Memorandum

To: Dr. Thomas L. Rogers
Re: Coding and Our Shift towards Information and Communications Technology
From: A. Kozlowski, D. Kranz

Date: September 17, 2015

A Brief History

A recent article in the Economist (April, 2014) sums up what has happened with "coding" in education.

> "When computer science was first taught in some schools in the 1970s, generally as an optional subject for older pupils, computers did little unless given instructions in a special language. So classes focused on programming. But the advent of ready-made applications and graphical user interfaces in the 1980s saw a shift to teaching "ICT" (information and communications technology) - how to use computers for word-processing, creating presentations and the like. The result was that pupils left school with little idea how computers work. The pendulum is now swinging back to teaching coding in schools for a few reasons.
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> 1) Digital technology is now so ubiquitous that many think a rounded education requires grounding in this subject just as much as in biology, chemistry or physics.
>
> 2) Employers' complaints are another. The shortage of skilled programmers is clear from the high salaries they command.
>
> 3) The shallower the pool of people who know the basics, the smaller the number of potential tech entrepreneurs.
>
> 4) A growing share of jobs requires "computational thinking" - the ability to formulate problems in such a way that they can be tackled by computers."

Recent high profile announcements have drawn attention to coding in the K-12 curriculum. New York City has announced that in 10 years they will offer computer science to all students[1], and Microsoft announced a $75 million grant initiative to advance computer science education[2].

The Syosset school district has already made a substantial investment in developing computer science offerings for students. The Syosset Board of Education's emphasis on enhancing the district's posture toward technology generally and most recently to explore enhancement of computer coding opportunities offers an opportunity to review what is already in place, and to consider options for expansion of efforts.

1. http://www.nytimes.com/2015/09/16/nyregion/de-blasio-to-announce-10-year-deadline-to-offer-computer- science-to-all-students.html
2. http://fortune.com/2015/09/16/microsoft-invest-75-million-computer-science/

In Syosset, we have a variety of opportunities for students to gain experience in coding and "computational thinking" at all grade levels. We have tried to strike a balance between conceptual exercises in algorithms and actually writing programs. We have increased the integration of coding/computational thinking into different curriculum as well as extracurricular clubs at various grade levels.

What follows are courses, clubs and student activities that the District has offered through the Board's ongoing support as well as recommendations for the next steps to enhance these offerings.

High School

Computer Programming Classes offered through our Math and Technology departments:

Class	Credits
Introduction to Computer Programming	0.5
Visual Basic Application	0.5
Advanced Computer Programming	0.5
AP Computer Science	1.0
Sy-System Robotics	1.0
Robotics	1.0
Advanced Algebra	1.0
Math Theory Honors	1.0
Math Research	0.5

- **Introduction to Computer Programming - 0.5 Credit, Grades 9-12** - This course is a beginning programming course. Students learn the basics of creating computer algorithms through the computer program AP Inventor and the Alice Programming application tool. Students with no previous programming experience will learn how to design and create interactive projects.
- **Visual Basic Application–0.5 Credit, Grades 10-12** - Students who have a foundation in programming can expand their knowledge with more sophisticated applications of programming. Additional applications in this class will include: retrieving and storing data and sequential data files; creating and using data bases of records and files; using control arrays and user defined data types with multi-dimensional arrays; graphing lines, circles, ellipses, and other functions using a coordinate system; using timer control and graphics and scroll bar functions; and using string functions and bar graphs to display data. Several major projects will be assigned and may include such things as a simulated graphing calculator as well as Pong and Hangman.
- **Advanced Computer Programming - 0.5 Credit, Grades 10-12** - Students will continue to learn object-oriented programming through the computer languages of Python and JAVA. JAVA is currently the teaching language of choice by colleges and the AP Science course. The application "Greenfoot" is utilized to develop programs and create interactive games.
- **AP Computer Science - 1 Credit, Grades 11-12 (open) –** Students wishing to gain Advanced Placement credit in computer science. The major emphasis will be on program methodology, data structures, and algorithms. The JAVA computer language will be used to implement computer-based solutions to particular programming-related problems. The course follows the College Board curriculum that will prepare students to take the Advanced Placement exam offered in May.

- **Sy-Stem Robotics - 1 Credit, Grades 10-12** – For students who are interested in taking Robotics Design and Engineering this course provides a comprehensive approach to problem solving in real-life situations using Science, Technology, Engineering, and Math (STEM) through Robotics. This provides an opportunity for students to combine computer programming with mechanical and tangible outputs. Students will learn how to program the LEGO Mindstorm robots using RobotC software and explore multiple engineering disciplines using the Tetrix hardware. The class will work collaboratively while emphasizing critical thinking, team building skills and student driven instruction. Students will work hands-on in both a computer programming lab and a technology materials processing lab. They will design, construct, program and test various robotic activities. The activities and opportunities align with preparation for multiple engineering fields and engineering career patterns. This is a new course for the school year 2015-2016.

Technology Classes that incorporate coding into curriculum:

- **Robotics – 1credit – grades 10-12** - Students will learn the basics of designing, building and programming (JAVA) a robotic device to meet specific design criteria. This class uses the FIRST Tech Challenge as an inspiration. The competition includes autonomous and operator controlled operation in tournament style matches (via PlayStation style controllers using Bluetooth for communication). Course topics will include mechanical systems, electrical systems, and elements of structures, motion control, programming, and radio communication. Student teams will develop strategies working in a competitive, fun environment.

Math Classes that incorporate coding into curriculum:

- **Advanced Algebra – grades 11-12** – Students learn how to write computer programs using the Basic programming language on the TI-Calculator. Mathematical functions and equations are introduced along with coding terminology to produce graphical interpretations of linear equations. Students also learn how to program the TI-calculator to manipulate a TI-Robot reinforcing functions and rate of change.
- **Math Theory Honors –grade 11** - Students learn how to write computer programs using the basic programming language on the TI-Calculator. This course content provides the application of these programs to mathematical proofs and conjectures.
- **Math Research – grades 10-12** - Incorporated into curriculum is experimental mathematics where students use software such as Mathematica. Mathematica is a computational program which can be adapted to the experimental needs of the students' research projects. Students learn to manipulate the program to meet their research design needs. Students, as part of a research project, have also programmed apps for Mathematica which are now currently shared on the program's website. Students in research have also learned the Python language using Code Academy.

Clubs and Activities:

- **Girls Who Code** – A national non-profit organization working to close the gender gap in the technology and engineering sectors. Students are learning how to program using JAVA script. All students are invited to participate.
- **Website Club** – Students develop and maintain the high school's website page using html.

Activities

- **Hour of Code** –participate in the national initiative to expose all students to coding K-12. All schools are encouraged to engage students in some form of coding during the second week of December. Computer Science teachers will be asking students to participate as an after school activity.

- **Programming Group –** students practice as teams to prepare for programming contests. Computer Science teachers will be asking students to participate as an after school activity.

Teacher Professional Development:

- **CSTA (Computer Science Teachers Association) –** Two of our Computer Science teachers are members of the executive board of the newly revived organization for the greater Long Island area. This association offers opportunities for our teachers to interact with other Computer Science teachers in the area to promote computer science and share teaching strategies.

Middle Schools

Classes

- **Computer 6** - full year alternate day course- Students will become proficient in all computer applications. Skills to be mastered include keyboarding, word processing, spreadsheets, desktop publishing, presentation and movie making software. This course will update and expand safeguards regarding Internet Safety. Students will learn how to safely utilize the internet as a research tool. Computer 6 students will use computers to participate in integrated team and school-wide activities. Students will create brochures, posters, greeting cards, spreadsheets and graphs for science projects, web quests and classroom presentations.
- **Introduction To Technology/STEM Exploration** –10 week course offered to all sixth grade students - Through STEM related activities that include reading, writing, problem-solving challenges, hands-on experiences, mind engaging activities, and discussions students will learn how technology developed through the ages, and how it influences our lives today. Students will develop an understanding of how technology continues to grow at an exponential rate due to the vast amount of information that is accessible today.
- **Technology/STEM Exploration – grade 7** - Students will broaden their knowledge while learning to integrate relevant topics about STEM applications while participating in real-life collaborative, cooperative, and competitive activities. This hands-on course provides an introduction to the world of energy that includes digital photography, web page design, virtual modeling, engineering of solar and battery powered cars. Students also code HTML documents. They use documents and files from Google docs and import them into their HTML code files.
- **Technology/STEM Exploration- grade 8** - This course involves a variety of STEM activities where students will design, engineer and test solutions to problems. Using a cloud-based virtual modeling STEM application students design, analyze, and create manufacturing outputs for CO2 powered dragsters in a virtual race. Using creative and critical thinking skills while applying classroom learning students engineer their own CO2 powered dragster. This hands-on course develops a practical understanding for safety, technical drawing, design and engineering.

Clubs

- **Technology Club** - The technology club supports a team that competes in the LEGO Robotics Competition at Adelphi University. Students develop the code using HTML Scratch which is needed to get the robots to function. Last year, for the first time, the team was awarded for their work.
- **Coding Club**- A newly formed club for the 2015-2016 school year. The club headed by two Science teachers will teach students coding related to gaming and other activities.

- **Computer Animation and Games club** -- Where students learn and apply iterative programming concepts such as conditional statements through game creation using tools such as Kodu Game Lab and ALICE platforms. Students also dabble in Scratch.

Activities

- **Hour of Code –** participation in the national initiative to expose all students to coding K-12. All schools will be encouraged to engage students in some form of coding during the second week of December.

Elementary Schools

- **New part-time STEM teacher –** This past year, the newly hired part time STEM teacher worked with the students and teachers in the enrichment program to become creators of technology instead of just consumers of technology!
- **"Scratch" Programming Instruction in Project Beyond –** Students began to explore the programming tool "Scratch" that was created at MIT which allows young students to develop computer games out of on-screen building blocks that have been compared to "virtual Legos."
  - Project Beyond teachers began to incorporate this exciting new tool in various ways depending on what units they were currently teaching.
  - Robbins Lane students explored many of the tools and sprites available in the program. At South Grove students created animated commercials for their superhero characters. Walt Whitman third graders created animations of the principles of aeronautics as part of their airplane unit and fifth graders created animations about the brain!
  - The fifth grade students took it one step further by using the "Makey Makey" invention kits from their school's maker cart to connect their physical brain model to the computer to make it an interactive controller for their animations!
- **"We Do Lego Robotics" Kits –** This year the district is providing "We Do Lego Robotics" kits that can be hooked up to the computer to interact with the animations the students create in Scratch.

Recommendations for further Exploration:

By its very nature the world of computer programming is a fluid and dynamically changing profession. Languages evolve, new platforms arise, and the marketplace invents and then demands new products. Likewise, new professions are emerging and evolving in Computer programming, Computer support specialist, Computer systems administrator, IT manager, Web developer, Market research manager, Information securities, Actuarial and Systems Engineer to name a few.

Our faculty and staff have already been exploring further opportunities to enhance our curriculum through a 3-part strategy:

1. **Lay Foundation –** We can enhance the opportunities for computational thinking and age-appropriate computing exercises at the elementary level.
2. **Enhance Breadth –** We will build on this foundation by offering additional breadth at the secondary level, and by evaluating offerings for currency and relevance in this fast-changing domain.
3. **Articulate Sequencing –** We can more explicitly structure the sequencing from early foundations through high school.

High School:

Possible new courses to be offered would include:

- **AP Computer Science Principles (AP CSP) course** — the College Board will be launching an AP Computer Science course as of September 2016, which introduces students to the fundamentals of computing and the creative aspects of programming with a unique focus on creative problem solving and real-world applications. This dynamic new course may help attract diverse students — including those typically underrepresented in computer science — to learn computing skills and understand their relevance to college and career plans. The high school will be proposing this course at Secondary Curriculum Council during this year 2015-2016 for approval.
- **Applications Development Class** – will be proposed at the Secondary Curriculum Council and would teach students how to program and create applications for iOS/Android. Focus will be on creating applications to benefit the greater Syosset School Community. This course will be proposed for approval.

Middle School

Possible new courses to be offered would include:

- **VEX Robot Kits** – A proposal from both middle schools is being developed for 6th grade technology. The goal will be to purchase VEX robot kits to teach all students Robotics. The proposal also calls for coding and robotics to be integrated into the curriculum in grades 7 and 8 in successive years.

District

- **Multiple Pilot Projects** – The district's Technology Committee is reviewing proposals sent forward by teachers at all grade levels to enhance and create opportunities for students to become creators and consumers of technology and the digital world.
- **Raspberry Pi** – One of the most recent introductions to this is 'Raspberry Pi' where students will learn to use Scratch and Python to create new applications for their use.
- **Focus on Top 10 Languages** – Teachers will also be exploring the top ten computer languages such as SQL - manipulating data, Java – google uses, HTML – web design, Java Script, C++ - operating systems, XML – everywhere, C#, C , Perl and Python to create class work and or courses to be proposed and new club activities to allow a greater number of students to participate in coding.