Grosse Pointe Public School System

Department of Curriculum and Instruction
Educational Programs Leadership Council

Proposals for Modification to Existing Course

Course name: STEM: Bots, Coding, and Applications
(name change from "Robotics")

Full name: Programming, Designing & Building Robots

Credits: 0.5

Duration: (semester, year, etc.)
Semester

This is being proposed:

☐ for study

☐ for pilot (complete page 2)

☐ for approval (complete page 3)

What is the rationale for the proposed change?
- As Robotics was formerly in the High School Program of Studies, it was a full year course. This is a change to make it a semester course.
- This curriculum would enhance the learning and experience of students in a classroom structure with applied projects that reinforce theory and lead to a deeper level of learning and experience with programming, engineering and design.
- This curriculum, as laid out below, is robust. It is also succinct and, when followed, fulfills only 14 to 15 weeks of instruction. It is for this reason that the former "Robotics" course be made a semester class rather than a full year class.
- An altered name for the course to "STEM: Bots, Coding, and Applications" is necessary to differentiate the class from the North/South *Robotics* team (the Gearheads). A student need not take the class to be involved in the club, nor does a student need to be involved in the club in order to enroll in the class. An altered name for the course to "STEM: Bots, Coding, and Applications" is necessary to differentiate the class from the North/South *Robotics* team (the Gearheads). A student need not take the class to be involved in the club, nor does a student need to be involved in the club in

order to enroll in the class. However, we foresee that this will be a natural pathway for many students into the robotics program. Additionally, the name change will be a more accurate reflection of the skills students will acquire and the activities they will participate in throughout the course. The name change will also benefit students on their college applications as STEM and coding are items colleges are looking for on transcripts.

- The following is from the Carnegie Mellon University National Robotics Engineering Center (http://www-education.rec.ri.cmu.edu). There are references to the Pittsburgh and Southwestern Pennsylvania schools but this directly applies to all regions. According to correspondence with the director there are over 6,000 schools utilizing the middle school and high school curriculum.

<u>Teaching Math, Science, Engineering and Physics using Robotics</u>

Bots & Coding would give students opportunities to develop the following work related competencies:

- Time management
- Resource allocation
- Teaming
- Information accessing
- Systems analysis
- Design and engineering

When students design and build robots they study math, science, engineering, and physics. Students are immersed in geometry, trigonometry, electronics, programming, computer control and mechanics while using industry standard software and hardware. They learn to compromise when working in teams. They learn the importance of time management and resource allocation. They are introduced to the concept of systems and systems analysis.

It challenges students in activities using today's technologies.

It is an excellent tool to teach systematic problem solving and design strategies.

We need to do a much better job of influencing a larger number of women and minorities into entering this important field. If we as a society would like to continue to maintain the standard of living to which we have grown accustomed, then we need to do a much better job of exciting and influencing youngsters to pursue science and technology related careers.

Girls as well as boys discovered that designing, building, and

programming robots is fun. Bots & Coding immerses students in today's technologies. We expect that some of the same students we influence today will develop the technology we depend on in the future.

How does this change fit with the general research on education or in your curriculum area?
- When the course previously ran (as "Robotics"), the purchased curriculum package from Carnegie Mellon University's Robotics Academy ran provided lessons and activities that concluded in December of the 2008-2009 academic year.
- The teacher at that time had to make the rest of the year's curriculum up as it went along.
- Interest in the course languished, and did not achieve adequate enrollment for implementation the following year.
- There was a lot of confusion surrounding the "Robotics" course and the Gearheads Robotics team, as well as whether enrollment in the course was a requisite for being on the team, and vice-versa.

The EPLC will hold a hearing on this proposal in order to assist the development of assessment committee plans and to vote on it. Following EPLC approval, an assessment committee forms and develops the proposal into a recommendation report.

Proposer: Matt McGuire

Others in agreement:
Lisa Bouda   Moussa Hamka   Kate Murray   Don Pata
(at least 3)

Revision Proposal

Enrollment

How many students are likely to enroll in the pilot?

> Minimum: 20 students, Ideal: 24 students, Maximum: 28 students. Any more than 28 becomes a management issue- this is a class in which students will use hand & power tools, small & delicate pieces of equipment, and ultimately moving robots. This is a class that requires students to move around, as well. With more than 28 students, their safety may be jeopardized.

Quality Standards, Benchmarks, and Assessments

What are the proposed standards of the course? What assessments will indicate whether the course was successful? (ie AP tests, MEAP/HSPT scores, final exams, course assessments, etc)

- One of the attached documents, NGSS standards with VEX, shows which NGSS standards are addressed by the Robotics Academy's VEX Cortex curriculum.
- The most useful assessment for this type of hands-on class is the product itself: a working robot that can carry out a sequence of complex, pre-programmed commands; detect and react to external stimuli; and respond to remote-control commands.
- The demonstration of the aforementioned abilities in a competition-style arena in which certain tasks are to be completed.

Possible Resources, including integration of Technology

What resources, including technology will you use and how will these be integrated into the course?

> Bots & Coding will require a computer for each group & robot kit. each computer must have the RobotC programming compiler and application installed, as well as to interface with the robot so as to transfer the programmed commands to the robot's CPU.

> The teacher will require a projector to display the video lessons that show the students how to go about building & programming the robot in different ways.

> Tools are required as well: hacksaws, a vice, pliers, wrenches, screwdrivers, etc. are expected to be used by the students, under safe shop guidelines. A power drill, operated by the teacher only, may be necessary for certain steps of the robot's construction.

Differentiation

What accommodations for differentiation will be implemented?

> The Bots & Coding class will draw a wide range of students. There are those who have no interest in tools but who desire to write the code, an indication of higher level thinking, may have been less than ideal students in Math & Science. There are students who simply want to build and operate a robotic machine. Much of the content of the class will be made up of team activities and students will learn how to work with others, bringing together all levels and learning styles, raising the outcomes and competencies of the entire group. The curriculum is designed so that groups could work at their own pace if necessary. There is a section of the VEX Cortex Teacher's Guide (page 9) that suggests how the VEX Cortex curriculum can be differentiated by group.

Costs

What costs do you anticipate? What additional expenditures would be needed for full implementation? Note: please address staffing, hardware, software, materials, etc.

Teacher Training: $999.00

Summer sessions (5 days) are available three different weeks for $999.00. In addition, online training is available for $499, but would require equipment & software to be purchased and delivered prior to session start.

Curriculum:

- Cost of the CMU Robotics Academy curriculum $499.99
  - Annual fee for the classroom license. This cost may be multiplied if multiple sections of the class run in the same semester.
  - Purchased from the Robotics Academy's RoboMatter Store.

Hardware/Software:

- ROBOTC programming software is free with the purchase of any VEX materials from VEX Robotics.
- VEX Classroom Bundle (Swept Away): $5,299.00
  - (6) Classroom & Competition Mechatronics Kits
  - (6) Clawbot Robot Kits (4 motors per kit)
  - (6) Mechatronics Add-On Kit (1 motor, 2 sensors per kit)
  - (6) VEXnet System Bundles
  - (6) Additional 2-Wire Motor 393
  - (6) Robot Battery, Joystick Batteries and Chargers
  - (1) Swept Away Field Kit (field perimeter and game objects)

- Additional Classroom Kits: $1049.00

*6 new kits will allow for 6 groups of 4 students, which may be too many students for one kit, but this may result in some students not having access to the robot and/or the computer for programming purposes. It is better to have groups or 2 or 3. Therefore, it is recommended that 2 additional Classroom Kits be purchased.

**It must also be clear that, if 2 (or more) sections were to run concurrently (i.e. the same semester, but different periods) then an entire set of 8 kits would be required. Since many pieces from these kits will be physically altered (bent, cut, etc) as each group builds their robot. They cannot undo everything in order for another class redo it. If there is enough interest for 2 sections in a given year, it is best to have that second section run during the following semester.

Total Start-Up Cost per section: **$8895.99**

Material Replacement:

- Replacement "Booster" Kits: $179.99

While the majority of the equipment used in the kits is reusable, some replacement is necessary. Some pieces may experience unintended permanent damage at the hands of the student. Other pieces are meant to be permanently altered and then replaced for the next group. Estimate: $179.99 per kit per section per semester (after the initial semester). Since it is recommended to have 8 smaller groups rather than 6 large groups, the total replacement cost represents purchasing 8 "Booster" Kits.

*** 12 VEX "Squarebot" kits exist from the pilot of the year-long Robotics Course that ran in 2008-2009. Many of the parts from those kits are usable, however the new curriculum and video modules apply to the current "Clawbot" platform. Any groups working with an outdated "Squarebot" will not have the same experience as everyone else in the class, which isn't fair.
Those kits will provide many spare parts, however. I hesitate to say that they could provide all the replacement parts necessary to replenish all of the new kits, but they could certainly help defray future costs.

Also of note is the purchase of many additional parts & accessories that are still quite useful and viable, so no request for additional parts is part of this proposal. Still, it must be remembered that things break, get lost, misused, etc. The

recommendation is to consider at least $500 above the aforementioned Replacement Costs, to cover incidental replacements.

The "Clawbot" platform was released in 2015. It should be expected to be replaced by a newer platform in 5 – 7 years, at which time a new Start Up purchase may be necessary as current parts get worn, and software & hardware grows obsolete.

Total Replacement Costs per Section (after the inaugural section): $2,000.00

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Total Cost for First Year (2 consecutive semesters) of renamed "Bots & Coding" Class: $10,895.99

Total Cost (approximate) for Each Subsequent Year: $4000.00

Impact

What impacts on the total school program do you forecast? What would be the impact of full implementation?

"Bots & Coding" can offer students an opportunity to apply engineering, mathematical, scientific, and technical knowledge to a tangible product in a classroom setting. It can also provide this opportunity to students who could not afford to do so otherwise.

Yes, this is an expensive class, especially given the (at present) limited number of students who may enroll in this class per semester. It may be useful to consider some possible benefits:

- Bots & Coding could increase our image and status among the elite schools with whom we are compared.
- Bots & Coding would ideally be housed in South's new MakerSpace and North's Innovation Lab.
- Bots & Coding could provide an excellent outlet for students who may be adept at designing & building and/or programming, but find the traditional classroom setting difficult or not engaging.
- The Next Generation Science Standards (NGSS) contains an engineering strand that is perfectly addressed by this class. Please see previously mentioned NGSS standards with VEX document.

Attachments

Please attach a copy of the proposed course description for the Program of Studies and the proposed curriculum.

> Bots & Coding semester course is open to grades 10, 11, and 12. This will be a rigorous and challenging class which will appeal to those considering Engineering, electrician trade, or computer science as a career choice. The curriculum comes from Carnegie Mellon University, well known for their robotics focus. It will be both theoretical and practical, with students working in two-three person teams. Each team will have their own VEX® Robotics kit with which to work. Students will learn about mechanical systems, programming, and control systems. Students will study the Engineering design process, and create robots to meet specific challenges, as well as some scientific principals to supplement learning in other classes. Attached is the curriculum overview from the Carnegie Mellon University Robotics Academy for the VEX Cortex with RobotC. While it is a lengthy document, pages 3-6 provide a recommended timeline, with plenty of time for design projects before the end of the semester.