5-2017

Computer Scientists in the Swamp: A Case Study and Examination of the State of Computer Science Education in Louisiana

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by

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Undergraduate honors thesis under the direction of

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Submitted to the LSU Roger Hadfield Ogden Honors College in partial fulfillment of the Upper Division Honors Program.

May, 2017

Louisiana State University
& Agricultural and Mechanical College
Baton Rouge, Louisiana

COMPUTER SCIENTISTS IN THE SWAMPS:
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HONORS THESIS SPRING 2017 (CSC)
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Abstract

Computer science programs, whether classes or extracurricular activities, are complex and often costly to plan and run; for cash-strapped schools in the east Baton Rouge area of Louisiana especially, they can be nonexistent. No real frameworks nor plans have been currently drafted or adopted by the state, much less the district, to bring the area's students' interests to one of the highest paying and lowest unemployment job sectors in the country (29). The state has struggled in the past to identify the best ways of reaching students to consider higher education at all, much less in technology, but recent developments have revealed that it may be at a turning point.

Louisiana has often struggled nationally, but it has recently refined its educational standards and implemented more options for students, including AP classes and dual-enrollment (30). In east Baton Rouge in particular, partnerships with local universities yield powerful results when combined with public grants and private donations, especially for technology classes and programs. However, a significant gap lingers especially between public and charter schools, potentially caused by everything from lack of educational support to a lack of funding.

In an effort to discover a cost-efficient, impactful way to teach computer science, GeauxCS was established in a partnership, sponsored by Google (through their IgniteCS program), with Louisiana State University students, who taught a computer science biweekly course at McKinley High School for a semester. The results vary but show a positive effect on students, especially on motivation for their futures in STEM fields.

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Introduction

Computer science education has been a growing concern across the world, especially in the United States with its heavy investment in the private technology sector. In Louisiana, however, the education system continues to lag behind national standards in standard educational requirements, much less computer science curriculum requirements. Much of the reasoning for this is spread between lack of funding, lack of teachers, or simply other priorities in the state. The eastern portion of Baton Rouge in particular is at a crossroads, with many of its charter and public schools excelling in teaching technology while others are severely lacking, despite, in some cases, the same resources being supposedly available.

In order to combat the many problems plaguing computer science classes in the area, many private organizations have stepped forward to fill in gaps of funding and teachers. One organization, Google IgniteCS, promotes partnerships between local universities and the community for undergraduates and graduate students to create classes or extracurriculars in high schools for accessible computer science knowledge. In this case, Louisiana State University received a grant of $10,000, and with a team of twenty people, set out to create an effective program that was friendly to both newcomers and advanced students of computing, as well as containing both hard and soft skills to learn. The main objectives were to promote a positive perception of the field and STEM in general, encourage staying in school, and sharpen technical skills. A study was then conducted throughout the semester long period to measure these perception changes and attitudes, as well as overall effectiveness and impact of the program.

Before exploring the results of the program, here is a brief picture of the education system in Louisiana and especially in East Baton Rouge Parish, with a focus on how it structures its computer science curriculums.

Louisiana's Education System and Computer Science

Background

Louisiana has always struggled in the field of education for various reasons, more recently placing at a rank of 44th out of all states with a grade of D+ in education quality as of 2015 (30). It consistently ranked under the national average. Its high school graduation rate continually falls below average as of 2016, landing at 75% against the national average of 82% of students finishing high school; however, the graduation rates for minority students of Latino and black ethnicities is just as low in comparison (2). Though spending per student is not necessarily a marker for success, Louisiana also spends less per student than the national average at $10,749 versus $11,009 per student; this is as of 2014 however and not as of the most recent 2016 budget cuts that have struck Louisiana (1). Those numbers indicate a much more grim future: a cut of nearly 12% for higher education (mostly in the Louisiana State University college system) and around 2% for the department of education as a whole (28). College enrollment has also dropped nearly 4.4% from 2010 to 2015, potentially spurred by widespread cuts to the heavily-utilized TOPS program, especially with public tuition costs rising on average in the same period nearly 66% (10).

Though education numbers are improving, with more students enrolling in college (and finishing within four to six years) than ever before, as well as rising test rates, Louisiana still continues to fall below national averages in nearly every education evaluation and test scores (30). Though some may blame the budget cuts or difference in curriculum requirements when compared to other states, others believe the learning environment outside of the classroom costs valuable student achievement (30). Regardless, Louisiana has worked tirelessly in recent years to implement programs and "pathways" to ensure every student has educational opportunities (28).

Louisiana has implemented multiple programs and frameworks in order to catch struggling students in their early high school years, whether the struggle stems from their personal life, a previously undocumented disability, or a lack of motivation altogether. The outline includes introducing career and further educational options, ranging from traditional four year universities to trades, as well as continual monitoring of progress and

encouraging students to participate in extracurriculars (28). Students can fall into three pathways, dependent on learning speeds and disabilities: traditional pathway, Act 833 alternative pathway, and an alternative pathway for students assessed on the LAA1 (12). The traditional pathway is as described, being the standard pathway for graduates; however, it can also be tailored for students with some disabilities. The Act 833 alternative pathway involves planning for students who have not achieved basic mathematics and language scores by the sixth through eighth grades, while the LAA 1 pathway is specifically for those with cognitive disabilities and drafting a path to graduation (12). Evidently, the state has and continues to make some effort in regards to improving graduation rates for those who struggle (27).

Computer Science Context

To start, a computer science course or coursework is defined here as any class offering some type of lesson plan involving the creation of technology rather than usage; this does not include classes that are business computer applications or technical drafting (previously defined as computer science classes in pre-2014 TOPS requirements) (32). As of 2017, the most recently revised set of scientific teaching standards were from 2005, which did not include computer science curriculum definitions (5). Another set has been introduced as of the spring of 2017; however, even in this new standard, computer science has no standards nor framework defined (7). The only reference to any type of computer science application involves scientific modeling in the physical sciences, such as physics or chemistry. Perhaps this is due to Louisiana's curriculum requirements not defining computer science as a required course in order to graduate high school; instead, it simply counts as another math credit (26). As of 2017, AP Computer Science A can fill in as a math credit for the Louisiana Basic Core Curriculum or Louisiana Core 4 curriculums, which are required courses to graduate high school and receive TOPS; this will also stand in 2018 with the introduction of the TOPS University Diploma curriculum, which permits the same replacement (26). TOPS, a significant source of scholarship for students pursuing in-state higher education and a great driver in course scheduling decisions in high school, used to require a half credit of a computer science course until the 2014 school year, where it has since been phased out in favor of using AP Computer Science A as a replacement for a math course (31). Nearly 90% of Louisiana high school students received TOPS as of 2015,

so the defined course requirements for the scholarship serve as a major scheduling incentive for students.

At this point, someone can graduate from a Louisiana high school with the more exhaustive requirements of TOPS (on top of their standard curriculum) without a single course in computer science being taken. Students may not have the opportunity to take a computer science class at all because Louisiana is not required to offer it at the high school level. There is also no clear pathway for teacher certification for computer science, and as previously mentioned, even if a teacher is certified, there is no state regulation on what a computer science class should consist of.

Nationally, more than nine of ten parents still surveyed desired the opportunity for computer science to be taught in schools, but only 40% of schools even offer a potential computer science class to begin with (29). At the state level, Louisiana has nearly 2,879 computing jobs waiting to be filled, which is nearly 5.8 times the state average for any type of job demand; combined with the average computing occupation salary in Louisiana at $65,891 (much higher than the state's average salary of $40,810), computer science could serve as a ticket for numerous students to improve their lives (29). However, only sixteen schools in Louisiana (six percent of schools offering AP courses at all) even offered an AP Computer Science course to begin with; these AP exams are the least taken out of all STEM subject area tests (29). At the very few institutions offering these courses, only 150 students even took the classes to begin with, with 19% being female and 16% identifying as a minority (defined here as black, Hispanic or Latino, Native American or Alaskan Native, or Native Hawaiian or Pacific Islander) (29). As of 2014, only 318 college graduates finished with a degree in computer science in Louisiana, with only 23% of students being female. This could be due to the lack of early exposure in high school rather than any lack of interest (29).

The Importance of Early Intervention

In order to produce more computer science graduates and thus fill the largely growing job sector, computer science must be introduced at earlier ages, preferably before college (39) . Students that have access to and take the AP Computer Science course in high

school are eight times more likely to major in computer science altogether and were more more likely to even know that computer science was a potential career path during their high school years (9). Nearly 98% of computer science majors said they were exposed to the field prior to college when compared to non-computer science majors (45%) as well (9).

The Framework Myth

The biggest hurdle to computer science education implementation has often been argued as lacking a consistent framework as well as adequate funding to implement the program or hire the proper faculty (39). Programs such as GeauxCS, which is funded by the Google IgniteCS grant and organized by a university, provide the bridge for that gap. If public funding is not acquired or cannot be, private institutions may have to help introduce, at the bare minimum, extracurricular clubs or activities for students to introduce computer science at the impressionable age of adolescence (8). At the same, the organizations such as Code.org, a byproduct of the Obama Administration's "CS for All" initiative, already have frameworks set aside (by grade year, nonetheless) as well as activities and online programs for students to learn computer science (6). The bare minimum requirement would be a single teacher or volunteer to oversee the mostly independent learning process; however, there are also detailed frameworks written for multiple year programs in a traditional classroom that are also free to consult and use. There are also dozens of free websites not officially government-sponsored where students could code on their own as long as they have access to some web-enabled device--including a smartphone or tablet, not even a traditional computer.

East Baton Rouge Parish

The Funding

All money reaching a local Louisiana school district goes through a public, well-defined process defined by the Louisiana Department of Education (4). State and local funding is combined under a state-defined formula, also called the Minimum Foundation Program, where local funding stems from property and sales tax while state funding is appropriated through the state legislature's designated formula (35). Federal funding is also allocated and typically targets specific populations of students (such as by "at-risk"

factors) or programs (such as teacher training). Every school district ultimately has its own formula for distributing funding between the schools themselves; however, the East Baton Rouge school district has some of the widest discrepancy in school funding in the entire state (34). This should not be a surprise that discrepancies exist at all, however, since Louisiana was one of four states that scored below average in four measures of "funding fairness",defined as districts fairly receiving funding for education between them based on school quality and population, between school districts in 2010 (35).

East Baton Rouge Parish is considered in the "third fifth" of per pupil funding as of 2010-2011, receiving between $8,507 to $8,938 per pupil; to give an idea of the range, the "bottom fifth" school districts receive between $6,729 to $8,159, while the "top fifth" school districts receive $9,350 to $10,474 in per pupil funding (35). For its average funding, East Baton Rouge Parish schools have wildly different performance results across the district and underperforming metrics when compared to the state average.

Demographics and Environment

The East Baton Rouge school district, as of the 2015-2016 academic year, ranked 43rd in the state's rankings, up one slot from the year before with an average score of 81.3 out of a 100 (37). Compared to state average performance, students in the district tend to perform at or under the scores (37):

Metric	District	State Average
District Performance Score	80.3	88.5
8th Grade Proficiency (ELA)	60%	69%
8th Grade Proficiency (Math)	61%	66%
ACT Average	18.3	19.5
Graduation Rate	66.0%	72.3%
Cohort Drop-Out Rate	20.4%	14.6%

The student demographic breakdown (totalling 41,850 students as of the 2014-2015 school year) is also primarily minority, with 89% of students identifying as a minority race of some

type, black being the majority minority at around 79%. Of those, 59% of students are on a free or reduced lunch program (37).

The family environment in the district is also not particularly highly educated, and it also has a relatively high poverty level, especially for single mothers. As of 2009, in a population census of people aged twenty-five years and older, only 86.7% of the same population had completed high school while 34.3% of citizens of the district had completed a bachelor's level education (15). Out of all families, nearly 15% have a family income below the poverty level, with families consisting solely of a female householder (no husband present) having a poverty-rate income at 35% (16).

Comparison of Computer Science Programs Inside the East Baton Rouge District

The disparity of high schools and their computer science programs certainly widens throughout the state of Louisiana, but the East Baton Rouge Parish school district in particular is no stranger to educational and funding gaps even from school to school. The following three schools serve as a general examination of just how varied an educational experience can be for a young student in the district, from one of the best schools in the state to one of the worst.

McKinley High School and Baton Rouge Magnet especially are a stark illustration of how much funding can differ between public and magnet institutions; both schools are also similarly sized. Both institutions have around 80 teachers and enroll around 1,300 to 1,400 students, though McKinley has grades 8 through 12 while Baton Rouge Magnet only has grades 9 through 12 (20).

Summary of School Comparisons versus Average District Performance

Baton Rouge Magnet High School

Baton Rouge Magnet High School is considered one of the best schools in the state (ranked seventh), and has been nationally recognized as a leading high school (42). Over ninety percent of students have proficiency in English and mathematics, with an average student-teacher ratio of 19 to 1 (42). Around 40% of students here are considered

"economically disadvantaged", or eligible for free or reduced-price lunch (42). There is also only a gap of around 3% between advantaged and disadvantaged students for proficiency in examinations. In nearly every aspect, Baton Rouge Magnet outperforms the district (as well as the state), with a graduation rate of nearly 95% versus 67% at the district level, as well as a college enrollment rate of 92% versus the district's 61% (13). The average ACT score has a difference of nearly eight more points as well, and 23% of students earn Dual Enrollment credits versus the district's average of 5% (13). Baton Rouge Magnet also makes progress with students who struggle, showing a score of 3.8 out of a possible 10 for "students previously non-proficient but who exceeded expectations in the current year" (13).

As far as computer science-related curriculum is concerned, Baton Rouge Magnet High School encourages participation in STEM fields through a variety of incentives. A program called "The National Math and Science Initiative" (NMSI), replicates a national scale program to strengthen performance in math and sciences, especially among the economically disadvantaged (43). This initiative includes teach training and support, more enrollment slots, awards, and additional time for students, and the goal is higher AP scores overall. It also provides ten thousand dollars for equipment and supplies for any classes that identify as AP ready; half-priced AP exams in Math, English, Science, and Computer Science; and, if a student scores a 3 or above on any test, both the student and teacher receive $100 (43). This is funded through a nearly $13 million dollar donation and partnership with ExxonMobil, and the program is slated to launch throughout Louisiana (44).

This is an incredibly uncommon program (only two schools have it), and one that serves to incentivize students to further consider STEM class options. Magnet schools such as Baton Rouge Magnet (and other magnets such as Lee High, who partners with Louisiana State University) commonly have these incredibly well-funded, often university-affiliated or privately-affiliated programs for students, as well as traditional public funding.

McKinley High School

McKinley Senior High School is considered one of the better public schools in the East Baton Rouge Parish school district, with 62% having English proficiency and 42% having mathematics proficiency versus the district averages of 46% and 28% respectively

(20). The school is primarily minority enrollment, with 92% identifying as a minority, and primarily economically disadvantaged, with 73% of students on free or reduced lunch meal plans (20). The gap in performance between disadvantaged and non-disadvantaged students is rather substantial at 17%, but 72% of students graduate versus the district's average rate of 72% (20). Unlike Baton Rouge Magnet, McKinley had a score of 0 out of 10 on making progress with students who struggled academically from the year before (13).

McKinley Senior High School is one of two schools as of 2015 that offers a "Gifted and Talented" program in the East Baton Rouge district; however, it continues to lose traditionally high-performing students to schools such as Baton Rouge Magnet (19). It also has a program catering to students that fall "a bit short" of gifted level called "Great Scholars." Traditional classes are capped at a student to teacher ratio of 33 to 1, but these gifted classes cap the ratio at 19 to 1 (19).

McKinley has also recently received the exact same grant from the National Math and Science Initiative as Baton Rouge Magnet, again providing AP class expansion, paying students for high AP exam scores, as well as assisting in testing preparation session availability and buy additional instructional materials (24). However, McKinley lacks a large amount of foundational resources that Baton Rouge Magnet had when receiving the grant, such as a much smaller computer lab (and other technology supplies) and much older facilities.

Tara High School

Tara High School is one of the lowest ranking schools in the district, and it performs consistently under the state in terms of test scores. On a search for information about the school, it was far more common to see a focus on athletics and about the numerous fights that plague the school between students. They also had a large influx of students in the days after Hurricane Katrina, many of whom were displaced from the rampant flooding.

Of all students enrolled, 92% identify as a minority while 77% are considered economically disadvantaged (13). Tara High School students perform at about the district level or right above for proficiency, and well below the state level (21). 53% of students are proficient in english, while 28% are proficient in mathematics, compared to the district averages of 46% and 28% respectively, as well as the state averages of 70% and 50%

respectively (21). The gap between advantaged and non-disadvantaged students is only around 7%, but around 40% of students who attend the school, on average, are not proficient according to end-of-year state tests (21).

Despite these shortcomings, Tara High School announced that for the 2015 to 2016 school year, they would implement a cyber engineering program, the first of its kind for the area (22). A handful of students were selected to participate in the program, which "covers subjects from cyber literacy to cyber science, cyber ethics and social issues as well as the regular core high school courses" (25). Computer-related college coursework readiness or immediate job placement is defined as a main goal for graduates of the program, which will be open to high school freshmen and sophomores and not depend on individual student performance. Curiosity, according to the principal, is the key requirement. By graduation, a participating student could have up to 15 college credits and could test for various certifications (23).

McKinley High School Case Study

Overall, as previously illustrated, Louisiana lacks computer science programs for a number of reasons, ranging from lack of staff and curriculum requirements to uneven funding allocation. A group of undergraduates at Louisiana State University thought about finding an alternative option for schools who could not afford a traditional computer science curriculum, and, after reaching out to Google's IgniteCS program for funding, GeauxCS was established. The goal for GeauxCS was to create a cost-effective, reusable program that could be expanded or shrunk (both in size and cost) for any school setting, from traditional class replacement to extracurricular. So the three pillars or goals of the program boiled down to the following:

1. To bring computer science exploration to underrepresented demographics through hands-on workshops
2. To increase interest and positive attitude toward computer science in general
3. To encourage students to stay in high school and pursue further education, especially in STEM fields

GeauxCS would serve as an inaugural program from IgniteCS for the state of Louisiana. After much debate and examination of schools around the area, ranging from

already well-funded schools such as Lee High School to private all girl schools throughout the state, McKinley High School was chosen.

Why McKinley High School?

As previously examined, McKinley serves as an interesting case when matched against some of the best and worst schools in the district. Most of its woes stem from lack of funding or proper resources, many of those instead going to magnet schools. However, programs like GeauxCS serve to bridge a gap to more resources, utilizing private funding and, to an extent, media attention through a university to hopefully draw public funding to the school as well.

McKinley was also specifically chosen due to its incredibly high minority and "economically disadvantaged" rates. Louisiana State University also has a partnership with the school previously through student teacher involvement; a relationship already existed here, making it far easier to penetrate administration and have the involvement be welcome. Finally, McKinley also approached us directly (one of the few schools to do so), openly asking for the aid.

Methodology

One main question formed the foundation of the GeauxCS program: how do students like to learn? Splitting the question off into sections, the program aimed to answer the following:

1. Does a hardware (circuits, etc.) or software (programming, etc.) based approach assist learning more?
2. Does an independent (self-learning) or traditional lecture-based approach assist learning more?
3. Does diverse mentor involvement, as well as presentations of soft skills and current events positively impact computer science "attractiveness"?
    a. This will be nicknamed the "soft factor"--anything not defined as strictly programming or hardware related.

Approaching these questions, several assumptions were also taken regarding designing the curriculum itself:

1. Students were assumed to learn best through a project-based curriculum, where skills such as the following would be utilized: collaboration, learning independence, learning by doing, interdisciplinary ties (here, a tie between software and hardware or soft skills and real life application), and a final product (40).
2. Students were also assumed to range in skill level from absolute beginners to being "very familiar" with different coding languages or hardware skills such as circuits.

GeauxCS then would, hopefully, prove the following hypothesis true: an interdisciplinary style class, with a mix of hard and soft skills, focusing on self-discovery and independence, combined with the guidance of a diverse mentor base, would promote a more positive perception of STEM and future education, specifically in computer science and related engineering fields.

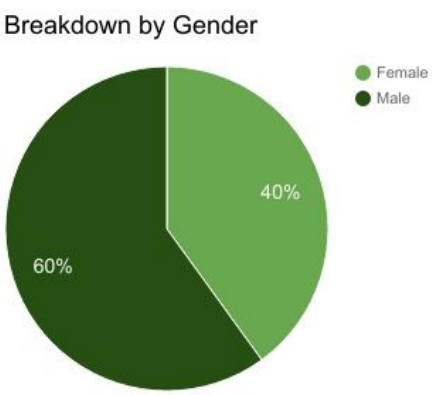
The data was gathered through Google Forms and Google Spreadsheet using semi-required surveys throughout the semester to a total of 28 students. Students were incentivised to perform the surveys through required grades or extra snacks, but near 100% participation was never achieved until student identification or "check-ins" was established to ensure every student participated. Most surveys had a result size of at least 15 to 25 responses. All survey answers were anonymous.

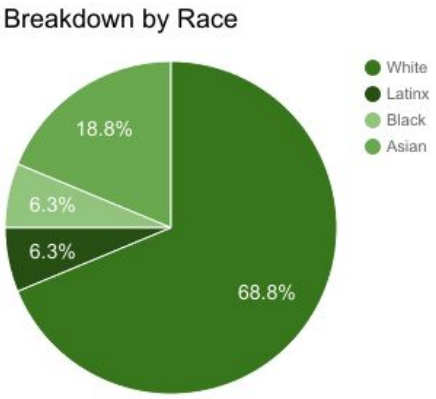
Demographic Breakdown

Teachers & Mentors

When mentors were selected, there was a strong emphasis on the two attributes of diversity and experience. Diversity could not only be of ethnicity or gender but also of interest (i.e. art or music) tied with their computer science skills, as well as their background or "path to college". Experience could be any previous teaching experience or mentorship experience, as well as previous coding projects or classwork.

Nineteen responses were received, and a core team of ten mentors were selected, with a handful of substitutes. The following graphs below illustrate the ethnicity and gender breakdown of the mentors:





Most applicants identified as white males out of all applicants received. Though the ethnicity diversity is not as high as desired, the gender breakdown is nearly equal. The mentors ranged in ages as well as education level from sophomore year to graduate student. Many had different interests such as research in digital music, research in user experience or human computer interactions, interest in start-ups or management, or an interest in infrastructure and hardware, just as a few examples.

The Students

Students came from a mix of ages and backgrounds, though they were primarily male (73.7%) and identified as a minority, specifically black (80% of students), and they ranged in age from 14 to 18. Some had previous programming or building experience (around 73.7%) while others did not, and attitudes were mixed toward their futures potentially involving computer science. Some findings regarding their feelings toward computer science in particular are summarized in the chart below, as well as attitudes toward whether or not they would pursue a career or consider themselves capable of using computer science as a skill.

Statement	Disagree (or Unlikely)	Neutral	Agree (or Likely)
I can apply computer science to my personal interests.	10.8%	26.3%	57.9%
People who do computer science have the opportunity to work on fun and exciting projects.	0%	15.8%	84.2%
I would not be embarrassed to tell others I enjoy computer science.	10.6%	5.3%	84.2%
I could make or build something using computer science.	5.3%	26.3%	68.4%
How likely are you to have a job someday where you would need computer science?	31.6%	21.1%	47.4%

Some had previous programming or building experience (around 73.7%) while others did not, and attitudes were mixed toward their futures potentially involving computer science. Many did not believe they would have a job that involved computer science period, but it seemed that students had little problem thinking computer science was too embarrassing to share as a hobby. 85% believed “Anyone can learn computer science” was a true statement, and every respondent noted that both women and men are equally good at the field. A significant number of students (around 70%) cited a “mentor”,

“family member”, or “friend” as a motivation to learn computer science; the remainder cited personal interest (36%) or a class (47%).

Finally, the survey also measured interest in computer science studies in the future as well as college studies, which most respondents (94%) agreeing with being “interested in attending college” . The chart below illustrate the incredibly mixed response however in regards to pursuing computer science as a career, as well as the students’ own personal beliefs in their technical abilities.

Statement	Disagree (or Unlikely)	Neutral	Agree (or Likely)
I’m interested in studying computer science in college.	36.9%	42.1%	21%
I think I could pursue a career in computer science/tech if I wanted to.	15.8%	42.1%	42.1%
I am not good at computer science, and I do not think I will study the subject in the future.	42.2%	42.1%	15.8%
If I didn’t study computer science in college, I would still want to keep studying it on my own.	31.6%	36.8%	31.6%

Students seem to believe they are technically able yet do not have interest in pursuing computer science long term. However, it is an even split on whether students would continue studying the subject regardless, which could show potential interest with the right motivation or subject.

Performance and Feedback Breakdown

Projects and Technical Skills

Projects were designs to demonstrate different learning styles or tools from session to session, and they varied in content and design overall. Some were more coding or software intensive, while others were more hardware intensive. Various classroom styles were tested, including guided lecture, independent learning, and competitive challenges. The results from each session boiled down to as follows:

Session 1 [Kit Introductions, Hardware, Dependent/Lecture Learning]

Students enjoyed the “hands on activity”, “how enthusiastic the mentors were”, and enjoyed “learning coding” and “using command prompt”. Only a few students disliked the paced (too fast or too slow), but overall the session was enjoyable, with 96% of students “looking forward to the next session”. They were also surveyed on previous hardware and software experience separately. Only 30.6% agreed with the statement “I have previous hardware experience”, while 34.6% agreed with the statement “I have previous software experience”.

Session 2 [Button Programming 1, Hardware, Dependent/Lecture Learning]

For the first time up to this point, a significant portion of students surveyed (31%) said the session had moved too quickly for them to keep up, though all students still understood their objective and what they were supposed to do during class time. Here, they were also surveyed on more technical skills. 44% of students disagreed and 31.8% agreed with the statement “I was familiar with Javascript before I took this session”, which showed a wide range of ability with the session’s language of choice. However, 68.8% agreed with the statement “This project helped me understand how Javascript works and how to write it”, as well as 75.1% agreeing with “This project helped me understand how circuits work and the physics behind it”. The most interesting finding was the response to

the lecture-led learning, where 87.5% of students agreed with the statement “I enjoyed heaving the lecturer (Stephen) walk me line by line through the code”. Again, students cited the “engaging of the mentors” and “the challenge” as things they enjoyed, and not much as things they didn’t enjoy.

Session 3 [Button Programming 2, Software, Independent Learning]

Here, a challenge was introduced that did not come with premade instructions. All students responded that they agreed with the statement “I enjoyed being able to team up with my partner(s) to complete the challenge” and 93.3% agreed with “I enjoyed the competition between me and my classmates to finish the challenge”. They were also surveyed on their first round of independent learning, where 66.6% agreed with the statement “I enjoyed writing my code myself and learning at my own pace”. Evidently, there’s some preference toward having some sort of guide to walk through code, although learning independently still seems to garner good responses. To ask questions however, students preferred turning toward their mentor or fellow partner rather than the teacher, with 66.6% agreeing with the statement “I prefer asking my mentor or partner for help rather than asking questions in a lecture from the teacher”. The pair programming or partner aspect seems critical in students not becoming lost in the material in lieu of asking a teacher.

Session 4 [LED Programming 1, Hardware, Independent Learning]

75% of students looking forward to the next session after this one, and around 25% thought the pacing was either too slow or too fast for their liking. Here, we also had our first presentation, whose results are in the next section. The survey also measured their preference of software or hardware, with 76% of students agreeing with “I preferred building the circuits and setting up the board more than our coding exercises so far”. An extra lecture on how circuits was also given on the board alongside visual aids, which 76% found “easy to understand”. Most students cited “building” as something they enjoyed in the session.

Session 5 [LED Programming 2, Software/Hardware, Independent Learning]

This session was mostly software-heavy and accompanied by a challenge. Enjoyment despite challenges was one factor measured here, with 95% of survey

respondents agreeing with “I enjoyed the session, even if my board had a problem with the circuit, or my code had problems I had to fix”. Despite observing frustration in students with code or hardware problems, it seemed they enjoyed the experience regardless. Programming attitudes were also measured, with 47.6% of respondents enjoying programming, 9.5% not enjoying programming, and a large 42.9% enjoying programming “depending on the subject/context/project”. Framing code with a purpose or impactful project seems to be the key to reaching students who may not necessarily enjoy coding. When asked why students did not enjoy programming, respondents said “it was hard”, “I’m not very good at it”, and “it’s frustrating at times”. Respondents who enjoyed it said it was because “after you’re done you feel like you accomplished something”, “it was easy”, “it’s fun”, and “I like the aftermath”. Overall, students who associated a challenge as a positive thing or focused on the end product (despite frustrations) seem to enjoy programming more.

Session 6 [Speaker Programming 1, Hardware, Indep./Dependent Learning]

This was a presentation-heavy session due to an initial discussion on internet privacy in the face of new legislation, and the results of those questions can be read in the next section. Otherwise, for this section, students prepared their boards and build circuits to hook up a speaker. Here, students citing all of the “wiring” as a significant factor they enjoyed, as well as “building”.

Soft Skills

Soft skill presentations were immediately imperative after the initial session zero with the selected students. Many voiced that they did not know what computer scientists did, and they had little idea of famous historical figures in the field as well as how to find computing jobs. Another large problem was that very few of the students knew what computer science was and how to incorporate (or find) their passions into it. In order to determine what the kids were interested in learning, the teacher sent out a survey with the students ranking what they would like a presentation on. With the limited number of sessions, three presentations were given, as well as an improvised discussion that became a presentation in its own right. The feedback from the presentations and soft skills portions are as follows:

Session 0 [Introduction, Q&A]

97.2% of students surveyed “enjoyed learning about the mentors and their projects”, as well as “enjoyed being able to ask questions and receive answers from the mentors during the session”. They also cited enjoying the “hands on activity” and having “every question be answered”. Also, 100% of those surveyed agreed with the statement that they “look forward to the next session”; evidently, a Q&A with mentors about their studies and their interests was an incredibly positive and engaging introduction to the program.

Session 4 [Presentation - Presentation Skills, Q&A]

A presentation was given on basic presentation skills for both technical and non-technical fields. 88% of students surveyed “enjoyed the presentation” and 88% also “think the presentation was helpful for when I have to present in the future”. A standard format of a short powerpoint and Q&A was used, along with mentors sharing their personal nightmare presentation scenarios and witnessing classmates or co-workers dominate or fail presentations as example stories.

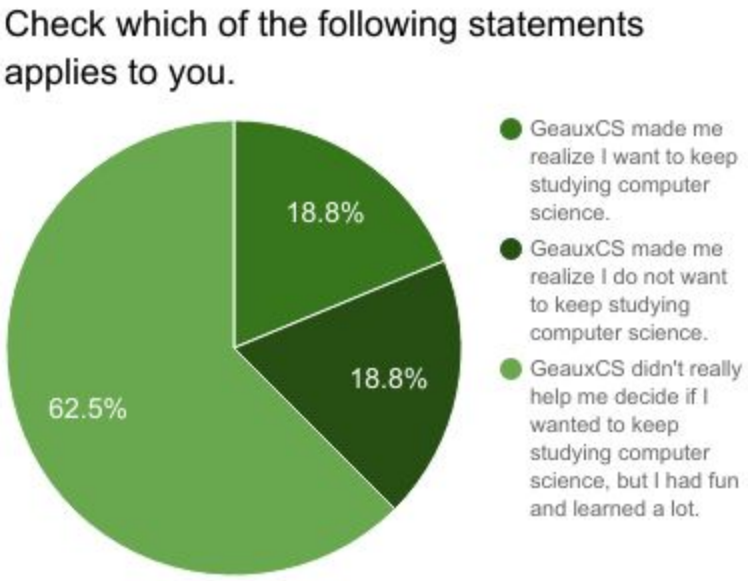
Session 6 [Improvised Conversation (Privacy), Presentation - Internships/Jobs]

An improvised conversation about internet privacy and internet legislation occurred at the beginning of the class. 91% of students found this information and discussion interesting, and 73.9% of students “want to learn more or talk more about current events involving technology”. Though unplanned, it seemed almost half of the students were not regularly exposed to technology journalism, with 53.6% saying they did not keep up with technology news and current events. Finally, there was a presentation on finding a job or internship, including an emphasis on opportunities available at the high school level; in comparison to other presentations, only 69% of students found the information “helpful and relevant to me”, perhaps due to the long time period until they would be searching for a job or internship (being in high school).

Personal Confidence and Positive Perceptions

Another part of this project involved determining if GeauxCS had a positive impact on perceptions of computer science or STEM as a whole, along with potentially pursuing it

as a career path. A post-survey was given to the students after a near-completion of the program, similar to the pre-survey where students' beliefs and demographics were recorded. Overall, all students found GeauxCS enjoyable and useful in some manner. Students defined computer science much more broadly in the post-survey, instead of just "programming" or "coding" often reported in the pre-survey. GeauxCS also helped 62.5% of students decide about whether or not they wanted to keep studying computer science, which broke down to the feelings below:



Students were also asked if they would like to elaborate on their choices, including how they realized they did or did not want to keep studying computer science or what engaged them during the program. Many cited a desire of wanting to "do architecture more", wanting "to be an electrical engineer", and enjoying the "building and wiring", so students seemed to discover their love for hardware or software. Some thought the program was fun overall, while others thought it "wasn't interesting to me" or had "an interesting experience but I wouldn't want it as a career".

47% of respondents agreed with "wanting to continue learning about computer science after GeauxCS", while 47.1% felt neutral about the idea and 5.9% disagreed with the

statement. All students agreed that having "the mentors in GeauxCS helped me have fun in the classroom", and 82.3% agreed with wanting "to keep in touch with the mentors from GeauxCS to help me plan for my future". Also, all students agreed or were neutral with liking to see "mentors from different background and interests", with 76.5% strongly agreeing with the statement. Evidently, the mentor/student relationship is a powerful one that incentivized many students to open up to computer science as an interest, especially when a diverse mentor base is created. Some results about other attitudes, compared to the pre-survey, are below, with tentative responses; more responses may be obtained in the coming few days to be edited into the second draft.

Statement	**Disagree (or Unlikely)**	**Neutral**	**Agree (or Likely)**
I can apply computer science to my personal interests.	5.9% *(vs. 10.8%)*	23.5% *(vs. 26.3%)*	70.6% *(vs. 57.9%)*
People who do computer science have the opportunity to work on fun and exciting projects.	11.8% *(vs. 0%)*	5.9% *(vs. 15.8%)*	82.3% *(vs. 84.2%)*
I would not be embarrassed to tell others I enjoy computer science.	5.9% *(vs. 10.6%)*	0% *(vs. 5.3%)*	94.1% *(vs. 84.2%)*
I could make or build something using computer science.	0% *(vs. 5.3%)*	35.3% *(vs. 26.3%)*	61.7% *(vs. 68.4%)*
How likely are you to have a job someday where you would need computer science?	11.8% *(vs. 31.6%)*	29.4% *(vs. 21.1%)*	58.8% *(vs. 47.4%)*

The most significant findings were a small bump in people who were “likely to have a job someday where you would need computer science” into the neutral or agree categories; students seemed to either consider how widespread computer science was or opened a door to that potential career path. More people also agreed with the belief they could apply computer science to their personal interests than before. Further results about their futures regarding computer science are also below.

Statement	Disagree (or Unlikely)	Neutral	Agree (or Likely)
I’m interested in studying computer science in college.	35.3% *(vs. 36.9%)*	47.1% *(vs. 42.1%)*	17.7% *(vs. 21%)*
I think I could pursue a career in computer science/tech if I wanted to.	5.9% *(vs. 15.8%)*	11.8% *(vs. 42.1%)*	82.4% *(vs. 42.1%)*
I am not good at computer science, and I do not think I will study the subject in the future.	41.1% *(vs. 42.2%)*	47.1% *(vs. 42.1%)*	11.8% *(vs. 15.8%)*
If I didn’t study computer science in college, I would still want to keep studying it on my own.	29.4% *(vs. 31.6%)*	47.1% *(vs. 36.8%)*	23.6% *(vs. 31.6%)*

On average with current results, students who felt negatively or disagreed about potential futures involving computer science were swayed to a neutral position regarding them more so than neutral parties being swayed to a more positive perception. The biggest change was self-confidence regarding pursuing a career in tech.

Finally, overall reviews were collected regarding the program. Many loved the projects, specifically the hands-on portions, though some cited wanting more “challenges”

and “improve on making coding [like actually asking people what interest them]” more relatable. One student cited enjoying the fact that “you guys were all young students perusing your dreams. It made it easier for you guys to connect with us”.

Data Analysis

Hardware-based vs. Software-based Approaches

Overall, this group of students enjoyed a hardware-based approach rather than software-based one; however, all of them enjoyed the projects and hands-on experiences that they were framed in. The physicality of dealing with something rather than simply seeing code on a screen seemed to be a drawing point for many students. They also found it less difficult overall.

Independent vs. Traditional Approaches

Surprisingly, students seemed to enjoy both guided and unguided lectures; many students who cited difficulties with code especially enjoyed the guided style of lecture by both the teacher and mentors in order to properly understand software problems. However, one common thread all students enjoyed was collaboration, both in a competitive and cooperative setting, with the competition component extremely well-received, even without physical incentives such as extra snacks.

“Soft Factor” Reception & Effects

All students seemed to enjoy and find the presentations useful for their future endeavors in the field. Many students approached mentors with future questions and advice regarding their futures, with many claiming they had not thought about it too much beforehand. For many, this was their first exposure to things like resumes and applying for internships, as well as any type of soft skills. Though students do have counselors at schools to guide them in career decisions, many cited the young age of the mentors far more relatable and easier to digest.

Potential Improvements

Prior School Knowledge & Resource Allocation

One significant challenge faced was the startling lack of resources at the school. There was no word that there was a limited number of laptops, often missing or allocated elsewhere when they were needed. Also, all students had smartphones and were supposedly not allowed to use them in class yet persisted in doing so, causing some distraction amongst the students. One improvement needed would be a dedicated pre-loaded set of laptops with all software, as well as back-ups in case of software failure, rather than spending countless hours loading software on ancient computers.

Data Collection

Data collected was through surveys, some tied with in-class grades and others not, but many seemed to do the wrong surveys, do them twice, or refuse to do them altogether. One complaint was doing too many. To remedy students not doing them, a number identification system was added so every student would be held accountable, which improved survey numbers. However, something to consider would perhaps be other incentives, such as a ticket into a raffle to win a prize per survey they do with proof.

Audience Consideration

No knowledge of the students were gathered before the program and curriculum were mostly crafted. However, looking back on student responses, this particular class may enjoy more hardware-based projects or coding projects tailored specifically to that area, such as a lower level language. In the future, demographic information about the students should probably be gathered before the program begins.

Conclusion

Overall, despite lacking resources and uncertain audiences, GeauxCS seemed to be a success with providing a more positive computer science experience. It reached students who dismissed the subject entirely and brought them to a neutral belief, as well as assisted students in discovering whether or not the field was for them entirely. Both mentors and mentees gained valuable skills and relationships along the way, and it seems that extracurricular classes such as this one provide a meaningful impact on students in exploring STEM options.

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