SCALING-UP THE BUILDING COMPUTERS, FAMILIES, AND COMMUNITES PROGRAM©: LESSONS LEARNED BY TEXAS TECH COLLEGE OF ENGINEERING

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Abstract— *An after-school program developed by Texas Tech University College of Engineering establishes a practical means for getting seventh through ninth-graders excited about science, technology, engineering, and mathematics (STEM). Several offerings of the program suggest that this program has significant potential to attract students from populations traditionally underrepresented in STEM disciplines into educational and career paths in these fields. A pilot study, conducted with 16 at-risk students from low-income families, their parents, and seven of their teachers during the Spring 2000 semester demonstrated a high degree of positive potential. As a result, a number of entities in the Lubbock community formed a consortium to significantly extend the scope of the program by offering it to 100 area families in 2001. This article provides a history of development of the program, an overview of the curriculum, the initial results from the consortium offering to 100 families, and plans to further increase the scale of the program by disseminating it to other communities, and plans to make the program sustainable over time.*

INTRODUCTION

Although the National Telecommunications and Information Administration (NTIA) Index of Household Charts indicates an upward trend in the number of households with Internet access despite ethnicity, Hispanics and Blacks still lag well behind white and Asian Americans, and it is 50% less likely for there to be access to the Internet in households of incomes less than $35,000 [1].

Problems related to keeping pace with the rapid development and adoption of technology and information tools such as the personal computer and the Internet are myriad and well documented. For example, the 1998 report to the Governor by the Texas Science and Technology Council concludes:

> Industry requirements for skilled technology workers are clearly growing faster than our state's workforce pool. The Council believes that Texas currently has between 26,000 and 34,000 technology-related job vacancies. Moreover, projections show that the state will need to fill over 130,000 new positions in the technology workforce by the year 2000. [2]

Bridging the digital divide–––the growing trend toward a stratified society, characterized by "haves" and "have-nots" with regard to science and technical skills, access to information, educational and career opportunities, and other vital affordances increasingly necessitated by our expanding use of information technology–––is increasingly a concern in every community.

The Texas Tech University College of Engineering, the SBC CLEAR Project, and a growing coalition of partners in the Building Computers, Families, and Communities (BCFC) program are addressing this division by providing computers, Internet access, and software training to low-income families, senior citizens, and other participants who cannot afford computers. In addition, high school students and senior citizens have few opportunities for significant interaction outside of individual family settings––a condition we call the generational divide. The BCFC curriculum seeks to help bridge both the digital and the generational divides using technology as the medium to span these social gaps.

The program puts computers into low-income students' homes and teaches them meaningful ways to use the technology to relate to their schoolwork, family, and community. At-risk students work side-by-side with their parents and teachers to build their own computers and learn to use them by participating in community-oriented projects. They also develop communication and writing skills with curriculum components involving essay writing, business communication, and civic discourse. One of the most exciting aspects of this program is that students are equal participants in a community of learners that includes both their parents and their teachers.

HISTORY

The pilot program of the *Building Computers, Families, and Communities* involved a local junior high school (7-8th grades) in a predominately low-income neighborhood of Lubbock, Texas. The majority of the 16 families participating in the pilot was Africa-American or Hispanic ethnicity and all participants qualified for free/ reduced-

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lunch or other forms of financial assistance. These families are representative of the "have-nots" in the digital-divide that the Department of Commerce characterizes in *Falling Through the Net: A Survey of the "Have Nots in Rural and Urban America"* [3].

The concept for the project originated as part of an Upward Bound course offered to high school students during their sophomore-junior-senior years. The Upward Bound program is a nationally recognized college preparatory program that provides summer classes for potential first-generation college students to take classes in science, arts, and technology at local universities. Texas Tech University has had an Upward Bound Program for 6 years. In order to provide these students with hardware and software training, while at the same time providing them computers to take home and use, the authors designed the Upward Bound CLEAR Scholars Program. It was during the first summer class that we recognized the excitement and ownership of building their own computers carried over to higher levels of engagement in other classroom activities than we had seen previously in the Upward Bound students.

An opportunity arose for us to work with Lubbock Independent School District administrators and O. L. Slaton Junior High School teachers to develop an after-school program that would involve students, parents, teachers, and technology. Although the focus of the curriculum was not engineering *per se*, both LISD and the TTU College of Engineering saw this as an opportunity to inform students about engineering careers and the importance of math and science to engineering, and we were given informal opportunities to talk to students and their parents about engineering.

In all, participants built a total of 21 computers, with the additional five built by the teachers and donated to the school. Researching the neighborhood in which their school is located and building a website for the neighborhood association was one of the projects the group completed as part of the program, and provides an example of a project that combines using technology and communication skills with community involvement.

The activities of the pilot garnered extensive publicity, and because one of the expressed aims of the Lubbock City Council is to address the digital divide, the City contacted us to discuss the feasibility of partnering to scale-up the program to include a larger number of participants. It was decided that we would attempt to provide the program to 100 families.

SCALING UP TO A CITY WIDE PROGRAM

Increasing the program participants by over five times proved to be just as exciting as the pilot program but with numerous other obstacles that had to be addressed. For example, to accommodate over 350 people who had other activities and family obligations, we meet twice a week during the construction stage; however, once we started the software training, in order to accommodate so many people with varied schedules and obligations, the directors, student facilitators, and volunteers held four 3-hour classes a week—two week nights and two sessions on Saturdays.

The City of Lubbock donated $75,000 to the program, which covered only the cost of the hardware components. Microsoft donated software for the 100 systems built by participants. And we relied primarily on our own labor and volunteers to deliver instruction.

Initially, we brought all the participants together in the Science Spectrum/Omnimax, a hands-on, interactive science pavilion, to build the computers, instruct participants in concepts regarding computer hardware and software, and provide an overview of the curriculum and program requirements. In our experience, program participants tended to bring other family members to meetings, so we estimate this group would number somewhere between 250 and 400 people each time, so we planned on accommodating up to 400 people. We used volunteers from student chapters of engineering and science professional societies; technicians from local businesses, LISD, South Plains College, Texas Tech University, and the City of Lubbock, as well as other volunteers to act as facilitators to help participants build their computers. After the computers were built, the participants took their computers home and were provided Internet access through a local ISP.

Next, during the software instruction phase of the project, participants began twice-weekly meetings at the Bryan Martin Advanced Technology Center (a South Plains College and LISD technology partnership) and the South Plains Regional Workforce Development Board's BRIDGES Center (a facility open to the public but designed to help develop workforce skills and GED training). The students and families attended informal classes for curriculum components that include software training, SMET projects, communication and presentation skills, and community oriented projects.

Recruitment

Using existing mechanisms, such as participation in free lunch programs to identify candidates for the program helped ensure that low-income and underrepresented populations were able to take advantage of the program. Of the 100 families participating in the pilot study, approximately 65% were of Hispanic origin, 25% were of Afro-American origin, and 10% were Asian or Anglo. Demographic information maintained by LISD demonstrates that the five schools participating in the program are predominately populated by underrepresented ethnic groups. In the pilot, five of the 16 students were female, but because in nearly every case the mothers participated in the program, a significant female population participated. In the scaled up program, almost 50% of the participating students were female.

Parental Involvement

Our experience with the pilot indicated that the involvement of the parents is one of the most gratifying aspects of the program. We saw the same indication when we scaled the numbers up to include 100 families. Survey results clearly demonstrate that the parents not only felt that they were gaining important technology skills that increased the number of career options available to them, but also that the program was allowing them to make a real connection with their child. In the pilot, because the program required at least six hours each week in after-school meetings, we were concerned that we would not get an adequate level of parental involvement, so we required the parents to sign contracts promising to attend at least one meeting each week. In the pilot program our attendance rolls indicate that in virtually every case, both parents (all of the households except two were two parent households) came to both meetings every week. In the scaled up version, we also required that parents and students sign a commitment contract to attend 2 class sessions weekly, and again, most parents came twice a week. In one case, the father could not always attend so the student's grandfather and father took turns attending the classes.

We found that the program also offered a unique platform for informing the parents about educational opportunities for their children and community programs that they perceived as advantageous for their families. During the software training segments, we invited representatives from the PTA, South Plains Workforce Development Program, Fourth Corp Program (targeted to hiring teenager in summer community programs), Lubbock United Neighborhood Association, and other community entities to present to the families opportunities that were available to them. All of these agencies report contacts by families participating in the BCFC program.

Participants were recruited from five Jr. High Schools with predominate populations of groups underrepresented in formal SMET programs. Selection was based on need (using mechanisms such as participation in free-lunch programs to identify candidates, and surveying this population to establish need, interest in the program, and willingness to commit the after-school time the program requires). Each school's administrators distributed surveys, and school counselors and principals made selection.

Because parents and teachers were actively engaged in the learning along with the students in the pilot study, it is important to establish goals for their participation as well. Certainly, chief among these goals is to get parents more actively engaged in their children's education and in the public school system. With the pilot program, one measurable outcome was increased participation in the local Parent Teacher Association by parents involved in the program. Similarly, the program is designed to encourage participation in community activities and improvement, which is a goal applicable to student, parent, and teacher participants. In surveys conducted in the pilot study, both parents and teachers overwhelmingly indicated that they felt the program curriculum and the technology skills they acquired contributed to their professional development and increased the number of career choices available to them.

CURRICULUM

The BCFC Program aims to improve student grades; to encourage students to take more rigorous coursework, such as advance placement course in science and math; and to increase student participation in additional educational opportunities already in place, such as science and math college preparatory programs offered by TTU, technology workforce development programs at South Plains Community College, or the use of Gates Foundation interactive educational software in the public libraries.

Level and Depth of Instruction

The curriculum for the pilot program stressed elements of the Texas Essential Knowledge and Skills (TEKS) criteria for the targeted student population. The curriculum also addressed technology skill criteria established by LISD for teachers and students in the district. These elements remained in the curriculum, and the recently published Standards for Technological Literacy also were built into the curriculum [4]. In our experience with the pilot program, these kinds of standards provided a base level of technical skill needed to complete the various elements of the curriculum; however, because of the level of engagement with using computer and information technology skills to develop meaningful projects, we found that the majority of the participants far exceeded the level of technical expertise reflected by these standards.

Participants met after school in three hour, twice weekly sessions during the course of the spring academic semester for approximately 16 weeks of intensive inquiry-based learning. The software training and communication skills components were ongoing during the whole 16-week curriculum and were aimed at developing workplace skills that are useful to all the populations engaged in the programs. Surveys conducted in the pilot demonstrate that students, parents, and teachers all applied the technology skills they were acquiring in their work environments to improve the quality of their work. For example, in the pilot program one of the fathers was a mechanic, and reported that information he gathered from the Internet significantly improved his work performance. In the City Wide Program, one of the mothers said that the training she was getting would go toward her advancement at a local day-care center. Teachers all reported that the program contributed to their professional development by not only giving them computer and information technology skills, but also by increasing

their understanding of SMET concepts and by putting them in touch with resources available at TTU.

The "Families" goals of the program are to get parents engaged in their students' education and the public school system and to learn along with the students. With the pilot program, one measurable outcome was increased participation in the local Parent Teacher Association by parents involved in the program. In the scaled up program, we interacted with almost 200 parents. Frequently the students were more advanced in computer skills than the parents, so it gave the students a chance to be "teacher" to their parents. The feedback we got from parents gave us the indication that we have reached a number of people who are now considering higher education as a part of their child's future and that they feel they have learned computer skills they did not previously have, which increased the number of career choices available to them. One of the projects the families worked on was a Family Web Page. We took pictures of the families so that they could insert their pictures, and they composed any interesting history or knowledge they wanted to share.

The "Community" goals of the program is to allow these families the opportunity to significantly give back to their community, thereby instilling the feeling of being part of the community and to provide opportunities for these families to interact with people in the community they might not otherwise see or talk with. For example, in one of the projects the students and parents interviewed a senior citizen about how technology has changed in their lifetimes and wrote an essay based upon the life stories of the senior citizens.

The students also produced a PowerPoint presentation about their schools, focusing on those things they like most—favorite class and why, favorite teacher, what extracurricular activities they were involved in, etc. In addition, they wrote business letters to all to the sponsoring organizations and emailed these letters to representatives of these organizations.

CONCLUSION

We are still assembling the data from this program in order to assess and shape the curriculum and to guide the program to its next level, that of dissemination. One of the most exciting opportunities the program offers is the potential to conduct a large-scale, longitudinal study designed to track a variety of outcomes of the program over time, such as the program's impact on student grades and educational choices in comparison to the rest of the student population in LISD. Such a study would allow gathering significant data on the impact of technology and the program in the lives of the participating families. The data and conclusions of a longitudinal study of this nature would provide a wealth of information useful to researchers and managers involved in workforce development, the design of educational and community programs, and understanding the impact of computer and information technology in the social milieu.

We have found in our continuing research with the project that the pride and family ownership vested in the machine provides a common interest that continues past the life of the program, as family members have continued to support one another in learning meaningful ways to use their computers. Additionally, this program gives a segment of the population that often has limited access to technology an opportunity to demonstrate the power and value of learning about technology to their extended families, friends, and neighbors. The positive potentials for this program go well beyond the activities of the classroom, and should yield benefits for the community for years to come. In the long run, this program aims at effecting systemic change in the community, not only by making careers in technology fields a real possibility for these students, but also by building an appreciation for the value of life-long learning in their families and neighborhoods.

Because of the statewide publicity this program has received and the support of the Texas Tech University president and administration, numerous towns in Texas and New Mexico have expressed a keen interest in offering the program in their own areas. With support from communities who are seeking to bridge the digital divide and to make a difference in diversity, the program has the potential of impacting a much larger area than Lubbock, Texas.

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