Technological Creativity in Low-Income Neighborhoods

Peter Gruenbaum[1], David F. W. Robison [2], Chris Airola [3], Susannah End[4], and Asfaha Lemlem [5]

Abstract - **In the United States, significant resources have been devoted to providing technology education to socio-economic groups who have less to access to technology. However, these resources have been focused predominantly on instructing people on how to use standard commercial software, such as word processors, spreadsheets, and Web browsers. The result is that the low-income populations are learning how to be technology users, rather than technology creators. This paper describes a series of classes taught to teenagers in low-income neighborhoods where final projects are collaborations between the students and technically skilled adults. This partnership allows youth to experience new technology, using either technology from research laboratories, such as the Augmented Reality technology from University of Washington, or developing software using Microsoft Visual Studio .NET. Results from student surveys were inconclusive regarding changes in attitude towards technology, but showed a positive response to the classes. The quality of the students' work for the final projects was quite high.**

Index Terms – Youth, After School, Augmented Reality, Creativity

INTRODUCTION

People from low-income communities tend to be under-represented in technology industries. Although many efforts are being made throughout the United States to address technology issues in low-income neighborhoods, the vast majority of these programs focus on computer literacy. This generally involves classes centered around teaching how to use common commercial software, such as word processing, or basic skills such as Web browsing. Occasionally Web design or media production classes are offered to youth, but this is generally the limit of the type of courses that require creativity. To be successful in a technology career requires not only proficiency in technical skills, but also the ability to creatively push technology in new directions. Florida has complied research that indicates that creative ability may be a larger factor in economic success than skill level[1]. Papert has discussed how creativity is important in using technology to enhance learning in schools[2].

A few youth programs exist that go beyond literacy. For example, the Intel Computer Clubhouse provides state-of-the-art creative software and an environment where youth can spend as much time as they need, using the design process as a learning technique[3]. There have also been creative programs to increase girls' interest in technology by using game creation[4].

What is a good approach for giving low-income youth the experience of working with new technology? The skills required for pushing technological boundaries take a long time to acquire: logic, mathematics, programming, and general knowledge of how computers operate. Design teams comprised of both children and adults have had some success[5]. Using a similar approach, we have youth collaborating with technically-skilled adults, where the students learn the simpler computer skills required to build elements of the project while the adults can integrate their work into the new technology.

This paper presents a description of classes for teenagers that were taught at the Yesler Terrace Community Center in Seattle, WA, USA. First, the general approach to the class is described. Next, details on classes that used Augmented Reality are presented, followed by a description of a class that introduced programming and database concepts. Finally, the results from the classes are presented, followed by a description of future classes.

TECHNOLOGICAL CREATIVITY CLASSES

I. Approach

The main philosophy behind the classes described in this paper is to use adult/youth partnerships to create technologically sophisticated projects. The youth make design decisions and learn skills that contribute to the project, such as 3D modeling, music creation, database design, and user interface design. The adults are responsible for the more complex technological pieces for the final project, such as integrating 3D models and sound into an Augmented Reality system, or creating a visualization system for data in a database. The purpose of the partnership is to allow youth to experience new technology, rather than learning common commercial products. By having interesting, creative projects,

[1] Peter Gruenbaum, Red Llama, Inc., pgruenbaum@redllamainc.com
[2] David Robison, Red Llama, Inc., david@redllamainc.com
[3] Chris Airola, Red Llama, Inc., chris@redllamainc.com
[4] Susannah End, Static Factory Media, susannah@staticfactory.org
[5] Asfhaha Lemlem , Yesler Learning Center, Asfaha.Lemlem@Seattle.Gov

we were able to attract volunteers for the program so that many of our classes had a 3:1 student to adult ratio or better.

The population of the Yesler Terrace neighborhood is composed largely of immigrant families from either East Africa or Southeast Asia. Another goal of the classes was to be sensitive to the cultures of the students and to encourage the final projects to be expressions of their culture. The inclusion of culturally relevant themes encouraged students to reflect on their personal voice while incorporating individual and cultural expression into their final projects. Despite being the first generation of their families to have any kind of exposure to computers, the Yesler Terrace youth were as comfortable with computers as any other group of teenagers, and demonstrated the ability to learn new concepts and skills quickly.

In general, we tried to use free or inexpensive software and hardware, so that these classes could be taught in other low-income neighborhoods and so the students could have access to the software themselves.

II. Augmented Reality Classes

Augmented Reality is the term used to describe the technology in which a real environment is augmented with computer graphics such that the graphics appear to be a natural part of the environment. There are several versions of this technology, but the one developed at the University of Washington Human Interface Technoloogy Laboratory called ARToolkit has the advantage of requiring inexpensive hardware[6]. ARToolkit uses a digital video camera (or "webcam") attached to a standard computer. While running, the computer shows the live scene captured by the camera. If specific black and white patterns are placed in front of the camera, the software performs pattern recognition and places a 3D model into the scene as if it is sitting on the pattern. This creates the illusion that the 3D model is a physical object in the live scene. ARToolkit is available at no cost as a collection of software libraries and sample code. For our advanced classes, we modified the sample code to incorporate sound and music.

For our first class, the students studied the history and culture of the Yesler Terrace neighborhood. Students then built 3D models of buildings from their neighborhood's past, present, and future. When Seattle was a young city, Yesler Terrace acted as a wealthy "suburb" with large mansions. Later, it became a working class neighborhood and smaller cottages were built. During World War II, the Yesler Terrace community was constructed to accommodate the need for defense worker housing. Shortly after the end of the war, Yesler Terrace became the first racially integrated public housing in the United States. When a major freeway was built through the neighborhood, many of these buildings were removed, including a good portion of Yesler's public housing. However, a large area of the public housing remains, providing homes and community to the majority of our students. For the final project, students built models of mansions, working-class cottages, and the current buildings within the housing project. Figure 1 shows a student with her model of the present day buildings as shown with the ARToolkit system. She took pictures with a digital camera in her neighborhood to obtain images which she used as textures on her 3D model for the siding, windows, and doors. Textures for the historical buildings were obtained from the Web.

The students used Anim8or for the 3D modeling, which is publicly available free of charge. MilkShape 3D software by ChumbalumSoft was used to translate from 3ds format into VRML, which was read by ARToolkit.

For the second class, we modified the ARToolkit sample code so that when a pattern was detected, not only would the 3D model appear, but a sound file would be played. The theme of the class centered around the new community center that was being built in Yesler Terrace. Students worked from blueprints to make 3D models of the new buildings, and they each wrote a short statement about what they had created. The students took a field trip to a recording studio where they recorded their statements. We taught them how to use music creation software (Sony's Acid) and they used it to create background music to go with their statement. The music and the sound file from the recording studio were merged together using Audacity sound editing software, creating a final sound file that was played by the Augmented Reality system.

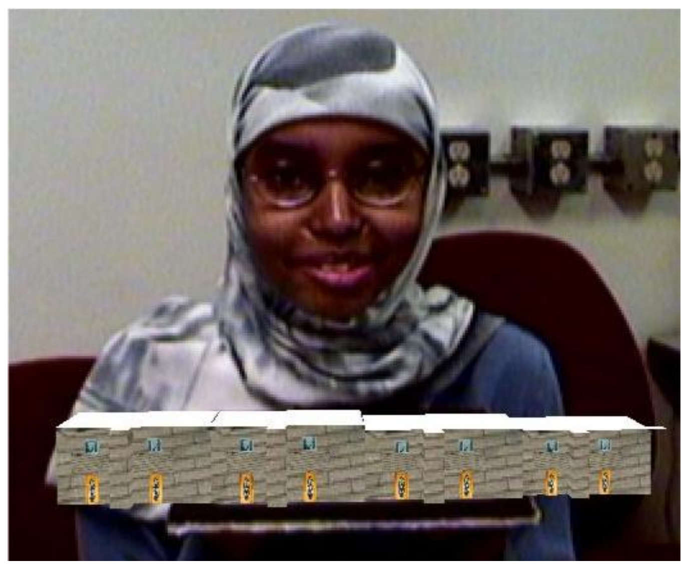

FIGURE 1
A STUDENT WITH HER MODEL OF CURRENT HOUSING IN YESLER TERRACE

For the third class, we modified the ARToolkit sample code to play many sounds at once in order to create a live music mixing technology. The goal was to create a simplified version of Augmented Groove, which allows users to modify music in real time by positioning ARToolkit markers[7]. Augmented Groove requires a music sequencer, whereas we wanted something that could run on a standard PC. The software contained five music loops playing simultaneously: drum, percussion, guitar, bass, and voice. The loops were chosen by students so that they fit together well. The volume of each of these tracks was set to zero, but when a marker was placed in front of the camera, ARToolkit would recognize that marker and turn up the appropriate volume of the track. The closer the marker was to the camera, the higher the volume. Multiple markers in front of the camera resulted in multiple tracks being played simultaneously. Thus a user could start with bass, add drums and then guitar, and so on. Once the music tracks were chosen, the students found images of instruments on the Web and then used them as references to model them in 3D. They also found black and white images on the Web to use for the patterns to be recognized. Figure 2 shows models of a tambourine and a guitar in the ARToolkit system, designed by students.

FIGURE 2
MODELS OF INSTRUMENTS SHOWN IN ARTOOLKIT.

III. Programming and Databases

For the fourth class, we moved away from 3D modeling and Augmented Reality introducing the students to concepts of computer programming and databases. The final project for this class was to create a software application that showed how people were socially connected. The students designed a database with one table that held information about themselves and another table that listed who their friends were. The information they chose to collect and store was determined by a class-wide brainstorming process. Each student designed a user interface that allowed the users to input their information and wrote the code behind the user interface to populate the database. The instructors wrote visualization code that read the information from the database and displayed everyone's name and how they were connected. Users can choose a piece of information (for example, what kind of music someone liked), and everyone who shared the same value in the database with the selected person would show up as red. Figure 3 shows the visualization component of the final project.

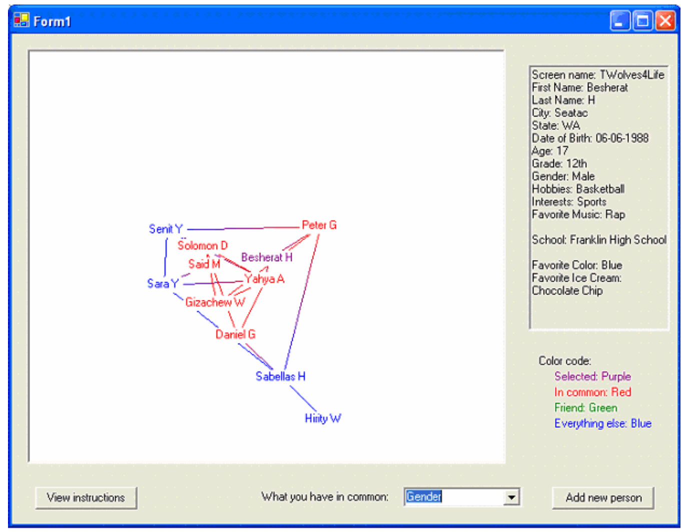

FIGURE 3
MODELS OF INSTRUMENTS SHOWN IN ARTOOLKIT.

We used Microsoft Visual Studio .NET for the integrated developer environment, Visual Basic .NET as the programming language, and Microsoft SQL Server for the database. This software was donated by the Microsoft Unlimited Potential program. The advantage of this software is that it has a drag-and-drop interface for databases. Once the database is designed, a table can be dragged onto the application, and code is automatically generated, which makes it easy to populate and read from the database.

RESULTS

We measured the success of the classes by attendance, the quality of the final projects and by short surveys that were given at the beginning and end of each course. Attendance generally started high, but quickly dropped within the first few weeks to a smaller group of committed students. The average attendance for a class started at 9 students and ended at 6. Surveys asked "Would you like to work in technology when you finish school?", "Is technology fun?", and "How do you rate the class?" In addition, each survey asked some question that showed knowledge of the subject that was to be learned. Because of turnover in the students, there were a number of students who did not complete both before and after surveys. Perhaps because the classes were short, we were not able to determine a significant difference between the before and after survey results, but the overall effect was positive. In general, on a scale of 1 to 5, students showed either no difference or a difference of one point. Table 1 shows that the difference between the pre-survey and post-survey values for each student increased when the difference was averaged over all students, but that the increase was not statistically significant. However, the average score from the class on a scale of 1 to 5, where 5 is a high ranking for the class, was shown to be very positive. We are continuing to work to improve our evaluation of these classes.

The final projects were generally of a very high quality and were appreciated by the community that observed them. 3D models, such Figure 4, which is the old gymnasium at Yesler Terrace, were often quite realistic. The students produced thoughtful statements about their models and the music components of the projects were very successful. The students also created some excellent user interfaces for the database project, and were very interested in the subject.

TABLE I
SURVEY RESULTS

Question	Rating from 1 to 5
Would you like to work in technology when you finish school? (Change from pre to post.)	+0.08 ± 0.67
Is technology fun? (Change from pre to post.)	+0.69 ± 1.25
How do you rate the class?	4.6 ± 0.5

FIGURE 4
3D MODEL OF THE OLD YESLER GYMNASIUM

From a technical point of view, we found that using freeware generally was successful. Anim8or, the 3D modeling software, did have some bugs, especially on the older machines that were available in the community center, and occasionally work was lost. The MilkShape translation software had problems with texture file names with more than eight characters. Once understood, these problems were easily avoided. We concluded that the Augmented Reality classes provide an excellent opportunity to learn the difficult skill of 3D modeling and get a sense of what it is like to work with new technology, and that they can be taught successfully in other low-income community centers.

We were able to achieve a good final project and high student interest in the programming and database class, but not without overcoming significant technical problems. Databases require a number of permissions, and community center's networks are often set up so that users have limited access to the computers so that they cannot cause significant damage. In order to access the databases, we needed to give the students administrative privileges, which could be dangerous, although we did not encounter any problems related to this. In addition, working with databases turned out to be difficult for the students. Despite the drag-and-drop interface, databases are not very user-friendly pieces of technology. If a student wrote code to populate the database, but forgot to put in a line to populate a required field, the error returned was very hard to debug. It required adults with significant SQL server experience in order to solve some of these problems. For these reasons, we determined that the introduction to programming and databases was not a good class for other community centers, unless a database technology with a more user-friendly interface to software is discovered.

FUTURE PROJECTS

In the spring of 2006 we will begin teaching a class involving mobile text messaging. Students will be work with adults to design games using mobile phones with Short Message Service (SMS). There will be two groups of students from community centers in different Seattle neighborhoods, with the purpose of using the technology to collaborate with people who come from different cultural backgrounds. The games will involve treasure hunts within the neighborhoods, competitions involving finding people with similar interests, and ways for the students to communicate with each other about the places where they live. Some of the games will use technology for mobile devices developed at Microsoft Research[8].

We are also taking our successful Augmented Reality classes into other neighborhoods. Two classes already have been taught outside the Yesler Terrace Community Center, and we are developing more. We have modified the ARToolkit sample code further to support simple animations by cycling through models that the students will create.

CONCLUSIONS

Creative technology classes for low-income youths can be taught successfully through partnerships between the students and technically-skilled adults. This partnership allows for the creation of new technology, such as building Augmented Reality applications using ARToolkit from University of Washington, or a social network visualization application using Microsoft Visual Studio .NET and SQL Server. Although it is difficult to quantify how well such classes inspire the students to consider technology careers for themselves, their experience appears to be positive, the students continue to return and take further classes, and creative projects have been successfully designed and implemented. Future work includes projects involving mobile text messaging, and an improvement of the evaluation process.

ACKNOWLEDGMENT

The authors would like to thank the Bill and Melinda Gates Foundation, the Microsoft Unlimited Potential program, the Medina Foundation, Communities Connect, and the City of Seattle for funding this work. We would also like to thank Mark Billinghurst for his technical support at the start of the project, Roger Mitchell for teaching multimedia skills and Yesler history, Bill Keller for providing fiscal support, the Experience Music Project for providing a showcase for the students' work, and the many wonderful volunteers who assisted our classes.

REFERENCES

[1] Florida, R., "The Rise of the Creative Class", *Basic Books,* June 15, 2002.

[2] Papert, S., "A Critique of Technocentrism in Thinking about the School of the Future", *Children in an Information Age: Opportunities for Creativity, Innovation, and New Activities,* Sofia, Bulgaria, May 1987.

[3] Resnick, M., Rusk, N., Cooke, S., "The Computer Clubhouse: Technological Fluency in the Inner City", *High Technology and Low-Income Communities,* MIT Press, 1998.

[4] Werner, L. L., Campe, S., Denner, J., "Middle School Girls + Games Programming = Information Technology Fluency", *SIGITE'05,* October 20–22, 2005, pp. 301-305.

[5] Knudtzon, K., Druin, A., Kaplan, N., Summers, K., "Starting an intergenerational technology design team: a case study", *Proceeding of the 2003 conference on Interaction design and children,* 2003, pp. 51-58.

[6] Yoram Chisik 2, Rahul Kulkarni2, Stuart Moulthrop2, Holly Weeks2, Ben Bederson'

[7] Billinghurst, M., Kato, H., Poupyrev, I., "The MagicBook: A Transitional AR Interface", *Computers and Graphics*, November 2001, pp. 745-753.

[8] I Poupyrve, R. Berry, J. Kurumisawa, M. Billinghurst, C. Airola, H. Kato , "Augmented Groove: Collaborative Jamming in Augmented Reality", *SIGGRAPH 2000 Emerging Technologies,* 2000.

[9] Counts, S., Fellheimer, E., "Supporting Social Presence through Lightweight Photo Sharing On and Off the Desktop", *CHI 2004,* April 24–29, 2004.