction with peers and adults, meaningful participation, self-exploration and self-definition [20]. Adjustments to better meet some of these developmental needs likely would improve the library session.

Because the campers are different ages, at different stages of development, and from different schools, they are diverse in many ways. People in this age group are undergoing rapid developmental changes, with different children changing at different times and rates [21]. Moreover, because the campers have a wide range of experience with computers, they have a large range of searching skills and of experience with web browsers. Much more than incoming college students, they have a broad range of abilities to complete multi-part tasks unassisted. Some of the campers work through the activity unassisted, finish before the end of the session, and look for additional assignments. Others need reminders of what their next step is and to stay on task, even when they have a worksheet in front of them. The time devoted to active learning allows librarians to adapt to this diversity. By having one-on-one conversations with the

campers, the counselors and the librarians can adapt their suggestions to the diverse learning styles of the students, a recommended practice for this age group [21].

Campers have more questions and need more guidance than college students. The need to circulate the room and make sure all of the campers have their questions answered is more pressing than in a college class. The presence of the counselors in the room helps. More adults in the room means that campers are less likely to sit with their arms up, waiting to have their questions answered. Beyond their ability to answer questions about the library activity, the camp counselors make the session run smoothly in other ways. They are able to provide their expertise about the Everyday Engineering camp as a whole to explain how the library activity fits into what campers will be doing later in the week. For campers who finish the assigned tasks early, counselors are able to give the campers additional tasks relevant to the camp. The counselors contribute to the camper's sense of competence and achievement by linking the activities in the library to the end-of-week goals of the camp.

The Everyday Engineering program lets campers know the rules of the camp early on and provides structure and clear limits. For example, the campers understand that they are to ask permission before leaving the room. During one of the three summer camps, the library was under construction. Instead of the campers coming to the library, the librarian taught the session in the School of Engineering building. The location had some advantages. The campers' familiarity with the building made it easier for them to exit the room, whether to use the restroom or to find a snack machine or break area, without also asking where to locate the facilities. On the other hand, their trip to the library gives them an opportunity to see more of the campus and to help them envision themselves as college students.

The Everyday Engineering camp already includes physical activity as part of the daily activities for the campers [3]. Small field trips to buildings on campus, such as the library, give campers additional opportunities to move their bodies. Nevertheless, some of the campers clearly want to move around more than a lecture plus time on a computer provides. Although previously rejected as not necessary, a tour of the library and a visit to The Workshop, the library's new makerspace, would give campers another opportunity for physical activity without straying from the goals of the camp to provide educational experiences that foster campers' motivation, interest, and awareness in STEM.

Offering this service requires librarians to balance the campers' development needs with the goals of the library. For example, the camper's need for positive social interaction with peers and adults creates noise. A classroom of adults working in teams can get loud; middle school campers working in teams are even louder. Although the library session of the camp is held in an area of the library building designated as a conversation / non-quiet area, campers nevertheless

get some dirty looks from other patrons as they talk and move about. The noise was just one piece of a set of challenges related to the mission and goals of both VCU Libraries and of the university.

Fitting in the University and Library Mission

VCU Libraries' Cabell Library, one of two libraries at VCU and the home of the engineering collections and librarians, was reconsidering how to handle group visits in general. From 2014 to 2016, Cabell Library underwent a major expansion and renovation to meet patron demand, as the library space was cramped [22], [23]. Prior to the renovation, VCU students could often be found sitting on the floor for lack of seating. The new building was named a landmark library by *Library Journal* [24]. Demand to use the building for events and to host groups quickly mushroomed [25], with use of the library as a study space for students growing as well. Rather than providing breathing room for patrons and events, demand increased to fill the expanded space.

In response, the library became more stringent in its internal guidelines for external events and programs, including limiting its access to programs for school groups to high school only, unless the program was a VCU-sponsored event from an academic department and had librarian involvement. The loophole for academic department programs with librarian involvement, along with the camp's relationship to the university and library missions and the timing of the camp, allowed the campers' visits to continue.

Although service to middle school campers is outside of the core services of many university libraries, VCU Libraries has a stated value to, "Engage our communities and evolve to meet their needs" [26]. Similarly, Theme III of VCU's Quest for Distinction [27], the university's strategic plan is, "Become a national model for community engagement and regional impact." The local community faces multiple community issues. The preliminary focus areas for the university's plans for a Center for Urban Communities are K-12 education / lifelong learning and health literacy and access [27]. Improving K-12 education is a pressing local need for which the university is a position to participate. VCU is near to downtown Richmond, a city with forty percent of its children living in poverty and increasing poverty in its suburbs [28]. Less than half of the schools in the Richmond Public School system have high enough pass rates on the state standardized tests to be fully accredited [29].

The camp's service to the community can be connected back to VCU Libraries' goals and the university's goals, justifying making some noise and using library resources. Ultimately, however, the camp experience is able to maintain administrative support in the library to continue because it is held in the summer and because the university's summer school program is

not especially extensive. During the academic year, library classrooms are heavily used, and students are busy studying, so both space and quiet are at a premium. During the summer, the Cabell Library building gets much less use, and there are resources available to offer this kind of program.

Future Work

Although two librarians have worked with the Everyday Engineering camp, the library session has always fallen on a day when only one librarian was available. With two librarians, it would be possible to work with smaller groups of campers. For example, one librarian could teach the lecture and search activity to half the campers while the other librarian takes half the campers on a mini-tour of the library. If possible, this could also lead to a collaboration with The Workshop, Cabell Library's makerspace, so campers could try their hand with the equipment. Visiting The Workshop while at the library may provide inspiration to the campers as they are doing their research and envisioning other ways in which they can build their prototype. In the future, the librarians will continue to experiment with different approaches to better match the activities to the particular needs of campers in the middle school age group.

The camp as a whole includes an assessment with an emphasis on campers' enjoyment of the camp and their attitudes toward STEM careers, rather than on their development of specific content knowledge in STEM [3]. Camp leaders also are able to informally observe the development of campers' design skill throughout the program, especially during the end-of-camp presentations. Given the camp's overall goals, if the library portion of the camp were to be assessed, the assessment likely would similarly emphasize the effect of the session on attitudes, for example their recognition of how library and internet research can help them as they work on an engineering task, rather than on their search skills.

Conclusion

Libraries can become involved in university-affiliated STEM summer camps. This involvement enriches the campers' and counselors' experience, by providing a connection to libraries in the research and innovation process and by exposing campers to the wide variety of resources available at a university library. The kind of involvement, however, involves multiple considerations: the structure and goals of the camp, the age and developmental needs of the campers, and the resources available at the library. An academic library may regularly provide engaging educational activities for college students, but younger patrons are different. When working with a middle school audience, programming should change both in content and in structure to acknowledge these differences.

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