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ABSTRACT

Parents, business leaders, and politicians agree that computer science (CS) education is a critical and necessary component of U.S. high school curriculum. Today however, key indicators, such as course offerings and participation in CS-related advanced placement exams, point to a significant lack of K-12 CS curriculum. Statesboro High School in Bulloch County, Georgia does not currently offer any formal CS-related course, making it a prime example of this gap. Faculty from both the high school and Georgia Southern University's Department of Information Technology decided to work together to 1) demonstrate the need for a CS curriculum, 2) demonstrate the desire for CS-related courses, and 3) begin laying the foundation for a structured CS program conforming to Georgia state policy and guidelines.

The need for a computer science curriculum is evidenced by the depth and breadth of private industry and government programs calling for and supporting CS programs. The desire for CS courses is clearly evidenced by multiple parental surveys and job opportunities, as well as the overwhelming positive student engagement in an on-site tech fair and informal survey regarding the start of a new after-school tech club. The foundation for building a computer science program at Statesboro High School began with the creation of an after-school tech club – named Code Blue – to establish potential enrollment and test various topics. Faculty and researchers learned multiple lessons concerning the technical details, execution plans, instructional techniques, and politics for introducing new curriculum.

Keywords

Pedagogy, curriculum, computer science, information technology, feeder school, high school, high school curriculum

BACKGROUND

In a 2014 survey conducted by Gallup and Google Inc., ninety percent of U.S. parents indicated that "offering opportunities to learn computers science [was] a good use of resources at [their] child's school" (Gallup, 2015). In 2016, President Obama called for a "bold new initiative to empower a generation of American students with the computer science skills they need to thrive in a digital economy" (Smith, 2016). In 2017, fewer than 10% of U.S. high school students took a computer science (CS) advanced placement (AP) exam (CollegeBoard, 2017). Clearly, computer science represents a critical element of U.S. educational efforts. However, not all high schools are properly equipped or funded to offer a quality computer science curriculum. Statesboro High School – part of the Bulloch County school system, located in Statesboro, Georgia – is a prime example of a school with both a desire and a need for a CS program. Although it has in the past, the school does not currently offer any CS courses.

THE HIGH SCHOOL TECH CLUB

In March of 2017, Georgia Southern's Department of Information Technology entered into an informal partnership with Statesboro High School to explore possibilities for the introduction of computer science curriculum. Although the need for CS curriculum in the U.S. is clear, faculty needed to establish that a desire for CS courses existed on the part of the student body, to ensure adequate enrollment in courses. If informal indicators showed a positive response from the students, the faculty would move to gather formal measures to justify new course development.

In order to informally gauge student interest, faculty from both institutions organized a "technology showcase" led by Georgia Southern faculty and students. The event, held in the school's gymnasium, consisted of more than a dozen "learning stations" focusing on topics and technology such as computer programming, security, robotics, networking, and web development. The 450+ students who attended the event were asked to indicate their interest in each of the learning stations, provide their overall impression of the event, and indicate if they might be interested in an after-school "tech club" beginning in August. Feedback from the students was overwhelmingly positive, with the highest levels of interest focused on cybersecurity, web development, and programming. In addition, a significant number of students indicated they would be interested in joining an after-school tech club.

Based on the positive feedback, the high school faculty moved forward with the creation of the tech club. The organization was chartered, approved, and began meeting weekly in the fall of 2017. Initial attendance averaged 7-10 students. By late November, the average number of attendees rose to 10-12. There was diversity in the demographic makeup of the students in the tech club which included special needs students. Georgia Southern faculty facilitated each meeting, which lasted one hour. The meetings typically began with a fifteen-minute technology demonstration, followed by a hands-on student activity. Each day's topics were selected by the student members and included such disciplines as programming, game development, web development, security, computing hardware, and networking. Student enthusiasm for the hands-on activities often led students to continue working on the projects at home and to report back on their individual efforts at the following club meeting.

LESSONS LEARNED

Technical Details

One of the biggest challenges university IT faculty will encounter while teaching in a high school are the differences in the computer laboratory environment. For example, although many university IT labs grant users administrative rights in order to accomplish their learning objectives – installing software, configuring operating systems, etc. – high school labs are highly restricted. Very few users, including faculty, are granted administrator rights. This can present a challenge for university faculty who will only be on campus one or two hours a week. Faculty cannot assume they will have the same flexibility they have in their university campus environments. Multiple approaches to each learning outcome will need to be designed since there will be technical restrictions that will not be foreseen and, with the limited access, there will be little time to test everything. This barrier does allow university faculty the opportunity to see another perspective to security and administration. It will also give an appreciation for the openness certain learning environments.

Execution Plans

The limited access in terms of time is just the beginning of some of the execution issues. Walking into a university classroom is fairly easy but getting into a high school – much less into the classroom in front of minor-aged students – is much more regulated. Permission for university faculty to get in front of high school students initially and on an ongoing basis must be established at the onset. The next hurdle is establishing a convenient meeting time for both the initial "technology showcase" and then the tech club. For the "technology showcase" there was a need to address as many students as possible which required this to be during the normal class day, removing student from their regular classes. This requires the cooperation and coordination of the school's administration and teachers. The tech club was offered as an after-school club but this meant that

transportation of the tech club members needed to be addressed. University faculty rarely have to deal with how students get to and from class and this was a new dimension.

Instructional Issues

University students often come straight from high school but there are vast differences between the average age of high school students and college students. The average age would be not one year but four years apart. This alone is significant but another difference is that high school students are required to be there and those in a university have chosen to be there. The mindset of the students, even if they have chosen to be in a club, is significantly different from their university counterparts. The ingrained techniques university faculty use in their classrooms may not work in the high school classroom. Keeping a high school faculty member in the classroom with university faculty is extremely helpful to assure compliance with rules and regulations but also with classroom management. Multiple approaches to address not only technical issues but also classroom management and instruction are a necessity. University faculty teaching methods are geared towards an older group of students with a wider array of experiences. High schoolers are more homogeneous in this respect and while sometimes advantageous, can also completely derail a lesson if it is too difficult or too simple. Backups for either situation need to be ready. In any case, high schoolers are different.

Political Obstacles

Lastly, there is a political set of hurdles. University faculty are accustomed to bureaucratic overhead and processes and should understand that this comes from a need to manage limited resources. Having to justify expenditures and answer the needs of diverse stakeholders should not be new. However, at the high school level there seems to be significantly tighter budgets with much more contention for resources. This means that adding curriculum will take resources from other areas. While there may be state guidelines that justify the addition of computing curriculum, they may be unfunded or underfunded. All this means that there has to be significant buy-in from the administrations at the high school and school board levels to champion this type of change.

CURRICULUM DEVELOPMENT

The "technology showcase" and tech club were intended as stepping stones from which to launch the CS curriculum. While all stakeholders agree there is a need for computer sciences classes, implementation is slow. There are many reasons for the lack of progress. The first is a shortage of high school educators and administrators with the requisite knowledge to develop the curriculum. The U.S. faces of shortfall of labor with computer science skills and public school systems face the same problem. There is also difficulty in place of the curriculum and the responsibility for it. Determining which core discipline the program should belong to is a matter of much debate. In the time necessary for this matter to be settled, computer technology has continued to advance and make any preliminary curriculum obsolete. This brings to light another difficulty in computer science curriculum development, its ever-changing nature. The curriculum must be continuously maintained. The material must be reviewed and updated on an annual basis to keep the knowledge lag to a minimum. This creates another drain on the already stretched resources of schools.

CONCLUSION

Trying to implement curriculum changes at the high school level requires significant planning in all areas; university faculty, high school administrators, high school faculty, and high school students, to name a few. To make lasting changes, there needs to be reallocation of funds which are often under high contention. This means that there needs to be a champion with influence over all those contending for those funds and other necessary resources. From the lessons learned it is clear that there are many different facets to developing and implementing a computer science curriculum in a public high school. In order to make progress, there needs to be a cat-herder, if you will, to champion the cause and reign in the various players. The goal of having a computer science curriculum is to give students the knowledge and skills they need to be successful in an ever more technology driven world. That goal can easily get lost in the details of delivering computer science to students.

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