VEGUETA Vol 13 Issue 02,May 2023
ISSN NO: 1133-598X

Computer Science Unplugged: school students doing real computing without computers

Dr. Koparthi Suresh[1] and Dr. RVVSV Prasad[2]
Professor, Bhimavaram Institute of Engineering & Technology, Pennada, Bhimavaram, India[1]
Professor, Swarnandhra College of Engineering & Technology, Narsapur, - 534275, India[2]
sureshkgrl@gmail.com[1], ramayanam.prasad@gmail.com[2]

Abstract

The goal of the Computer Science Unplugged initiative is to provide students an introduction to CS concepts in a non-technical setting. Outreach, supplementary curriculum, and extracurricular activities are just some of the many possible uses for this.

Canterbury University's "Unplugged" programme introduces young people to the line of thought required by computer scientists via a variety of activities, games, magic acts, and contests. There is no cost to participate in any of the events listed on csunplugged.org.

Recent years have seen massive industrial backing and worldwide acceptance of the initiative. It has been translated into 12 languages and is recommended in the ACM K-12 curriculum. There is an active program that does more than just provide instructional materials; it also actively develops and evaluates new formats and activities. Integration with other outreach tools like the Alice language, modification for usage by kids in big classes, and films to assist instructors and presenters understand how to utilize the material are all part of the plan.

This article will investigate the reasons for this method's success, and it will detail the innovations and modifications that are being utilized for outreach and education in New Zealand and beyond.

Keywords: Movement-based CS education and outreach

1 Introduction

The urge for students to improve their "ICT" skills stems from the goal of creating a "knowledge-based economy" and the realization that prosperous software and hardware development businesses may significantly bolster national income. The phrase "computer scientist" is unfortunately quite vague, including a wide range of abilities from being able to add numbers in a spreadsheet to creating a video website that sells for US$1.65 billion. While knowledge of spreadsheets is useful, the real economic benefit will come from groundbreaking new services developed atop robust and trustworthy computer infrastructure. Ingenious developers with experience in programming, security, parallel computation, data compression, human-computer interface design, and other areas typical of Computer Science, Computer Engineering, and related fields are essential to the success of systems like YouTube, Google, Apple's iPod, Facebook, and other technological success stories.

The problem is that many kids in schools have a limited knowledge of what a computer job entails, thinking that it is limited to word processing and online surfing (Yardi & Bruckman, 2007). Instead of dismissing ICT study as "advanced Powerpoint techniques," students should gain exposure to the breadth of topics available in Computer Science to help them plan a career, even if it isn't appropriate for them to learn advanced topics like graph algorithms while in school.

Despite rising demand from companies for people with computer science abilities, enrollment in the field is falling worldwide. There are a variety of obstacles that make it hard to introduce Computer Science to children in schools, including the fact that it is hard to integrate into a comprehensive curriculum, that few instructors have the background to teach it, and that administrators don't comprehend what it is.

Enrollment as a whole is falling, but the situation is much worse for female students, as data from the United States (www.cra.org) shows that the number of female students is falling at a faster pace than that of male students. New Zealand is not alone in seeing these patterns emerge.

Programs such as computer camps (e.g. Adams. 2007, Doerschuk, Liu, & Mann 2007) and mentoring initiatives (e.g. Bennett, Briggs, & Clark 2006) have been developed to address these concerns.

Two issues arise from inaccurate stereotypes of computing careers: first, they discourage students from pursuing a field that they might otherwise enjoy, and second, they "burn bridges" early on by discouraging them from developing the math (working with symbolic notation) and communication (working with other people) skills necessary for a future in computing.

The University of Canterbury's "Computer Science Unplugged" initiative is an approach to the issue that has gained significant attention throughout the world. The website, csunplugged.org, is a free resource for CS outreach and education.

It takes the unorthodox tack of teaching kids the fundamentals of CS without actually having them touch a computer. We'll get into the specifics of how this can be done in a little, but for now, know that it doesn't mean teaching kids to play at becoming computer programmers. Unplugged events often require participants to use their problem-solving and critical thinking skills to complete a task that incorporates basic CS topics. One game has players frantically searching the playground for a route to "Treasure Island" according to an incomplete "pirates' map" (really a finite state automata) (Figure 1).

Figure 1: Visiting a node in a finite state machine (akadrawing a pirates' map)

Because most kids see computers as a play rather than a serious piece of academic equipment, having breaks away from them is beneficial. Taking a break from their screens allows them to consider broader challenges faced by the field of Computer Science. There is no need for prior technical knowledge to handle topics like algorithm complexity, data compression, graphics techniques, interface design, and computer science models. Many kids are captivated by the content, although they wouldn't normally be interested in

have had to overcome the challenge of learning to code before they could delve into the subject's meatier material.

Computer Science Unplugged not only introduces students to the discipline of Computer Science but also encourages them to participate in "Computational Thinking" (Wing, 2006). Proponents of Computational Thinking contend that all students, regardless of their future academic plans, may benefit from learning Computer Science-based approaches to solving issues. Instead than using a computer, Computational Thinkers apply concepts from Computer Science to everyday issues. Let's say you're attempting to have a conversation with someone who can only communicate through eye blinks. Would you have them spell words by blinking in response to the letters of the alphabet being read aloud (a, b, c, etc.)? Or is there a more time-efficient method? An individual using Computational Thinking could weigh the pros and drawbacks of several strategies for solving a problem, such as the divide-and-conquer method, greedy or brute-force tactics, or checking for speed restrictions. They may think of helpful abstractions, or investigate recursive methods, sequential methods, and concurrent methods. Problems in the real world may often be solved by using concepts from Computer Science, even if no computers are directly involved.

The popularity of the Unplugged method may be attributed, in part, to its simplicity of implementation as an outreach tool for computer programs. When compared to other outreach efforts (such as mentorship and programming courses), "Unplugged" just requires a single one-hour visit to a school to make a substantial effect. since a result, sessions are more likely to take place, since presenters now have a fun opportunity to connect with students while still delving into substantive CS topics. The Unplugged website does this by providing a plethora of free materials, such as printable classroom handouts, videos, contextual information, and planning checklists. Given the significant influence that role models have on the professional choices of their followers, even brief interactions with students may pay dividends. This is especially true for female role models (both faculty and students), who make up a disproportionately small percentage of most IT programs but nonetheless may be available for the odd school visit despite their limited availability.

There has been significant worldwide interest in the CS Unplugged initiative in recent years. It became well-known in the United States after the Association for Computing Machinery included it in their recommendations for K-12 curriculum (Tucker et al., 2003), in Asia after studies were conducted in the computer science education department at Korea University (Yoo et al., 2006), and online after Google Inc. sponsored a revamp of its online presence. Thanks to the support, all of the exercises may now be done at no cost and new content can be created to maintain the project's relevance.

Over time, this genre's fan base has expanded. While its original purpose was outreach, it is now being included into the curricula of several nations. This raises questions that will be addressed in future research.

discussion to follow. The content has also been modified for usage in front of bigger audiences, such as at science fairs or in classroom presentations. In a patent infringement lawsuit, the unplugged technique was so effective that even a jury of

laypeople could grasp the CS ideas at issue.

For group discussions, Unplugged has shown to be a great tool. The first author has spoken to senior citizen user group "Seniornet" on many occasions. Members of Seniornet enjoy, if provided in an interesting manner, some insight into the ideas underlying the technologies they are using, even if the major objective of Seniornet is to assist people utilize computers. Although this may not seem like a productive type of outreach, it is important to remember that grandparents often have a great deal of sway over their grandchildren's choices, and this is more true now that they are being asked to help pay for their education. Service organizations like Probus and Rotary also give access to this demographic via their sponsorship of similar educational events.

Teachers who spend their days in computer laboratories will appreciate the respite from screen time that the Unplugged materials give. According to one Japanese educator, "Now the teacher sees the faces of the children, rather than the backs of the computers."

Not only is Unplugged content prominent in the ACM K-12 curriculum, but it has also been promoted by the CSTA (Computer Science Teachers Association, an international organization aimed at school teachers) and the NCWIT (US National Center for Women & Information Technology) to encourage young women to pursue careers in technology. The "Rebooting Computing" effort, a spinoff of Peter Denning's "Great Principles" project (Denning, 2007), is being influenced by the "Unplugged" project, which aims to improve the public's perception of Computer Science via a grassroots movement incorporating major leaders in the field.

To ensure that CS Unplugged stays on track, the team has formed an advisory council.

Forty-eight of the world's top computer science academics and industry experts. Many different types of institutions and industries are represented here, from elementary to university, from scientific museums to tech giants like Microsoft and Google, and from Asia to Europe to the Americas and Oceania.

This paper, an extended version of a presentation delivered at NACCQ (Bell et al., 2008), starts with a brief summary of an Unplugged session before going on to describe other presentation strategies. We then discuss the potential worldwide applications of Unplugged after identifying the elements of a great activity. At last, we talk about how we're using Second Life into our continuing Unplugged research to recruit people from all around the world.

Not only is Unplugged content prominent in the ACM K-12 curriculum, but it has also been promoted by the CSTA (Computer Science Teachers Association, an international organization aimed at school teachers) and the NCWIT (US National Center for Women & Information Technology) to encourage young women to pursue careers in technology. The "Rebooting Computing" effort, a spinoff of Peter Denning's "Great Principles" project (Denning, 2007), is being influenced by the "Unplugged" project, which aims to improve the public's perception of Computer Science via a grassroots movement incorporating major leaders in the field.

CS Unplugged has assembled a group of 28 notable CS educators and practitioners from 10 countries to provide guidance and assure the project's success. This collection of people hails from a wide range of backgrounds and organizations, including schools of all levels, museums dedicated to science education, tech giants like Microsoft and Google, and people from all over the world, including Asia, Europe, the Americas, and Oceania.

This article, which is an expanded version of a work given at NACCQ (Bell et al., 2008), begins with a general description of an Unplugged session and then goes on to detail many presenting options. After outlining what makes for a great activity, we go into how Unplugged may be implemented in a global context. Finally, we discuss how we are using Second Life into our ongoing Unplugged study to reach participants who are geographically dispersed.

.

2 Unplugged activities

Most of the "Unplugged" events center on a problem that the students must figure out on their own. One such instance is the "Routing and Deadlock" exercise.

As can be seen in Figure 2, each student is wearing a different colored t-shirt, and a total of five different colored pieces of fruit must be handed around the circle according to a single rule so that they all end up with the person who is wearing the t-shirt matching their color. Every color of fruit is represented by two pieces, with the exception of a single color. Two pieces of fruit are in the hands of each pupil, with the exception of one. They may only give their fruit to their neighbors who are holding out an empty hand.

The students will learn, for instance, that in order to avoid a stalemate scenario, it may be necessary to sacrifice a piece of fruit even if it is the proper color for you in order to reach a solution to the issue. Although the "buffer" size was relatively little in the game - simply one open slot at one server - the experience may be drawn on when discussing routing and stalemate for information on the internet after the exercise has been completed.

!

Figure 2: The "Orange Game" – a routing anddeadlock-avoidance challenge

Other activities on the Unplugged site include data compression, image representation, graph algorithms, HCI evaluation, and sorting (e.g. quicksort) and searching(e.g. hashing) algorithms.

3 Formats of Unplugged

Multiple iterations of the CS Unplugged content exist, from online demos to a show to live performances in the great outdoors. Some of the formats and the uses they have are discussed in this section.

Twenty distinct computer science (CS) subjects were originally presented as a series of exercises detailing how to deliver them in a classroom setting as part of an outreach program. This was eventually reworked as a book for educators, complete with suggestions for incorporating the exercise into existing lessons and reproducible handouts.

The primary purpose of the program is outreach; the target audience should walk away with a more nuanced understanding of what Computer Science entails, realizing that it is more than simply programming and is not a "boring, solitary" profession (Yardi & Bruckman, 2007). More instructors are showing an interest in turning these activities into curricular materials, which calls for more background knowledge and evaluation. At the very least three American institutions of higher education (New Roads in Los Angeles, Pomfret School in Connecticut, and AMSACS in Boston)

are taking the materials as a standalone course, and are assisting us in creating resources for other educators to use. All of these institutions are private, which is interesting given that the public school system in the United States places heavy demands on educators to adhere to standardized lesson plans in light of the "No Child Left Behind" policy, which evaluates schools based on the results of standardized exams administered to students.

While the original Unplugged books were written with educators in mind, a student-friendly edition was published in early 2009. Originally intended for use with Chinese high school students, this version is now being converted for use in western classrooms. The 15 areas it explores are still "Unplugged" in the sense that they don't provide computer training, but they do provide a wealth of knowledge on how these pursuits influence regular computer users. Students study picture run-length encoding, which may be applied to various image compression schemes; parity error checking, which can be used to RAID schemes; and Minimal Spanning Trees, which can be applied to algorithms on graphs for network architecture design. In addition, a "Curiosity" is included in each subject to highlight an unexpected or intriguing use of the idea being discussed. Figure 4 depicts a standstill at a crossroads, while Figure 3 depicts a bracelet that encodes a girl's name as 5-bit binary digits (black/white are 1/0 respectively, and the number codes the location of the letter in the alphabet).

We want to review a more palatable, westernized edition of this textbook for possible use in New Zealand secondary schools. If it works, it will provide a means to educate senior students computer science that is both substantive and does not need them to know how to program before beginning the course. Each section will be supplemented by programming assignments (in the parity game, for instance, students would be tasked with creating an algorithm to determine which bit in a two-dimensional input is erroneous).

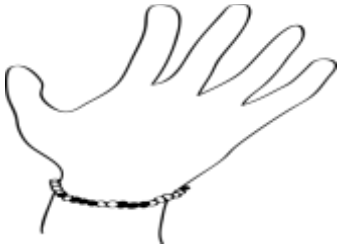

Figure 3: Girl's name coded in binary on a bracelet

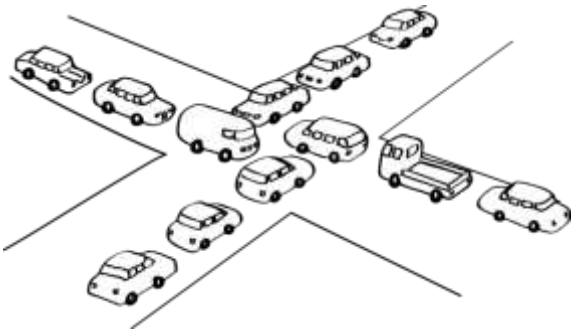

Figure 4: Deadlock at an intersection

In Korea, offline activities have been analyzed for teaching computers at the elementary school level (Choi et al., 2008), demonstrating the unplugged movement's impact on education policy. The key takeaways from this analysis are that instructors need substantial support in order to adequately explain the relevance of the subjects they cover in class, and that assessment is required in order to evaluate students' progress.
The Unplugged website (csunplugged.org) was created in part to facilitate communication amongst teachers interested in using the activities in their classrooms. Although it is still in its infancy, the site is quickly becoming a hub for the publication of novel ideas and modifications (with proper attribution), as well as the promotion of events and seminars for educators.
Those contemplating using the activities for outreach and education have found that seeing videos of them in action is a useful way to get a sense of how they operate. The film is superior than a written explanation because of the kinesthetic nature of the exercises. Figure 5 is a still from a film illustrating a parallel sorting network; it depicts a group of students comparing 6-digit numbers and moving along the floor lines in an attempt to sort the data in ascending order. The videos' soundtracks have been translated into a number of languages (including Maori), including Korean, Chinese, Japanese, German, and Swedish. Some viewers have remarked that the children's uniforms are the most glaring example of cultural mismatch. However, in other nations, children routinely wear uniforms to school. Some words in the commentary take longer in their translated form, thus in our newer editions, we have included larger spaces in the English commentary to prevent having to hurry or elide the translated version.

The videos may be accessed without cost through several online platforms, but especially YouTube. Since some institutions restrict access to YouTube, TeacherTube.com has also been used to disseminate the films.

Figure 5: From a video demonstrating a parallelsorting network

Competitions are another method of reaching out to schools. Traditional computer contests have centered on programming, although "non-programming" events are gaining popularity. We tried sending submissions from intermediate school pupils (about 10–12 years old) to the "Cantamath" competition and the Canterbury-Westland Science fair in 2007. The students presented written pieces based on an Unplugged assignment they had completed in groups. We found that having students describe their work to their classmates piqued their interest in the material and led to a more thorough comprehension on their part. The possibility of winning a reward served as inspiration, but there is a danger with cash awards at scientific fairs: outstanding work may not get any acknowledgment if it doesn't happen to be among the top few that "win" (Somers & Callan, 1999). As a result, a student who is already very skilled in the subject can be put off from further study. Having "standard" based prizes, such as a "highly commended" award to any initiative that attains a qualifying standard, may help prevent this problem. Without adequate exposure to the Unplugged content, we discovered that the thought of completing Computer Science without computers looked like an unattainable feat, thus we considered it vital to give professional guidance for the students.

Assuming these problems are fixed, this approach has promise since it allows students to apply the scientific method to concepts from the field of computers and encourages them to immerse themselves in the material. At the conclusion of the course, students expressed more enthusiasm for the field of Computer Science, a more nuanced understanding of the link between CS and mathematics, and a firm grasp of several quite complex ideas. Having students more actively participate in an activity (rather than just watching a small number of their classmates do it) and making the activities more personally relevant (using a picture of a teacher, for example) both boosted the effect.

The Unplugged content may also be used for a variety of programs, including school assemblies, demonstrations at scientific centers, and performances at science festivals. The primary purpose of these performances is still to get the word through that Computer Science is fascinating and should be taught in schools.

Technology is just one aspect of science, which also requires collaboration. You may find an hour-long clip of a typical program online (see http://www.youtube.com/watch?v=VpDDPWVn5-Q).

The parity "magic trick" is sometimes performed at the beginning of the performances to introduce the idea of binary representation and to detect which card a pupil has turned over. Another trick is to have someone in the audience celebrate a birthday, and then use "divide and conquer" to cut the cake in half, and then in half again, to demonstrate the speed with which issues with logarithmic complexity decrease. The Stroop effect (Stroop 1935) is used to humorous effect, with the audience being asked to name colors that are susceptible to interference by displaying text written in a color distinct from the one presented. This is used to cause disruption in Human-Computer Interaction (HCI), such as when a button's label is misleading (like when the "Start" button in Windows XP is used to shut down the computer, or when users are unsure of what to do when given the "Yes," "No," and "Cancel" choices). An knowledge of human behavior is crucial to HCI, which in turn leads to a consideration of additional examples of subpar interface design.

For example, if a class is learning about World War II (history), an Unplugged session that begins with the Enigma ciphers and moves on to encryption techniques might be utilized to fit in with the subject and get access to the classroom. The Unplugged crew makes an effort to showcase the activities' versatility by showing how they may be adapted to fit a number of situations. For instance, attendees at the 2009 SIGCSE conference, which was held in Chattanooga (Tennessee), were handed a set of CS-based puzzles with a "Chattanooga Choo Choo" theme (Figure 6 shown).

Many of the Unplugged pursuits may be performed outside, providing a welcome diversion from traditional classroom settings; they also integrate physical exercise with creative problem-solving. Chalk on the sidewalk or signage positioned strategically around the playground may be used to create ground-level puzzles or paths. Some of these puzzles and games, such as the seven bridges problem, a six-way sorting network, and an eight-queens puzzle, have been arranged in a "Maths/Computer Science garden" (Figure 7) at the University of Canterbury. During school visits or even normal lessons, having the students run around the seven bridges and think about the answer is a welcome diversion from the lecture theater activities.

The exercises are also being translated into a (ironically) online game, where kids can practice what they've learned and discover patterns and algorithms in a hands-on, self-paced setting. Three of the games may be played in Flash format at this time. Future work in this area will examine the potential of melding "Unplugged" with kid-friendly programming languages like Scratch and Alice. Students who are able to master one of these animation-centric languages will have an advantage. animate anything they have been doing physically, they will have effectively implemented the problem's logic, not unlike a typical programming assignment in a computer science course. There haven't been any formal experiments using this method yet, however there have been camps where kids participate in Unplugged activities during parts of the day and (unrelated) programming activities during others.

.

Figure 6: A shortest paths algorithm adapted for a“Chattanooga Choo Choo” theme

Figure 7: A maths and computer science garden

Sharing program details with educators is also crucial. We've held many seminars for educators to explain the value of the exercises and encourage their implementation. Teachers have found these seminars useful since they contribute to their required ongoing professional development and they get a deeper grasp of the topics covered.

We have also held seminars for computer science faculty, with one early 2008 session for 40 postgraduate computer science students who were in Christchurch for a research students' conference standing out as especially fruitful. Unplugged was shown at the workshop by bringing in 60 middle school children for a one hour performance, which was seen by 40 graduate students. As we discussed each subject on the program, we asked the graduate students in the audience to raise their hands if they were currently engaged in research on that issue. Both the graduate students and the elementary school students benefited from the event; the former got to interact with a diverse group of researchers who may not have fit their preconceived notions, while the latter witnessed students as young as five discussing complex issues in computer science.

Designing kinaesthetic activities

The Unplugged program's fundamental idea is, as its name indicates, to create CS education strategies that don't rely on computers. This paper's introduction explains the thinking behind this decision. We don't advocate for this to the exclusion of other methods (such kid-friendly programming languages), but we have decided to concentrate on it, take it as far as we can, and share the insights that arise from that with the world.

The project's guiding principles include, among others, the fact that it is "off-line"; a concentration on presenting CS ideas, rather than programming, since the latter might be a bottleneck that stops some students from ever discovering the latter's deeper concepts; and so on.

The exercises should be interesting and engaging, not merely busy labor; this includes making them kinaesthetic, often on a big size, and incorporating team effort.

The materials must be reasonably priced.

• A Creative Commons license is used for the distribution, allowing others to freely distribute and build upon the materials.

The emphasis is on teamwork rather than competition, and the activities are designed with both sexes in mind (or at least with females in mind).

• The activities frequently have a narrative quality to pique the kids' attention and keep them engaged. Stories may be a little out there (like the pirate transportation service or a kid who talks to his friends by decorating the Christmas tree with lights) to capture the attention of young readers.

The goal is not to impart knowledge, but rather to let students to "play" with the ideas presented to them via Socratic questioning and constructivist activities.

• Small mistakes made by a youngster or instructor shouldn't completely derail the activity's intended consequence.

A game's compatibility with the Unplugged ethos is determined by whether or not it is easy to learn (the rules can be explained in a few minutes), enjoyable (kids will want to participate), and collaborative (or competitive; kids will be motivated to work together to achieve a common goal) in nature.

There are a variety of methods via which activities have progressed. Some are just reimaginings of classics, while others were born out of the need to give concrete form to an abstract notion (Nishida et al., 2009). First, identify the building blocks of the CS idea: bits, states, weights, transitions, and comparisons. Toys and games can sometimes be found that make use of the aforementioned components (for instance, cards have two sides that correspond to the two values of a bit; balance scales can compare two values at once; stickers can be used to make choices permanent; strings and chalk lines can be used to dictate transitions). The next step is to reframe the issue as a challenge, either to locate a workable solution (such as a route to the desired destination) or the optimal one (the quickest route).

Once an activity has been planned, it is piloted with students to see whether it is interesting to them and whether or not it can be implemented as planned. It's not always easy to anticipate such factors; some seemingly simple activities may be very stimulating for kids, and vice versa. The main collection is for proven and tested activities, with changes and adjustments proposed based on experience; we have recently added a "half bakery" to the Unplugged site for activities that are currently being polished.

To evaluate if an activity fits in with the Unplugged philosophy, we look for simplicity (the rules can be explained quite quickly), engagement (the activity is attractive for children), and cooperation or competition (the children are motivated to work towards a goal, either as part of a team, or to try to find a better/faster solution than another group).

Activities have been developed in a number of ways. Some are simply adaptations of existing ideas and games, while others have resulted from taking a concept that we wish to illustrate, and working out how it can be turned into a challenge (Nishida *et al*, 2009). The first step here is to work out the key elements of the CS concept, such as bits, states, weights, transitions, or comparisons. Sometimes games or toys can be identified that use those elements (for example, cards have two sides that correspond to the two values of a bit; balance scales can compare two values at a time; stickers can be used to make choices permanent; strings and chalk lines can be used to dictate transitions). The problem then needs to be turned into a challenge, perhaps to find a solution (suchas a path to a goal), or the find the best solution (such as the shortest path).

Once an activity has been designed, it is tested with students, and inevitably will need some adjustment to make it engaging, or even feasible. Often such elements are hard to predict; some apparently simple activities turn out to be very motivating for children, and vice versa. We have recently added a “half bakery” to the Unplugged site for activities that are still being refined, as the main collection is for tried and tested activities, with variations and adaptations suggested based on experience.

4 Internationalisation of Unplugged

The Unplugged program has generated interest aroundthe world, and currently has advocates in at least 16 countries, in addition to international organisations such as the ACM/CSTA.

The reason for interest can vary between countries; some are interested in growing interest in students, others want to use it for school curricula, some are interested in novel teaching methods, and other countries have very limited access to computers and wish to use it to make it possible to teach the topic at all.

The international interest is reflected in multiple translations of the material becoming available. The teachers’ edition of the material (12 activities) has been published in Korean, Japanese, Italian and Spanish, with drafts versions completed in simplified Chinese (for mainland China), traditional Chinese (Taiwan), and Arabic. Partially completed versions exist in Hebrew and German, and initiatives are in earlier stages for Swedish, French, Greek, Bahasa Indonesia, Tamil and Bengali. The web site is also being translated into several languages, and the videos are available in six languages.

Taking materials to other countries involves more than just translating the text (Bell *et al. 2008*). For example, several of the activities rely on using the English alphabet as a character set, with 26 characters that can, for example, be represented using a 5-bit code. In contrast, Chinese has thousands of characters, and even the simplest forms of Japanese require around 50 characters. Korean has just 24 characters, but they are combined to form new characters. All of these issues can be dealt with,but need some care to make sure that the point of the exercise is still achieved.

There are other cultural issues, such as an example which uses Christmas trees, and even the assumption that space will be available for some of the outdoor activities (in some countries it is not unusual for a school to be upstairs in a high-rise building).

The Unplugged project has brought about strong collaboration between educators in China, Korea and Japan, and there have been two workshops in Wuhan(China) in 2007 and 2008 with the purpose of sharing ideas and developing plans for promoting Unplugged in that part of the world. An important aspect of Unplugged is that it should be self-sustaining, which is achieved by local groups developing the program for themselves with support from the main project run from Canterbury.

5 Current research

Multiple studies are now being conducted to improve the Unplugged programs.
So that researchers may draw from a broad variety of resources when discussing a specific topic with students, new activities are being created to fill in certain gaps in the field of Computer Science.
Some pupils may not be able to participate in the activities because of space limitations, a lack of available playmates, or physical limitations. Second Life (http://secondlife.com/), an online virtual environment where users can control avatars and communicate with others in real time, is a platform we are testing out for Unplugged events. Figure 8 illustrates a sorting network used in Unplugged, a virtual world. Avatars sort numbers while wearing t-shirts depicting the network they are working on. People with restricted movement may still use the navigation features since just a few keystrokes are needed to go around. The activity calls for six participants, any of whom may be located anywhere with an Internet connection (or even be computer-generated "players"). While it may seem strange to employ one of the most electronic kinds of social connection for "Unplugged" tasks, the fact that students may jump right into complex CS ideas without first learning to code is a significant advantage.

Figure 8: A sorting network in Second Life.

Si Piuh (Bianco & Tinazzi, 2004), based on made-up characters (Figure 9) that reside in a computer (the "realm of Si Piuh" - pronounced CPU) is a similar project that emphasizes the story-telling technique to introducing young pupils to CS. In order to combine the motivation of story, the activities of Unplugged, and the experience of computer programming, we are investigating the possibility of incorporating these characters with a visually based programming language such as Alice, and then having children experiment with kinaesthetic activities from Unplugged in this environment. We are also creating cartoon storylines in which characters from Si Piuh, who play the role of hardware, are tasked with solving hypothetical issues from Unplugged, which are mostly concerned with data and algorithms. Since many of the Unplugged difficulties are based on made-up tales, this may be a great place for the Si Piuh characters to find interesting stories to play out. Figure 10 depicts a segment of such a cartoon, in which a bus driver must carry LZ-compressed data to a decompressor.

Figure 9: Combining the characters from Si Piuhwith the problems in Unplugged.

6 Conclusion

The "Unplugged" initiative began as a set of classroom exercises but has now expanded into a wide range of outreach and educational resources. To enable students to study Computer Science without initially learning to program, we need to construct a community that can exchange effective teaching approaches and creative ideas. The community is expanding fast, and many different techniques to teaching the notion have emerged as a result.

7 References

(2007), Adams, J. C. Alice, sixth graders, and the real vs. fictional vs. fantastic debates. Covington, Kentucky, USA: ACM, New York. Pages 307-311 in Russell, I., Haller, S.M., Dougherty, J. D., and Rodger, S.H. (Eds.), Proceedings of the 38th SIGCSE Technical Symposium on Computer Science Education.

According to Bell, B. T. Wada, S. Kanemune, X. Xie, W. G. Lee, S. K. Choi, and B. Aspvall (2008). Facilitating Japanese, Korean, Chinese, and Swedish participation in CS activities. Proceedings of the 39th SIGCSE technical conference on computer science education. Edited by J. D. Dougherty, S. H. Rodger, S. Fitzgerald, and M. Guzdial.

It was published in 2008 by Bell, T., Alexander, J., Freeman, I., and Grimley, M. How to teach people about computers without using computers. Documents Presented

At conference proceedings from NACCQ08, held in Auckland, New Zealand: the National Advisory Committee on Computing Qualifications.

Clark, M., Bennett, A., & J. Briggs (2006). Computer science club pilot program in high schools. The 11th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education (ITiCSE 06) (pp. 38-42) was held in Bologna, Italy and was published by the Association for Computing Machinery in New York, New York.

Bianco, Giuseppe M., and Stefano Tinazzi. Within Si Piuh's domain. Published by ACM in New York, New York: Boyle, R.D., M. Clark, and A. Kumar (Eds.), ITiCSE 04: Proceedings of the 9th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education (p. 247), Leeds, United Kingdom.

S. K. Choi, T. Bell, S. J. Jun, and W. G. Lee (2008).

Making Computer Science Lessons for Korean Elementary Students Available Offline. Proceedings of the 13th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education (ITiCSE 08) (pp. 338–341), Madrid, Spain: Association for Computing Machinery (ACM), New York, NY.

As cited in Denning (2007). Computing is a branch of the hard sciences.

50(7), 13–18, Communications of the ACM.

(2007). Doerschuk, P., J. Liu, & J. Mann. From planning through grading, a pilot summer program for middle school females in computers is presented. According to Hughes (2007), Peiris (2007), and Tymann (2007), Innovation and Technology in Computer Science Education: Proceedings of the 12th Annual SIGCSE Conference (ITiCSE 07) (pp. 4–8), Dundee, Scotland: Association for Computing Machinery (ACM), New York, NY.

An Unplugged Computer Science Design Pattern, by Nishida, Kanemune, Namiki, Idosaka, Bell, and Kuno, 2009. Chattanooga, Tennessee, USA: ACM, New York. Lewandowski, G., & Wolfman, S. (Eds.), 40th SIGCSE technical symposium on computer science education (to appear).

An analysis of scholastic math and science contests Somers, L., & Callan, S. (1999). Written for the National Science Foundation. Located at http://www.wmich.edu/evalctr/competitions.pdf and retrieved on May 16, 2008.

Stroop, John R., 1935. Interference in sequential verbal replies has been studied. 18(6), 643-662 in the Journal of Experimental Psychology.

Researchers Tucker, F. Deek, J. Jones, D. McCowan, C. Stephenson, and A. Verno published their findings in 2003. New York: ACM. K-12 Task Force Curriculum Committee. A Model Curriculum for Computer Science.

Wing, J. (2006). The ability to think computationally.

The ACM Bulletin, 49(3), 33–35.

In a 2007 study by Yardi and Bruckman, Bridging the gap between high school students' and college and university graduates' understandings of computers. Third International Workshop on Computing Education Proceedings Anderson, R., S. Fincher, and M. Guzdial (Eds.).

Research (ICER '07), ACM, New York, NY, pp. 39-50, Atlanta, GA, USA.

Development of an Integrated Informatics Curriculum for K-12 in Korea, in Mittermeir, R.T. (Ed.), Proceedings of the International Conference on Informatics in Secondary Schools (ISSEP) 2006 (pp. 199–218). Yoo, S.-W., Yeum, Y.-C., Kim, Y., Cha, S.-E., Kim, J.- H., Jang, H.-S., Choi, S. Springer, Berlin/Heidelberg, Germany, 4226 Lecture Notes in Computer Science.