The magic of HCI: Enthusing kids in playful ways to help solve the Computer Science recruitment problem

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ABSTRACT

With interest in studying Computer Science having dropped worldwide in recent years, the inclusive approach to the subject of Human-Computer Interaction (HCI) has strong potential to make a difference. The cs4fn outreach campaign has drawn on this, and is based on core messages with links to HCI themes. cs4fn consists of a free schools magazine, a website and live activities. We present research in a playful, offbeat way. This has led to large increases in applications for places on our undergraduate Computer Science courses. cs4fn and the HCI aspects within it are also playing an important role in our attempts to attract more women to the subject. We discuss here some of the ways we have implemented the campaign's messages using HCI topics. We overview the way HCI has played an integral part in the articles we write, in cs4fn activities on the web and in our lectures, workshops and shows such as the cs4fn Computer Science Magic Show.

Categories and Subject Descriptors

K.3.2 [Computing Milieux]: Computer and Information Science Education – *Computer science education*

H.1.2 [Information Systems]: User/Machine Systems – *Human factors*

General Terms

Human Factors

Keywords

Outreach, Human-Computer Interaction, Public Engagement with Science, Recruitment, Computer Science, Gender issues.

1. INTRODUCTION

Since 2001 UK University applications to study Computer Science have dropped by almost 50% according to the UK Council of Professors and Heads of Computing [5]. There are many reasons for this, including: its image problems such as stereotypes that it is a geeky male-only subject; the aftermath of the dotcom boom and bust leaving perceptions that there are no longer jobs; and the fact that only ICT– essentially about *using* computers – has tended to be taught at school. Traditional wisdom is that what is needed to overcome such problems is a serious approach to determine the precise issues, and then address each directly. For example the issue that young people do not think there are good career prospects should perhaps be addressed by cataloguing the careers that are available after taking the subject. This seems at first sight promising given that the demand for IT professionals is predicted to increase dramatically over the next few years so a core message such as "There are jobs" ought to work.

We argue here that, while such serious material may be part of a solution, a "serious fun" approach, based on an assumption that the core issue is that the subject is no longer seen as being engaging, is more vital. Our solution has therefore been to focus on exciting, and so re-engaging, young people with the subject. We argue that this is a highly effective way to solve the problem. Once young people are engaged with the subject once more then the serious messages such as that there are careers available are more likely to be effective. Such messages can also be embedded in a fun, playful approach. Furthermore, we argue here that Human-Computer Interaction (HCI) provides a good foundation around which the key messages of such a serious fun approach can be based and discuss how it has been a core element of our activities.

At Queen Mary, University of London, we have been running an initially local, but more recently UK-wide, and increasingly international, campaign along these lines. It has had a great deal of success. Called cs4fn (Computer Science for Fun) [8] it consists of a magazine sent free to schools, a complementary website (www.cs4fn.org) containing far more than is in the magazines and a series of linked school talks and shows. All focus on presenting interdisciplinary computer science research in an engaging and entertaining way. We aim to go beyond the school syllabus providing enrichment rather than supporting the existing syllabus. It emerged as a way of binding our previous outreach initiatives together – most notably Sodarace (www.sodarace.net) [17], a booklet one of us wrote to help students struggling with understanding programming and data-structures and algorithms

concepts [7], together with talks we had developed using games and puzzles to teach computing concepts [6]. The first issue of the print magazine was created specifically as a handout to give to visitors to our Sodarace stall at the Royal Society Summer Exhibition in 2005. The resulting campaign however has proved to be much more powerful than just a handout.

In this paper we overview our experiences of cs4fn with an emphasis on the HCI related activities that have contributed to the early successes of that campaign. In Section 2, we outline the key messages that we used as the foundation of the campaign and look at their links to HCI. In Section 3 we discuss how HCI has been used to deliver these messages in the magazine and on the web. In Section 4 we look at how they have been incorporated into our live lectures, shows and workshops. We then discuss in Section 5 the effect this has had, in conjunction with more traditional responses to the problem, on Queen Mary recruitment to computer science courses. Finally we draw conclusions in Section 6.

2. THE MESSAGE

2.1 Serious fun

The overall message of the cs4fn campaign is that:

Computer Science is serious but fun.

The writing and shows are based around computer science research presented in a playful and accessible way. Because of the research link, the topics all have a serious side. An important aspect of this is that we do not patronize. We do not treat our readers as children but as lay adults. The writing therefore aims not to be simplistic, just good accessible writing that is understandable both by children and lay adults alike. Each article or talk aims to teach some simple but important aspect of computer science.

There are also a series of sub-messages that form the foundation of what we do:

- *Computer Science is about people too.*
- *Computer Science is not ICT: it is about creating new and better systems not just using existing ones.*
- *Modern science and engineering are inter-disciplinary.*
- *Computer Science is for everyone.*

We overview each of these sub-messages below, discussing their link to HCI. We describe how they have been incorporated into the cs4fn activities in the subsequent sections.

2.2 Computer Science is about people too

The message that Computer Science is about people too is clearly also a core HCI message. The stereotype that it is just about technology, and so only for gadget-loving boys, is one aspect that may be responsible for the low level of take-up of the subject. It is an important point to engage the public with if they are to have a good understanding of the subject. This message also opens up wide-ranging avenues for playful engagement with the subject as discussed in the subsequent sections.

2.3 Computer Science is not ICT

Computer Science is not the same as ICT as taught in schools, and HCI research provides a useful alternative to the converse stereotype that computer science is all about programming. It gives a different distinction between the ICT of using existing systems as against designing new and better systems. The focus on methodologies and processes of much of HCI research also covers a set of useful and critical investigative skills that can be linked across the school curriculum.

2.4 An inter-disciplinary subject

A second sub-message is that science and engineering today do not on the whole stick to subject boundaries but are inter-disciplinary. This is especially true of computer science. Human-computer interaction, drawing as it does from a range of areas including psychology, social sciences as well as design and engineering is a natural area to get this message across. In fact Computer Science sits in a unique position of linking naturally to virtually every other subject. Indeed computational methods are changing the ways other subjects are explored, from Physics to Art. These points where subjects meet lead to exciting and accessible research and so also to naturally engaging stories. Whilst the focus of cs4fn is on computer science, actually we see it as part of our mission to engage students with mathematics, the sciences and engineering more generally. Computer Science is just a good vehicle to do so.

2.5 Computer Science is for everyone

There are several aspects of the message that Computer Science is for everyone that we have addressed. The first is to break the stereotype that computer science is a male-only subject. The way we have done this is by specifically profiling female high-achievers, presenting their work in accessible cs4fn style. Several of those covered to date are professors of HCI related topics. We have similarly tried to portray positive ethnic role models too, for example bringing out the often forgotten Muslim roots of algorithmic mathematics. Future work is planned to enhance appreciation of the diverse ethnic roots of Computer Science. The further HCI aspect of the "CS is for everyone" message addressed so far has been to cover design for all. This is another area we intend to cover in more depth in the future. In this paper we consider mainly the aspect that Computer Science is for women.

3. THE MAGAZINE AND WEBZINE

The core activity of the cs4fn campaign is in the magazine and linked webzine. The free 20-page magazine is produced twice a year and sent to schools across the country as well as to subscribers. This is supported by a website where all the magazine articles and more are placed. We aim to write on average 6 new articles a month for the webzine. All the writing follows the serious fun approach. The writing and story-telling is made playful using a variety of techniques. In some cases the story itself is naturally playful – for example the use of games technology for some serious purpose to further research. In other cases we use offbeat links with popular culture, such as with films, books or music. We also use strange connections, or anecdotes directly from the researchers concerned, as the hook. HCI linked articles feature regularly. One issue of the magazine was devoted to ubiquitous computing and design for all. A forthcoming issue is to be on mobile computing.

In addition to the straightforward article writing we have also experimented with other ideas in the website. We review below those with a link to HCI.

3.1 Human error Space Invaders

One of our earliest efforts to add fun, active learning with a direct link to research to the website is linked to our HCI research project exploring and modeling the causes of systematic human error in the use of interactive systems [10] [22]. Following the methodology of Byrne and Bovair [4], this involves running empirical, laboratory-based studies using games and microworlds. Each introduces opportunities for subjects to make systematic slip errors, such as post-completion errors (where a tidying-up action is forgotten that is required to be done after the person's goal is achieved). By manipulating variables such as the salience of cues, and levels of different kinds of cognitive load, the causes of the slips can be better understood.

To support a cs4fn article about human error in the use of interactive systems, we developed a human error version of the Space Invaders game as an applet to go on the site. A post-completion error is embedded into the game such that if made, the player loses all their points. Readers of the cs4fn article are challenged to play the game and gain a high score, by never making the post-completion error. This allows players of the game to gain an active understanding of the issues surrounding slip errors and whether training is a way to eliminate them. The Space Invaders pages are regularly in the top 30 pages on the site showing the popularity of the idea. Data from the applet, which also records the errors made, also led to published research, making the link even more direct between research and fun learning [1].

3.2 The Fundamentals of HCI

Unlike with subjects such as History or Physics that are studied at school, a school student considering taking computer science may have no real idea of what it will involve. Worse, school ICT is likely to give a false impression. University prospectuses and other similar material aim to overcome this by outlining programmes with a brief paragraph or two and a list of modules that will be studied. However, without having studied some of the subject already these lists and descriptions may well be made up of meaningless, jargon-filled phrases to their intended audience.

To address this problem we created an area of cs4fn that we have called "The Fundamentals of Computer Science" (www.cs4fn.org/fundamentals/). The idea is to give a cs4fn style description of the major first year topics that would likely be covered in some form whatever university a student ultimately chooses. Each fundamentals page takes the reader to a mixture of written articles and interactive applets or other forms of fun, active learning. For example, the section on algorithms includes an applet of a simple algorithmic solitaire puzzle that introduces the idea of efficiency of an algorithm (following the approach of using puzzles to teach algorithms [6]) together with articles on Muslim science.

In addition to more traditional first year modules we also included a fundamentals page on HCI because of its potential to give the wider view of what the subject is and so support our central messages. It includes links to the Space Invaders Human Error Experiment to discuss human error (see Section 3.1 above), an online version of our usability workshops introducing usability evaluation methods (see Section 4.3) and the pencil and paper game of Spit-not-so to discuss why GUIs are better HCI than console interaction (see Section 4.1).

The fundamentals areas of the website are some of the most frequently visited areas, suggesting this does fill a need. As a consequence we are adding further topics as we develop the resources to cover them in a suitably playful and active way.

3.3 The Maze

The Maze is a further early example of playful HCI introduced into the website. We could just have used normal navigation techniques, but wanted the site structure itself to be playful. The idea of the maze is to provide a mechanism for people to explore the website in a fun way that encourages serendipity, taking readers to subjects they might not have otherwise thought interesting enough to search out. Rather than applying web navigation design rules we decided to break them and so explicitly encourage people to get lost in the hyperspace of our website. This also gives a playful way to learn about why navigation design is important.

The Maze works by placing links at the bottom of each page, labeled as being part of the Maze, that take the reader to other pages. These linked pages are chosen to have no connection to the current one. Each link has a cryptic description describing the page as though it were a room or other physical location but with some hint of the article found there. Readers who wish to explore the maze use the maze links to move from page to page attempting to get to the page that is at the "centre". As in a real maze there are often interesting things along the way. You can either try to head straight for the centre or explore the pages you pass through.

We currently have two mazes, the second being an equivalent graph to the real Hampton Court maze. This not only reinforces the maze metaphor but also illustrates the computer science idea of abstraction and shows how solutions in one domain can be mapped to another.

The Maze appears to be a popular way to explore cs4fn. The start page for the Maze is consistently the second most popular page on our website, after only the home page. The following is an unsolicited comment from an ICT teacher: "*I keep plugging the website which I think is an excellent resource. I and my colleagues keep getting lost in the maze .....! Excellent concept.*" School students enjoy the Maze as well – one wrote that the best thing about the site was "*Your articles on various topics and the maze layout...I learn so many new things just by poking around*".

The Maze also illustrates how HCI is more than just usability and that when user experience is the concern, the solutions chosen may be different.

3.4 Women in Computer Science

To address the problem of so few women wanting to do computer science we have taken three main approaches. We have made an explicit effort to profile the work of women for each issue of the magazine. We have then developed a women in computer science portal for the website, and finally we have used this material in a talk on women in computer science. HCI has played a direct role in these aspects, though there is more to our approach of portraying women than just HCI. Other aspects we do not discuss here include taking care over the imagery used, exploring the way women have been portrayed in films and in featuring the role of women in the early history of computers, all in a playful way.

We have profiled a series of women in computer science in the magazines, and many of those we have focussed on have a HCI aspect to their work. For example, the feature article of the Computer Science Everywhere issue was on Yvonne Rogers and her work on the ambient woods [21] [9]. We have also looked at Kirsten Dautenhaun's work on social robotics [15] [18]. More recently we have profiled Bonnie John's work on GOMS and CogTools [16] [12]. In each case we have not made a big issue of the fact that the researchers concerned are women, but take it as a given that top researchers are just as likely to be women as men.

As with all cs4fn writing the aim is to avoid dry expositions of the work. We do not take it as enough in giving role models that we just describe a person and show that they have been successful. We aim to get across that their work is enjoyable and useful, in an accessible and playful way. Often with the work of HCI researchers this is easy. For example Yvonne Rogers' work aims to be playful in its own right. Similarly Bonnie John provided the playful grab for her work in the seminar that it is based on: by talking about the work as 'cognitive crash test dummies'.

We have not just focussed on female leaders, but also on the work of female students. HCI related student project work has featured, such as a team project to design the interface for a mobile digital radio. The all-female student team concerned decided (uniquely in the year group) to go beyond the basic brief and create a radio that was also suitable for the blind.

We have further pulled these articles together into an area of the webzine specifically about women in computer science (www.cs4fn.org/women/). This area is still in its infancy but we hope that as we add to it, it will become a major resource to show the contributions of women to the subject and so break the stereotype. The Westfield Trust have recently awarded us a small grant to further develop this area of the website and specifically to produce a cs4fn special on Women in Computer Science and Electronic Engineering.

We have also developed a women in computer science talk, popular with girl's schools, which pulls this material together into a coherent story demonstrating that the stereotype of computer science being a male only domain is not the reality. It shows that women both enjoy the subject and are highly successful.

4. LECTURES AND SHOWS

In addition to the written material in the magazine and on the web, the cs4fn campaign also includes a series of workshops and interactive lectures, which are essentially live presentations of collections of cs4fn articles woven into coherent stories. These all follow the kinaesthetic style of outreach championed by Bell *et al* [2] and Cutts *et al* [14]. We outline those with HCI themes below.

4.1 The Tower Hamlets Workshop

The immediate precursor to cs4fn was a workshop and booklet we developed for the annual Tower Hamlets Science and Engineering day where students from Year 10 are given a feel for a range of science and engineering subjects and careers. In groups they do 20 to 30-minute activities before moving on to another stall. Stalls are run by employers, university departments and other bodies with an interest in public engagement with science and engineering.

For our stall on computer science we decided to do "unplugged" activities to help get away from the idea that the subject was about using computers. The aim embodied the main messages that ultimately went into the cs4fn campaign: notably that it is about people, the interdisciplinary aspect and the fact that it is not ICT. Our workshop combined an introduction to programming with artificial intelligence and the importance of human computer interaction in computer science.

We did a version of our "intelligent piece of paper" activity where we make a claim that a piece of paper is more intelligent than any of the group, discuss what might be the basis for such an apparently outrageous claim, then hold a noughts and crosses match between the paper (which instructs a human to do the physical things it can not do) and a human. As the paper contains perfect noughts and crosses instructions it never loses and often wins. This leads to a discussion of where the apparent intelligence actually is, what a program is and how programming is about writing rules to be followed blindly.

We then switched tack and showed some optical illusions leading to a discussion of how our brains at some level are following rules too as it is the rules failing to work that shows up as illusions. This is linked to the point that as psychologists understand more of how the brain works we can program computers to do similar things.

We finally switch back to a game, this time one called Spit-not-so, with a challenge for someone in the audience to take us on in this new game. It is a word game where the aim is to take words from a list of 9 possibilities aiming to hold three letters the same. The words are presented in a simple list. This makes it hard to pick out the combinations of words with matching letters. The game is in fact isomorphic to Noughts and crosses. This can be seen by laying the words out in a grid so that common letters share rows, columns or diagonals. Then instead of looking for letters, you can play the game by looking for lines of crossed out words – playing Noughts and crosses. The twist at the end is therefore that actually the person was playing against the piece of paper again. The link made to computer science is that different ways of displaying information and interacting with that information can make a task easy or hard – just as a GUI interface can make tasks easier by presenting them in a way that fits with our cognitive psychology.

As we wanted the students to reflect on the activities afterwards, we wrote up the 'story' of the stall in a photocopied booklet that each participant was given. This formed the basis of what was later to become the first issue of the cs4fn magazine.

4.2 The Computer Science Magic Show

The idea behind the Computer Science magic show [11] is that magic tricks provide a good metaphor for a wide range of computer science ideas, from formal verification to how medical tomography algorithms work, and this includes HCI issues.

The format of the show is that we present a magic trick and then challenge the audience to work out how it is done (if they do not think we are psychic). We then explain the trick so that the audience can do it themselves, and finally we explain some linked computer science.

For example a whole family of card tricks are self-working. This essentially just means they are algorithmic. If you follow the steps then the magical effect will result. This provides a fun way to introduce the idea of an algorithm and so how computers work by following programs.

This equivalence of magic as algorithm however opens up a second link. A magic trick, even where the algorithm is followed precisely, can have the right execution but still fall flat and not seem magical at all to the audience. What is needed to make a trick work is a good presentation: a good interface between the algorithm and the audience. This can be used to introduce why interface design is as important as programming. A program with a poor interface is unlikely to be successful.

The links of HCI to magic go much deeper than this however. Magicians have to have a very good understanding of cognitive psychology as should interface designers. Good interface or web page design involves working with the fact that people have limited attentional resources, for example. If these attentional resources are controlled well an interface will be easier to use. Magicians similarly control the attention of their audience when performing tricks, though with the converse aim of ensuring certain things are not seen. This provides a way to introduce our research on human error from the HUM project for example, exploring the causes of error. We will be exploring this further in forthcoming magic shows, and specifically at the Royal Society Summer Exhibition in June 2009. Our exhibit on our research on perception and attention will be fronted by magic tricks to engage the audience with our research.

We give everyone in the audience of the magic shows a copy of our Computer Science Magic book [19]. It follows the format of the show. As a further indication of the popularity of this approach, the pdf of the Magic book had over 1000 downloads within the first month of its release on the web. We are intending producing a second magic book that will have a greater focus on HCI to accompany our Royal Society stall.

4.3 Usability Workshops

4.3.1 The Primary School Usability Workshops

Whilst the core of our activity has been aimed at secondary school students we have also started to explore activities with much younger students. We have found that variations of the same kinds of physical, kinaesthetic activities work with a wide range of age groups [13]. Our first activities along these lines were based explicitly on HCI topics.

We took what were essentially the topics of a university course on Human-Computer Interaction and based a Primary School workshop around them. The students concerned were in Year 6 (10/11 year olds) of a London primary school. The initial version of the workshops was given over 6 sessions to a whole class that included the full range of abilities. A compressed version of 4 sessions was given to the whole year group of a second Primary School of the same age range later in the year.

The aim was to use interface design to give the students an understanding of how computer science was focused on design and analysis of computer-based gadgets rather than just the use of computer applications. We specifically wanted to give them a flavour of a range of research methods used by HCI practitioners.

The workshop was set around the goal of designing and evaluating an interface for a digital radio that was to be very easy to use. Such radios had only recently appeared on the market.

To initially introduce them to the topic of interaction design, they first investigated the design of doors following Don Norman [20] as well as of a range of everyday gadgets including digital radios. They had to design the interface to a digital radio, create a post-it note prototype of it and then a Powerpoint hi-fi prototype, evaluating the design at each stage.

These activities and some of the student's results were turned into articles on the cs4fn website (www.cs4fn.org/manorside/).

4.3.2 The Sixth Form Usability Workshops

After the success of the primary school version of the usability workshop, we developed a one-day Science week version for sixth formers too. This was done as a Dragon's Den style event where teams role-played being a design team in competition to create and evaluating the interface to a digital radio. They first explored existing radios of a range of designs and makes and came up with specific design guidelines either to avoid problems or to ensure good design. They then learnt about and tried out think-aloud user testing and cognitive walkthrough. The evaluations were again based on real radios. In the afternoon they developed their own designs, created post-it note prototypes and did Wizard-of-Oz style user evaluations on them. Finally they gave a presentation illustrating the design with judging based on an audience vote and expert panel as to who should "get the contract" to design their radio.

The workshop was far more popular than anticipated. It was initially advertised to Year 12 students at sixth form colleges, and was quickly oversubscribed and as a result we increased the number of places available, adapting the workshop slightly to cope. Many applications still had to be turned down. Participants were from a range of schools and had a mix of ethnic backgrounds. The male-female mix was roughly 55%-45% suggesting that the topic helps break male-female stereotypes about computer science.

The feedback on the activities was given via a standard Research Councils UK science week evaluation form. 68% rated the workshop as very or fairly interesting, 74% enjoyable, 61% topical and 71% rating it as very or fairly educational. 76% felt they understood the issues and had time to explore them. Numbers rating it negatively in each category was low (5 -15%). 42% said the event had made them want to find out more about science and engineering with 34% having no view. An issue leading to negative feedback was that some students (and their teachers) had assumed the workshop was about doing hands-on electronics because it was about "fixing designs of digital radios". This reinforces the point of the problems with terminology. The fact that the advertising talked about usability not electronics was not enough to overturn the preconception of what it must be about.

4.4 Artificial Intelligence Lectures and Workshops

Our most popular talk to secondary schools is on Artificial Intelligence: "The Mind of the Machine". We explore questions such as: what is intelligence and how can you recognize it. We then look at two approaches to developing intelligent machines: writing programs to do things intelligent humans can do like playing chess (in whatever way possible) and understanding how the brain works (and so copying the machinery rather than the effect). A version of this 90-minute lecture was also adapted as a Year 6 (10/11 year olds) primary school workshop series over 4 sessions. Feedback on these lectures and workshops has been excellent throughout [13].

Whilst HCI is not the primary focus of these lectures and workshops it still plays a major role in making the talk work. A theme is that intelligence is wider than just IQ and involves things like an ability to communicate and emotional intelligence too. The Turing test is after all essentially a test of human-computer interaction. This leads to the point that for machines to be intelligent on human terms they need to be able to understand and use natural forms of human-human communication such as gesture and emotion. This is illustrated using a video of an affective robot head developed by a Queen Mary student that reacts to the tone of a speaker's voice. If their tone is angry then its expression changes to a sad expression. If their tone is soft then the expression becomes happy. It also can shows surprise after sudden sounds. In the primary school workshop we turned this into an activity by getting students to individually operate different parts of a giant face – the eyes, eyebrows and corners of the mouth. They each had a simple set of if-then-else rules to follow to give their behaviour and so make the face mirror that of the robot on hearing different sounds.

4.5 Caring Computing Lecture

The core of the caring computing talk is actually about search algorithms and the difference between linear search and binary search. This traditional computer science topic is however embedded in a HCI story about how to help people with severe disabilities to communicate through computers. The basic premise is based around the autobiography "The Diving Bell and the Butterfly" written by Jean-Dominique Bauby [2]. He suffered a stroke and was left totally paralysed, able only to blink. Despite this he was able to write the book by communicating with a helper. The talk revolves around how he could communicate at all and how this might be made easier.

The way he communicated was for the helper to read through the alphabet. The talk explores how this might be improved by learning from the game of "20 Questions". We look at the kind of questions that are good in that context to work out a name someone is thinking. The focus is on efficiency in terms of reducing the number of questions asked per letter. Once this basic problem is solved we then look at different technology that might be used to replace the helper with a computer, including brain-computer interfaces. The talk however ends with the HCI twist that perhaps we were counting the wrong thing. If he found blinking hard then perhaps we have made things worse. The final message of the talk is thus that we should have found out about the person first not dived in with a technical solution to what may be the wrong problem.

This talk illustrates our "Serious Fun" approach well. It is about a very serious real-world problem that if solved will make a person's life much better. It covers a core computer science topic while drawing on active research areas. As an antidote to the seriousness of the topic, a game is used to explore the computer science.

5. INCREASES IN APPLICATIONS

Has all this activity around the cs4fn campaign had any effect? The Queen Mary context suggests it does work.

The UK drop in applications post-2000 was mirrored locally at Queen Mary. In the year 2000 home applications were over 1200. By 2004 they had dropped to under 500. It was at this point that we made the conscious decision to change the direction of our work with schools, initiating the cs4fn campaign. Instead of running a recruitment campaign aimed directly at attracting students to the University we switched to an emphasis on just selling the fun of the subject itself as outlined in the previous sections.

Despite our move away from directly advertising ourselves or specific courses, the result was a dramatic increase in applications within a year. Within two years, in 2007, our home applications were back to 2002 levels at just under a thousand applications. Over this period other UK Universities were still reporting drops across the UK of 10% or more. The number of computing students UK-wide fell 22.3% from 2003-04 to 2006-07 [5]. In 2008, the UK university application rules changed. Applicants were given only 5 university choices instead of the previous 6, leading to a drop in our figures. This also suggests that up to that point a notable proportion of our extra applicants were placing us as their sixth choice. However at the time of writing in March 2009, the increases have continued with a further 20% increase apparent from the same point in 2008. Similar improvements in conversions have essentially followed a year behind leading to a large increase in our first year intake over the past two years.

Over the same period overseas applicants had seen a drop of 50% up to 2005. This has been followed by a small rise, but nothing on the same level as seen in our home applications. Whilst they presumably have helped, this suggests that other changes we made such as improving the departmental web site, changes to entrance requirements and addition of new programmes is unlikely to have been the driver to the dramatic changes. If they alone were the cause of the applications other universities doing similar things would have seen similar results. Whilst a large proportion of the web hits are from around the world, we have not directly advertised cs4fn outside the UK, other than in two academic conference papers [8] [11]. The interest there has been developed by word of mouth. This also suggests the web site alone is not the secret to recruitment.

After initiating the women in computer science theme in the form of cs4fn articles and talks, the number of women enrolling on our undergraduate courses this year rose to 28%.

This all suggests that our combined package of activities directed at schools in the UK and specifically locally, given our intake is highly London based, are most likely to have been the cause. It is the combination of the magazine, web, talks and social effect of being seen to help schools, all delivering the same "Computer Science is fun" message that makes the difference.

6. DISCUSSION AND CONCLUSIONS

6.1 Summary

The cs4fn campaign, taking a serious fun approach based around our core messages is a powerful way to do outreach. Human-computer interaction research provides an excellent vehicle for this approach. It gives a natural way to address our sub-messages and especially that of "it is about people too". Human-computer interaction has been a central apsect of cs4fn from the start.

As a campaign to enthuse a new generation about computer science, cs4fn is certainly working locally in London. It is likely it is having some effect elsewhere as well. Much of our effort now is to ensure the benefit is spread across the UK. Whilst we had been mailing single copies of the magazine countrywide from the

outset, funded by Queen Mary, the main focus of our combined activity has been in London and the Home Counties. However with the award in early 2008 of a Partnership for Public Engagement grant from EPSRC and major support from Google as well as support from ARM, Microsoft and Intel, we are now able to extend our activities. An increasing number of other Universities are joining the cs4fn campaign, subsidized via our grant. UK partners at the time of writing include Glasgow, Edinburgh, Dundee, Swansea, Bristol, Manchester, Hull and Essex. Whilst it is early days we hope that we will be able to demonstrate a similar effect in other areas, where the magazine and website are used to support local activity. We are therefore actively seeking further partners in other areas of the country (and overseas) who would like to use cs4fn in their outreach.

A vast amount of work goes into producing cs4fn. Rather than others having to repeat the work to reproduce something similar, we hope it can be a vehicle to support the activities of others. If each university puts its efforts into some subject-selling outreach for which there is local enthusiasm to do the work, then we all benefit. The more diverse that activity is the better. cs4fn has the potential to support any such activity by providing more material for an engaged individual to maintain the enthusiasm. It is easy to enthuse someone in the moment by some wonderful activity or competition, but to turn that in to a resurgence in the subject we need as a community to be able to continue to nuture the interest.

6.2 Selling HCI

HCI is good for the computer science campaign as we have seen. However, doing outreach is also important for the discipline of Human-computer interaction itself, and so of the interactive systems that we all ultimately have to use. We need to ensure that young students are excited about human-computer interaction not just computer science. We must be the ones to enthuse them if we are to develop the next generation of HCI researchers and practitioners. We believe cs4fn provides an existing platform to do that that complements other activities.

Furthermore, funding bodies increasingly demand that our research has demonstrable impact. cs4fn is an outlet available to help give impact from a project provided fun slants on the project can be found.

6.3 An Interdisciplinary Subject

We have aimed from the outset to present computer science as a diverse interdisciplinary subject as one of our key messages to overcome narrow stereotypes of what it is about. Focusing on HCI helps in this, though it is not the only way this has been done.

The interdisciplinary message also taps well into current agendas in schools that are concerned with cross-disciplinary teaching. Teachers are in particular, expected to integrate ICT across the curriculum. Much more project-based teaching is also now being used. Whilst ICT is not computer science this gives an avenue to bring real computer science into lessons across the curriculum.

This interdisciplinary approach to the subject also has a further advantage. A key problem is to change the perceptions of teachers. They ultimately are the ones who can change the perceptions of school students, both directly and indirectly. For example, a teacher that invites us to give a talk who believes the subject is about using computers, will likely give us access to a small ICT class. If they believe the subject and the talk are of wider interest then they may invite us to talk to a whole year group. That opens up an opportunity for us to talk to those who are not already "converted". Furthermore it is important that all students, even those not destined to be computer scientists do have a basic understanding of the subject. We should not just be aiming to recruit, but to educate society as a whole.

One of the issues for computer science as a subject is the lack of agreement as to what the subject actually encompasses. This ranges from discussions of whether it is really a science or is better thought of as engineering, to arguments about whether it is a vocational subject or not and whether it covers some or all of adjacent areas such as library science. We side-step such issues by taking an inclusive approach. Ultimately if a topic touches on some aspect of computation we are happy to write about it. We have gone further than this though, explicitly exploring the overlaps between subjects. The physical magazine follows this approach, with issues on topics such as the links between Computer Science and Biology, the Space Sciences, Environmental Sciences, Art and so on. Excitement lies on the boundaries of subjects. It is a good place from which to enthuse students.

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