Increasing the Interest of Elementary Age Students in Computer Science though Day Camps

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Introduction

Computer Science and related majors have seen a decrease in enrollment across the country in recent years. While there are several theories behind why this may be the case, as educators in many areas of computing and information technology, this is a trend we should attempt to reverse. While it is true that many children are "computer literate", their knowledge of subjects actually relating to the computing sciences is often limited. We feel that exposing younger children (those of elementary school age) to computing topics may help to increase their interest in these subjects as they mature. Thus, they may be more likely to choose computing majors when they go to college.

At the start of the 2003-2004 academic year, the officers of our local ACM (Association for Computing Machinery) student chapter "brain stormed" for ideas as to how we could expand the visibility of our organization on campus and in the surrounding community. Several of our group members had worked in the past with regional and national organizations that provide educational science camps [1, 2] for gifted youth. After a few hours of conversation, we decided that we could indeed conduct a similar event on our campus for local elementary and middle school age children. The planning of this event became the class project of our Senior Seminar course, taught by the first author. The students who were in this course are the remaining authors of this paper.

While initially a primary purpose of the camps was to raise funds for our ACM student chapter, we quickly learned that there were tremendous benefits of this activity beyond financial. Our students found that preparing courses and teaching what they know to young children is a great way to strengthen their own knowledge about their subjects. The positive feedback we received, from the camp participants and their parents, was very good for our group and our college. This was one of the most positive experiences that any of us have been involved with in higher education, and would make an exceptional activity for students and faculty at any college or univer-

sity. The rest of this paper discusses the specifics of our camps, including the content of the courses and how we advertised in the community.

Our First Day Camp

Our first camp was organized as a two-day workshop, which took place October 23rd and 24th, of 2003. The dates for these workshops corresponded with two "Teacher's In-Service" days in the local school system, so the participants were off from school. Campers were charged $10 per day for attendance, which included lunch. We were able to solicit free food from several local restaurants with which to feed the campers. Practically all of the equipment we needed was freely available for our use at the college, which kept our overhead costs low. Obviously, if you were to need to purchase equipment for the camps (like the LEGO Mindstorm kits), the cost for attendance may need to be higher. Our college is in a rather economically disadvantaged county, so we did not want attendance fees to be prohibitive. On the other hand, we were afraid that if we charged too little, parents would "unload" their kids on us just so they would not have to find a babysitter on these days. We wanted kids at our camps who wanted to be there. We feel the $10 charge worked out quite well.

Several Computer Science majors visited a nearby elementary school to advertise our camps and hand out registration flyers. They were able to visit classes briefly and talk about some of the things we would be doing in the courses. We also invited the children of faculty and staff at Hanover College. A total of 20 children (between the ages of 7 and 12) attended at least one session of our camps, and most attended all sessions both days). Each day, the children participated in two 3-hour courses on one of the following topics: Robotics, Computer Hardware, Virtual Reality, and Web Programming. The schedule for our camp is shown below.

Computer Science Camps		
Time	*Thursday- Oct. 23*	*Friday-Oct. 24*
8:30 am	Registration	Registration
9:00am	*Session 1* Robotics Computer Hardware	*Session 1* Robotics Computer Hardware
12 Noon	LUNCH	LUNCH
1:00pm	*Session 2* Virtual Reality Web Programming	*Session 2* Virtual Reality Web Programming
4:00pm	Pick-up	Pick-up

We arranged the schedule such that students could attend both days to take part in each course that was offered.

Course Curricula

For the most part, the college students designed their own curriculum for the courses, attempting to present the material at a level understandable and entertaining to the camp participants. The following is a brief description of the content for each course.

Robotics

This course began with a discussion of the general characteristics of robots and robotic systems. Students were made aware that we encounter robots around us in many forms every day. Participants were then introduced to the LEGO Mindstorm Robotics Invention Systems [3]. Groups of 2 to 4 worked together to design, build, and program a robot to compete in a contest against the other workshop participants. The visual programming language that comes with the LEGO Mindstorm kits is very appropriate for this age level, and the campers seemed extremely excited about learning this interface.

The final challenge for the students required building a robot that could push four empty soda cans out of a square indicated with heavy black tape. The Mindstorm kits come with light sensors to help the robots distinguish between light and dark surfaces. For a three-hour course, there was definitely enough content to keep the campers busy the entire time. Most groups really needed to be helped along in order to make the contest deadline at the end of the class. Figure 1 shows some campers hard at work on their robots (left) and the final challenge (right).
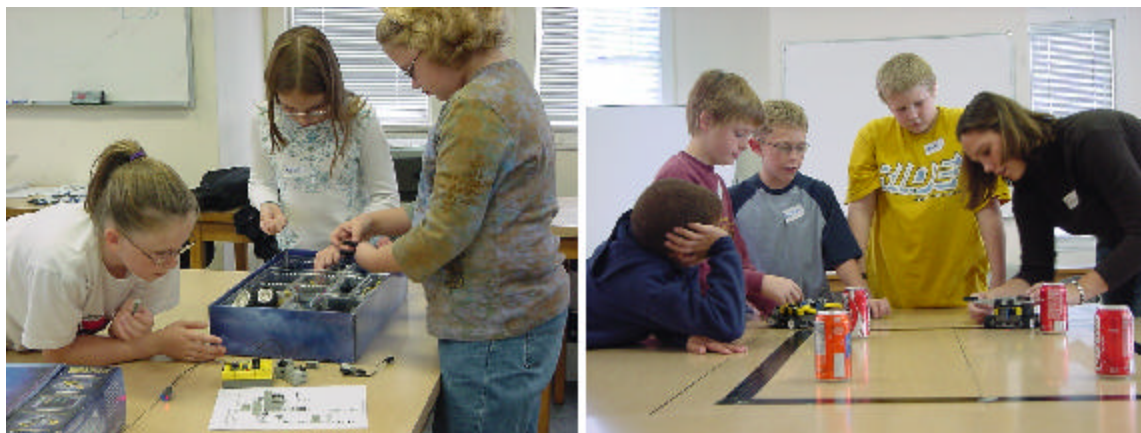
Figure 1

Computer Hardware

In this course, students were taught the basics of binary number representations and computer hardware. We began by explaining the significance of binary numbers to computer processing. The campers were then taught how to count in binary and we had each of them write their age in binary on the board. Some of them initially did not want to try this, so we bribed them with candy bars! It was amazing how effective this particular form of positive reinforcement can be with children of this age.

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Next, we briefly explained the significance of binary numbers to digital logic. Students then worked in groups to build a computer from spare parts. As each major component of the computer was discussed, we added it to the machines. Students discovered (at least some of) the reasons for an operating system when we tried to boot the machines and were not successful. Windows NT was then installed. We also briefly discussed the need for device drivers in response to why the resolution on the monitors seemed so "funny".

Of the courses we offered at the camps, this was the one whose effectiveness was most difficult to determine. Each group had a college student working with them to tell the participants how to assemble the machines at each step of the way. Since we did not have any means of evaluating the student's own abilities, we were not able to assess how much they learned. We also had a difficult time filling the whole three hours with material for this course. Most of the campers ended up playing games on their computer for the last twenty minutes (which they seemed perfectly happy to do). Figure 2 shows the course instructors explaining various computer components to the students (left) and some of the campers building a computer with an instructor (right).

Figure 2

Virtual Reality

The Virtual Reality (VR) course began with a discussion of the components of a virtual reality system. Students learned that the distinguishing factor between VR and most video games is the level of immersion provided by a VR environment and that this "enhanced" immersion is typically accomplished through stereo projection. We convinced the students that their sense of depth perception was due primarily to the fact that they have two eyes, and showed them that each eyes perceives the world differently by having them focus on at object and look at it with one eye open at a time. Various techniques for performing stereo projection were then explained.

We had constructed a passive stereo VR environment at Hanover College for an unrelated project [4] that allows users to view 3D images while wearing special polarized glasses. We took advantage of the availability of this equipment for our camps. The students viewed several 3D applications and then competed against each other in a virtual "solar system scavenger hunt." The campers were split into two teams and given a list of questions whose answers could be as-

certained by "flying" around outer space in our makeshift simulator. Teams alternated between planning sessions on where they would need to travel to answer various questions, and actually using the simulator.

Initially, the campers seemed quite captivated by the stereo images and the space simulation. Their enjoyment seemed to wane, however, during the times when they were supposed to plan while the other team was taking its turn in the simulator. We also tried letting the students "pilot" the application themselves, which turned problematic when it became obvious that we did not have enough time for every student to have a turn. Some of them just wanted to fly around and did not care about answering the questions, which made the more competitive campers quite upset. In hindsight, it would have been better if we had just piloted the application ourselves. Figure 3 shows the students and teachers in our VR simulator viewing the solar system application.

Figure 3

Web Programming

The first time that we taught this course, we began by jumping straight into HTML programming. Later, we decided that the students would appreciate some background information, so we added a discussion of computer networks and the Internet. Participants were also taught at a high level about client/server computing and how a web server works. The structure of an HTML document and its tags were discussed, and students were shown how to put text and graphics into their web page, along with how to change text and background colors. Students also learned to construct links to other web pages.

During the second half of the course, students learned the basics Flash MX. Flash topics included layers, objects, animation and "motion tweening", as well as the creation and publication of movie clips. Participants were allowed to construct their own web pages, which were later saved to disk so that the campers could take them home. Figure 4 shows the students learning about Flash MX from one of the instructors.

This course actually contained the greatest amount of freedom for the students to experiment and design their own creation. Filling the time was not much of a problem for this session, as most

of the students enjoyed having an opportunity to create a web page that they could take home. In fact, the students wished we had given them more time to work on their web pages.

Figure 4

Evaluation of the Camps

Overall, we felt the camps were very successful. Many parents told us later how much their children enjoyed the time they spent with us. We had the campers fill out a very simple anonymous exit survey upon completion of each course, consisting of the following question, "Has this workshop improved your interest in computers and Computer Science?" A total of 56 surveys were submitted and **all** answered, "yes", to the question. While we feel that some of the kids may have answered affirmatively just to please us, the unanimously positive response does reflect well on the quality of the experience for those students who attended.

Ideally, we would like to check back with our camp participants sometime in the future to see what, if any, impact these workshops may have had on their academic interests. The local elementary school has several computing courses, but does not really further any of the topics we introduced. Our hope is that we provided enough information to peak their interest in technology, so that they will pursue these topics when given further opportunities.

More Camps

The first series of camps went so well, we decided to offer a camp again in a weekend format. On February 7th, 2004 (a Saturday) we offered our second camp. The two major adjustments to the schedule were that we reduced session lengths to two-hours and we did not offer computer hardware the second time around. We decided upon evaluation of the first camp that the robotics class could use more time – so it was expanded to 4 hours (covering both the morning and afternoon sessions). Under the "new" format, students had to choose either all day of robotics or web programming then virtual reality. The computer hardware course was dropped largely because the spare computers we had been using for the camps were "reclaimed" by our academic computing department. The schedule for camp number two is shown below.

Computer Science Camps	
Time	*Saturday, February 7th*
9:30 am	Registration
10:00am	*Session 1* Robotics Web Programming
12 Noon	LUNCH
1:00pm	*Session 2* Robotics (continued) Virtual Reality
3:00pm	Pick-up

The two-hour time blocks for courses seemed to work out very well. We observed during our first camp, that many of the students became easily distracted and inattentive during the last hour of the sessions. Shortening the courses really helped. On a day off from school, four hours of learning is probably all you can expect from most elementary age children.

Suggestions for Camp Implementation

There are many possibilities for sessions at day camps such as the ones we have described here. The best advice we could probably give is to do what works best for you. Our virtual reality sessions, for example, take quite a bit of technical expertise and may not be feasible for many institutions. Other topics, however, such as Visual Basic programming, computing literacy, or even networking, could easily be substituted in its place and make for a great session. The important thing is to teach what interests you, and what you can use to inspire the children's interest.

When designing your sessions, make sure you come up with lots of activities for the participants to do. Children will listen attentively for about 15 minutes, and then they get bored if they are not doing something active. Remember, that they are giving up their weekend or break to be with you, so they want to do something interesting! Allow them to learn by doing. We also found that arranging some sort of competition seems to work well for getting the kids motivated. When they felt like they were working for a prize, the children seemed to get more intent on the project they were supposed to do.

Remember to be flexible and patient. Elementary age children are not like college students. Try to make things fair, be prepared for children to cry over seeming insignificant events, make sure you know how to contact their parents, and try to make them be nice to each other. If you can, group the children with others of similar age - they seem to work better with peers than with those from different grades. Older children tend to boss the younger ones around, which can make the camp experience unpleasant.

Our final piece of advice is to get the children's home address when they register. Our initial registration forms had only a space for their name and contact phone number. As we began to prepare for a third camp with courses designed specifically for the children who had come before, we realized that we did not know how to mail invitations to them.

With some hard work, you can put on a great event at your institution. The college students will get just as much out of preparing and leading a camp as the children you have come. The best way to get kids interested in technology is to introduce it to them when they are young. These kinds of camps are a great way to do just that.

References

[1]   Johns Hopkins University Center for Talented Youth, http://www.jhu.edu/gifted/about/index.html.

[2]   Sci-Tech Adventures, http://www.scitechcamps.com/.

[3]   LEGO Mindstorms, http://mindstorms.lego.com/.

[4]   Cliburn, D., *Virtual Reality for Small Colleges*. The Journal of Computing Sciences in Colleges, Vol. 19, No. 4, 2004, pages 28-38.