

Launch-IT

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Abstract: The Launch-IT project launches at risk middle and high school students in the Lehigh Valley, Pennsylvania, towards college and careers in Information Technology (IT). Summer and Saturday curricula include programming remotely control mobile robots in a simulated Martian landscape (for 6th and 7th graders), creating a web-based music juke box using Flash (for 8th and 9th graders), and learning object-oriented design and Java for AP college preparation (for 10th through 12th graders). Programs emphasize use of innovative technology, including a Java program that lets student both simulate and control the Mars robots, interactive multimedia that introduces computer science and Java programming, and intelligent tutoring systems that prepare students for the math section of the SATs and introduce object-oriented design.

Need—Connecting and widening the pipeline for women and minorities in IT

Discussions with IT teachers in middle and high schools in the Lehigh Valley confirm national trends. The number of computer science degrees awarded to women declined from 35.8% to 22% between 1984 and 2002 (Robb 2003). The trend has worsened with overall declines in CS enrollments. Computing Research News reports that “interest in CS among women fell 80 percent between 1998 and 2004, and 93 percent since its peak in 1982” (Vegso 2005). As Camp (1999) observes, “the computing community cannot sit back and assume that as the numbers of students rises, the percentage of women students will automatically rise and that the ‘[incredible shrinking pipeline] will take care of itself.’ We must take direct action to attract and retain more women to computing at all points in the pipeline (i.e., K-12, undergraduate, graduate, faculty and industry).” Indeed, the pipeline shrinks even before female students get to high school. One high school in our region reports having just one girl out of 125 students in IT elective courses.

A look at Taulbee Reports (Zweben 2005) for Computer Science enrollments indicates that the situation for minority students is similar. During a recent tour of Historically Black Institutions around the country, Microsoft Founder Bill Gates highlighted the need for more aggressive action to increase the number of women and minorities who pursue college degrees in IT/computer science.

To enhance the quality and diversity of the American workforce, it is essential to encourage minority and women students to pursue college degrees in IT fields, where the demand in the work force is expected to grow for the next decade. Based on discussions with regional teachers and administrators and projected demands for a future workforce in the field of IT, Lehigh University created the Launch-IT program with NSF ITEST support. Modeled on Lehigh’s highly successful S.T.A.R. (Students That Are Ready) Academy for at risk students (including 75-80% minorities), which boasts 100% completing high school and over 95% going to college, over its 18 year history. S.T.A.R. already has a strong track record of success, combining parental involvement, teacher led programs, and undergraduate student mentoring and tutoring, to help struggling K-12 students succeed and become college-track material. Launch-IT (www.lehigh.edu/launchit) follows the successful model of S.T.A.R., with high student expectations and parental involvement, programs led by teams of Lehigh faculty, graduate and undergraduate students, and committed K-12 teachers as mentors and teachers. It also inherits and extends novel curricula developed in our earlier NSF GK-12 project, LV STEM (www.lehigh.edu/stem).

Target audience—grades 6-12 in the Lehigh Valley, Pennsylvania

Launch-IT provides a year-round program designed to connect and widen the school-based curricula segments of an educational pipeline put in place by LV STEM. Launch-IT provides a three week summer program and a once a month Saturday academic year program for middle and high school students in the region, focusing on inner city schools in the Allentown and Bethlehem Area School Districts. Since its inauguration in March 2007, Launch-IT has recruited 70-80 at risk students into the academic year program and 55 students for the summer program, of whom over 70% are from underrepresented minorities and over 55% are girls.

Focus—mobile robotics, interactive web design, and AP Java

Launch-IT includes programs for three teams of students: 6th and 7th graders, 8th and 9th graders, and 10th through 12th graders. With the first team, the goal is to teach skills for conducting science, math and technology 'missions' using remotely controlled robots in a simulated Martian landscape that was created in the basement of a local middle school in connection with the LV STEM project. During the summer program, students assembled a mobile robot from GEARS Robotics, then learned how to develop missions with a simulator created for Launch-IT (see Rieksts and Blank at this conference). With the second team, the goal is to create a web-based juke box or iPod™ as an interactive, animated web site, giving them a taste for programming, user interface design and accessing music files on the network, coupled with exposure and education on security & copyright issues. With the third team, the goal is to prepare students for the AP Java exam for college credit, building on the introductory "design-first" course for object-oriented software development in Java developed by an LV STEM team and introduced in a local inner city high school (Moritz and Blank 2005, Moritz et al. 2005).

All of these programs incorporate innovative technology to facilitate inquiry-based learning. For the robotics group, students assembled a mobile robot from GEARS Robotics, then learned how to develop missions with a simulator created for Launch-IT (see Rieksts and Blank at this conference). The Fuego Flash team learned how to create interactive animation using Flash™ and ActionScript. The Java team learned with web-based multimedia (Blank et al. 2003) and created object-oriented designs in Unified Modeling Language with a novice-oriented tool and the support of an intelligent tutoring system providing hints based on student actions (Moritz et al. 2005, Parvez and Blank 2006, Wei and Blank 2006, Wei and Blank 2007). These students also used a web-based intelligent tutor, Wayang Outpost (Arroyo et al. 2004), to help develop math skills in preparation for SAT exams.

During the academic year, volunteer undergraduate tutors from Lehigh University and Cedar Crest College provided one-on-one tutoring to help Launch-IT students succeed in school—imitating a crucial component of the S.T.A.R. Academies—for about an hour out of the six hours of learning activities each Saturday. The rest of the day involves curriculum related and field trip activities similar to those of the summer program, described below.

Working with 6th and 7th graders, the Robotics team served as the funnel for the Launch-IT pipeline. Wide and appealing variety of activities included inquiry-based study of the Hero engine, hands-on rocket experiments, robot simulation, lessons on website legality and reliability, travel plan missions, structure building competitions, a marble run, construction of a GEARS robot including soldering, and pod casts reflecting on each day. After learning about the history of the first steam engine and witnessing rockets simulators online, the students on the Robotics team were ready to make their own rockets. The rocket experiments included an Alka-Seltzer rocket constructed from Alka-Seltzer and an empty film cartridge. After constructing a basic Alka-Seltzer rocket, students had to conceive different designs in order to balance a pay-load and achieve maximum height with the flight of their rockets. The robotics lessons educated students to the wide range of capabilities of the robots used on Mars. Thanks to support from a PITA (Pennsylvania Infrastructure Technology Alliance) grant, students had access to state-of-the-art GEARS mobile robots. After several demonstrations, the students were ready to drive the robots themselves. The robots were operating in the Mars Yard, a makeshift Martian surface with a mural of the Martian terrain and horizon, at Harrison Morton High school in Allentown, PA via remote control. Using the newly-created interface program students navigated the robots to complete different missions. The missions required teamwork, planning of an effective strategy, as well as incorporating their knowledge of geometry, as the missions would require reaching a certain destination point with the least amount of turns or navigating a circuit that represented an equilateral triangle.

The final Robotics project had the students working in teams, the girls' team and the boys' team. Students had to create an assembly manual for the leg of the robots using PowerPoint and a digital camera to take pictures of the robot parts. The directions were written as the students took the leg apart, then after completion of the manuals the teams switched instruction manuals and had to put the leg back together using the other teams' directions. Overall the students on the robotics team were pushed to think logically and creatively as they were faced with many projects focusing on the design aspect, requiring proper planning, teamwork and execution. The critical thinking skills that these students developed and enhanced during the summer Launch-IT program will benefit the students throughout their academic year at school and provide them with the skill set that is beneficial for next years on involvement in Launch-IT, launching them towards successful futures in academia and beyond.

The Fuego Flash team of 8th and 9th grade students focused on learned Flash and ActionScript programming. Students used Flash and Action Script to create their own jukebox on the computer. Each student imported a song for their jukebox and designed custom animation to complement their song choice and own personal style. After the completion of the jukeboxes, students participated in their version of *The Apprentice* where each student presented their final jukebox creations to their peers for constructive criticism. Students enjoyed this activity as they had to exemplify public speaking skills, use their creativity to present an appealing marketing plan, and best of all the exercise did not feel like work, but more like role playing. The Fuego Flash teaching team described their students as being highly motivated to learn Flash and create their jukebox designs. Although writing code sometimes had the students frustrated, overall they were determined to succeed, and in the end they requested more knowledge on the software programs and inquired as to how they could access these programs at home on their own computer. Students also enhanced their math skills with inquiry-based activities with geometric shapes and tessellations, FirstInMath online skill building exercises (see www.firstinmath.com), and learned how to interpret and break UPC and ISBN codes.

The Java team consisted of 10th through 12th graders whose focus was learning object-oriented design and programming in Java. The main project for the summer involved the design and development of a movie ticket machine. Students created a functioning ticket machine able to sell tickets based on how many tickets have already been sold. Students also utilized Flash to create an interface prototype that could be customized for the student's particular ticket machine, adding a sense of pride and ownership to the project. In addition to learning straight forward programming skills, the Java team had to use their analytical skills as well. Students were presented with real life complications with their ticket machines and challenged to design and implement solutions to problems. The problem solving activity was grounded in grammar and object-oriented design, as students had to first dissect the word problems, identify classes, attributes, methods and parameters in the design, and then develop their design with a Unified Modeling Language (UML) diagram tool. After designing the UML for a movie ticket machine, the students implemented it in Java, learning how to create methods with assignments, if-then and looping constructs.

In addition to object-oriented design and programming, the Java team incorporated a lesson on computer ethics. The computer ethic topics included copyright infringement, privacy, and censorship. Students were assigned to teams to prepare a PowerPoint presentation and then educate their peers on their specific computer ethics topic. The PowerPoint exercise was instrumental in expanding upon the student's computer skill set as well as, enhancing public speaking, presentation abilities, and teamwork.

Lehigh University On-Campus Field Trips and Professional Guest Speakers

To enhance student awareness about the multitude of applications of Information Technology, Launch-IT scheduled several Lehigh University on-campus field trips to explore the technology resources available on a college campus. The four educational trips included visiting the Glass Lab in Materials Science & Engineering, visiting the Research Experiences for Undergraduate E-NOSE robotics project in Mechanical Engineering, time spent with librarians giving a virtual tour of the Digital Library, and a presentation on mobile robotics in the Computer Science & Engineering department. E-NOSE, involved a presentation by biology and engineering students who designed a robot able to track and identify scents electronically. Students were taken through a sensory experiment with jelly beans as an introduction to a graduate student presentation on the complications and challenges of designing a machine that attempts to recreate the human sense of smell. The on-campus trips allowed Launch-IT students to witness the various departments at Lehigh University engaged in interesting uses of IT and helped inspire the students about the possibilities for college and careers in IT.

Students gained first hand knowledge about IT careers from local information technology professionals. Guest speakers provided detailed information on their day to day job responsibilities, background on how they were able to navigate through high school and college to find themselves in their current occupation. The local professional that visited Launch-IT included Dilivium Graphic Arts, Just Born Inc, Alcatel-Lucent, Merck, and Johnson & Johnson. The time spent with these IT professionals inspired young students with the possibilities of IT. The representatives from Alcatel-Lucent, Merck and Johnson & Johnson made their visit a day long affair. After their presentation to all of the Launch-IT students in the morning, the trio visited all three IT teams in their classrooms, ate lunch with the Launch-IT students, contributed during creative activity time, and finally participated in a panel discussion with the Java team to initiate an in-depth conversation concerning college and careers. The professional IT guest speakers were a pivotal element of Launch-IT Program as these individuals were able to convey their life stories and their professional journeys, both triumphs and failures, to illustrate to students how anyone regardless of background can achieve academically and professionally. Students on the Java team took advantage of the opportunity to discuss their future aspirations in more detail with the guest speakers during a professional panel. In addition to hearing these speakers present to the Launch-IT students as a whole during the morning session, it was important to provide an opportunity for the oldest students to speak to these IT professionals in a more intimate setting, to allow for students to ask more personal questions regarding career choices, their future educational aspirations and create an environment for personal interaction for networking purposes.

Creative Activity Time and Roller Coaster Competition

In addition to exposing at-risk students to the field of information technology and college opportunities, Launch-IT incorporated an additional educational feature to stimulate students. Students were exposed to a creative activity time that focused on teamwork and communication skills, self-expression, and games intended to exercise the imagination. These activity sessions were designed to increase self-confidence, generate appreciation and respect for ones peers, enhance public speaking abilities, and broaden their imagination. Students responded positively to the creative activity time as it provided a great balance to the educationally rigorous program and allowed students to continue their personal development socially & artistically.

The IT design project was created to provide cross-collaboration between grade levels and to present students with an example of a multidisciplinary project. The 2007 summer design project was a roller coaster competition. The competition was a unique project as it incorporated several aspects of IT and design. Roller coasters were evaluated based on technical merit (engineering & design), theme and creativity, and IT research and design. Students were divided into groups based upon grade level and proven leadership abilities. Students began the project with computer research on the history of the roller coaster then they created preliminary sketches in order to use online computer programs to simulate their designs. The research component was extensive to emphasize the importance that proper planning leads to successful execution. According to the students, the best part of the project was the field research. The Launch-IT students and staff went to Dorney Park, took pictures of actual roller coasters and their designs and rode them judging for rider appeal. The goal was to incorporate certain components of the roller coasters from Dorney Park into their design, to consider consumer appeal and evaluate design feasibility. The research, IT history of roller coasters, on-line roller coaster simulation, and the Dorney Park field research were aspects of the project that contributed to a group's final score. The more detailed and complete the research, the more points that were awarded.

After the completion of an intense week of research, students were equip with supplies including glue guns, scissors, popsicle sticks, paper clips, and cardboard boxes to construct their roller coasters. The challenge was to create rollercoaster from recycled materials only (i.e. empty soda cans, milk cartons, newspaper, bottle caps). Although at the start of the project some students doubted the feasibility of completing a project of this scale in just three weeks, at the conclusion of the summer session students were surprised to find that with proper time management, creative enthusiasm, and teamwork all groups completed innovative rollercoaster designs and competed for the first place, second place, and third place awards. The rollercoaster design project was a successful way to integrate students across grade levels to illustrate another fun and interesting application technology.

Summer Closing Explosion

To commemorate the 2007 Launch-IT summer session, Launch-IT students, school guidance counselors, school administrators, teachers, community leaders, program advocates, parents, friends, and family were invited to

Launch-IT's Closing Explosion. The Closing Explosion was an opportunity for students to share their academic achievements accomplished throughout the three week Launch-IT summer experience. Students from each team presented their final works in a presentation for a group of over 70 attendees. Java team members presented their websites created with Dreamweaver to display their custom ticket machines. Students on the Fuego Flash team presented their jukeboxes designed using Flash and Action script, and the Robotics team featured their instruction manuals on how to assemble a leg on their Mars robots through PowerPoint presentations. Students, parents, and school administrators alike enjoyed the opportunity to celebrate the conclusion of the three-week Launch-IT program over exhibitions highlighting student projects, summer memories shared by Launch-IT students, and presentations from all three IT teams.

Overall the team curriculum, on-campus technology field trips, guest speakers, creative activity time, roller coaster competition, and Closing Explosion served to be valuable components of the Launch-IT summer experience. The 2007 Launch-IT summer session was a success in terms of student recruitment and retention, interesting IT activities provided in and out of the classroom and diverse networking opportunities for students with IT professionals, teaching staff and undergraduate and graduate students. We look forward to expanding upon these activities and ideas used during the summer program to continue to launch Launch-IT as a well-rounded beneficial information technology camp for students throughout the Lehigh Valley.

Evaluation

An independent evaluator conducted surveys, focus groups and project ratings to assess the effectiveness of the summer program. The result of feedback of the surveys indicate that all of the students were between "pretty" and "very" (over 3.5 out of 4.0 on a Likert scale) satisfied with working on the computer, learning about the computer, and outside activities. The satisfaction level for working on the computer stayed constant over the three weeks of the summer session. For several other aspects of the program, the satisfaction level rose as the project progressed, for example, learning about the computer, doing schoolwork with a Lehigh student, and outside speakers. The students were most satisfied with the outside activity for the first week—understandable, because it involved going to the amusement park.

In focus groups, Launch-IT students described briefly what they learned each week. In the Robotics sessions, the students learned how robots work and how to disassemble and assemble a robot leg. They also learned about the laws of physics through rocket modeling. Others learned about different types of glass, general computer information, roller coasters, and making pod casts. Students in the Flash sessions worked with the Flash Program to create their own jukeboxes. They learned to program simple code to use animation and create buttons and videos for their jukeboxes. Almost every student in this session mentioned that they learned to use the Flash Program. In addition, students learned about bar codes, such as the UPC and ISBN codes, and how to crack these codes. Others mentioned Pentiminoes and tessellations, and they learned about glass, roller coasters, and about Lehigh University. One student also wrote that he/she learned social skills. Finally, the Java students spent a great deal of time learning how to write Java code; however, they also learned about Flash, Dreamweaver, and computer ethics.

Each teaching team developed a rubric for a software development project to assess whether student learning of the core curricula. The Flash team had students use Flash to create a jukebox. Their projects were rated using a rubric to rate the Design, Timeline, ActionScript, and Components, rating each criterion on a Likert scale of 1=Poor, 2=Satisfactory, 3=Good, and 4=Excellent. The students received the highest rating for Jukebox Design, for which all students received an excellent rating. They also did very well on the Flash Timeline, where the overall score was 3.7. The mean for ActionScript programming was 3.0, and the mean for rating the Flash Components was 3.4. These results indicate that all students did a satisfactory job on their projects, and the majority of them did "good" or "excellent", and the teachers were very satisfied with the students' performance. The Flash students demonstrated several of their jukebox creations at the Closing Explosion.

The Java team had students create Ticket Machines, design Java programming to print the tickets, develop Flash interface prototypes, insert program code into an applet, then personalized them. They were instructed to use Dreamweaver to produce a descriptive summary of the ticket machine project and to demonstrate their work. Projects were then rated by a combination of teachers and peer Launch-IT students, using the criteria of organization, content requirements, originality, content knowledge, visuals, and mechanics. The average score was 3.3 out of 4.0, with the highest ratings in originality, organization, and cooperation.

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