

2023 Minerva Informatics Equality Award

Nominated Person: In Honour of Ms Rae Harbird

Name of university: University College London (UCL)

Department: Computer Science (CS)

Date of application: 15 July 2023

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Brief Summary

In Honour of Rae Harbird (26th March 1963 – 9th June 2023) who died after an 18-month battle with ovarian cancer.

Rae Harbird, Lecturer (Teaching) in the Department of Computer Science, UCL, UK, made a significant contribution over 24 years to the promotion and development of initiatives inspiring generations of students from under-represented groups, in particularly women and girls, to study Computer Science. Her novel teaching and learning approaches were used successfully worldwide (London, Finland, Africa, Japan, India, Caribbean). Rae's legacy is that she was able to change perceptions; perceptions of how you learn, perceptions of how you teach, and perceptions of who can achieve- a true inspiration to those who benefited and to those who will continue her tremendous work.

How the award Prize will be used

The award prize will be used to continue Rae's legacy through the work she pioneered at the UCL Department of Computer Science, developing outreach programs with schools to increase diversity in Computing. A set of annual awards will be created, awarded through competitive application, to the most creative and innovative ways of communicating and developing materials for computer science outreach activities.

Description of initiative

Rae Harbird was a committed member of the Athena Swan committee within the Department of Computer Science (CS). The Athena SWAN Charter is a gender equality framework used across the higher education sector to transform, support, and recognise the commitment to advancing gender equality. The outreach work that Rae championed and ran has made a consistent impact on schools and teachers both nationally and internationally inspiring the next generation of children in CS. Rae's significant activities contributed to the Department of Computer Science's successful Athena Swan awards in 2012 (Bronze) 2015 (Silver), in 2019 (Silver), and will be included in the application for a Gold Athena Swan award.

Her own academic career started in 2003, when after a successful career in the IT industry, Rae joined the UCL Department of Computer Science to do a PhD in resource discovery techniques for pervasive and ubiquitous computing environments, and the application of new technologies to social services, particularly the Risk Assessment process. She designed and developed RUBI, a Resource discovery algorithm for Ubiquitous computing [1]. Her research activities included Keeping Children's Stories Alive [2,3] a collaboration with child protection experts at NCH-The Bridge Childcare Development Service and Logica CMG to investigate the use of computing to support the protection of children from abuse and neglect.

Since 2008 Rae was a Research Associate and Teaching Fellow responsible for teaching a wide range of programming and system design modules in CS and the Faculty of Engineering. She set up the Coding Helpdesk staffed by other students to support introductory programming modules. Rae supervised many exciting Undergraduate and Postgraduate CS dissertations over the years and continued her work until her illness. These included developing a software system to support automated call blocking and reporting of nuisance calls; improving computational thinking in children who are not yet ready to use either block-based or text-based programming languages; a campus water monitoring systems for UCL; a programming toolkit for blind and visually impaired learners; and an assembly language/machine code simulator needed to support the teaching of students about the structure and role of the processor and its components at A-level (a key education qualification required for entry to University).

Outreach Activities to Promote Computing to School-Students

Rae led and committed her own time to UCL's Schools Outreach activities, as these activities were not an integral part of her job. Rae was instrumental in establishing the first UCL Department of Computer Science initiatives in schools' outreach. She explained that her motivation for this work was *"to shine a light onto the myriad of Computer Science applications for children and young people who may not know much about the subject. It's highly rewarding to see them enjoying problem solving and the creativity that comes along with it."*



Being fully aware that women are vastly under-represented in engineering sciences coupled with her life-long passion for Computing, Rae tried to rectify this situation by inspiring more women and girls into Computer Science through outreach activities nationally and internationally. Some of her recent activities are listed below.

Bioinspired Robotics Activities with UK Secondary Schools

- Ran a series of bioinspired robotics sessions for East London Science School's (ELSS) Science Day with ELSS teachers in 2019. 80 students in Year 9 participated in sessions. Teaching materials for the practical activity can be found [here](#), kits are [available for loan](#) to schools in East London. Rae has also written a research paper on this topic [4].
- (Repeatedly) ran a 10-day Biorobotics Summer School, initially within UCL and then with In2Science, a charity supporting students from disadvantaged backgrounds to progress to Russell Group Universities to study science or engineering. The course included a range of extra-curricular activities such as visits to DeepMind and IBM.
- A UKRI-funded project started in 2022 extended this biorobotics project to include sensor design and applications that are relevant to the UN global goals. This project is ongoing and is being run with local UK schools for school students aged between 11 and 17 years of age.
- Led a school visit from 30 teachers and pupils from La Sainte Union, a local girls' secondary school in 2019.
- Ran a Hackathon for 6th form (16-18 years) students with Deloitte in 2019.
- Received visits from 2 state schools from outside London and conducted hands on robotics activities with students (20 x 13-14 year-olds and 15 x 17-year-olds).
- Talk given to 6th Form students in London who are considered disadvantaged because they are either from a black or ethnic minority, come from low-income homes or do not have parents with a Higher Education-level qualification.
- Worked with [CLOCK Your Skills](#), an organisation offering an accreditation framework enabling those working in the creative industries to gain qualifications at the Higher Education level through their work experience. Ran a 5-day bioinspired robotics summer school.
- Organised UCL Ada Lovelace Day 2015, a fun-packed event at UCL that involved 70 students (14-16 years old) and 5-6 teachers.

Supporting Teachers who Teach Computing in UK Secondary Schools

- Worked with UCL Museums to train teachers and loan robotics kits related to animal movement to secondary schools throughout London.
- Organised and led teacher training and focus groups for Computing teachers in secondary schools. A long-standing relationship with the teachers in the 10 state secondary schools in Camden was subsequently built.
- Developing a scheme that encouraged Computer Science students to assist in the design and development of materials for schools. This supported teachers in their introduction of computer programming topics (EduTech). The scheme dovetailed with the Coding Curriculum series which is part of the SchoolsLab initiative to generate more Computer Science related teaching materials.

Supporting Outreach Activities Internationally

Rae's international activities include regular training workshops for 30 Norwegian teachers from NPED – The [Norwegian Society of ICT in Education](#) (NPED) since 2017; contributing to bio-inspired robotics workshops in St Lucia; and ran a robotics workshop for 20 Japanese students visiting UCL from Yamaguchi University for an exchange visit, and workshops from 2017 in Gibraltar. Rae also provided advice regarding setting up computing resources to Narxoz University, Kazakhstan in 2018.

Evidence of its Impact

We provide below evidence of impact for some of the activities, through objective feedback received from students, teachers and staff demonstrating how these activities have changed students' attitudes towards Computer Science and have inspired the career development of PhD students and postdoctoral researchers within Computer Science.

A. Bioinspired Robotics Schools Activities

In this section, the evaluation of the bioinspired robotics schools' activities in schools will be discussed to demonstrate the impact of the work. The evaluation had two parts: assessing student responses to the project and gathering the teachers' feedback.

Changes in Student Perceptions of Computing

A key aim of the bioinspired robotics project is to raise student awareness of the interdisciplinary nature of engineering and research. In most schools, subjects are taught and examined as silos of knowledge; students study subjects such as biology or maths and many will not have the opportunity to experience how knowledge and skills from multiple disciplines can be used to solve real-world problems. As part of the evaluation, students were asked to provide drawings of scientists and robots at the start of the project and at the end of the project as a means of capturing how their attitudes and thinking had changed. Analysis showed that students had a male-centric conception of scientists (Figure 1); wore white coats and worked with chemicals (Figure 2) at the start of the project; and had a classic view of robotics (Figure 3).

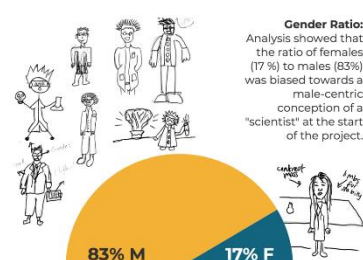


Figure 1 Students' drawings of scientists before the project

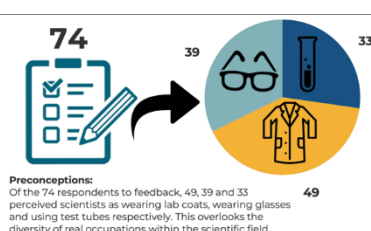


Figure 2 Infographics showing the results of the drawings

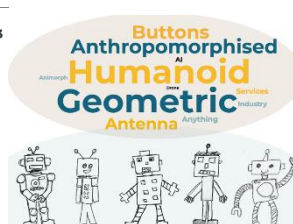


Figure 3 Students' representation of robots before the project

At the end of the project, students' drawings of scientists were obtained again, and this time the drawings indicated that students have incorporated elements of themselves into the drawings demonstrating that they now saw themselves as scientists. This was a fundamental paradigm shift in the minds of the students – a direct product of Rae's teaching.

Teachers Feedback

Teachers were asked to give feedback on the project as a whole. Teachers thought the programme was strong; it had good links to the STEM subjects including the Computer Science curriculum in secondary education; the programme was extremely clear; and students were really excited and enjoyed all the workshop activities. The perceived learning outcomes for the teachers included the ability to code and to learn about computing, science and robotics. One of the teacher's comments was: "Gaining an understanding of bio-robotics and how subjects can be interlinked. Develop an appreciation of how animal adaptations/movement can be used to inspire design and creativity. Inspire them to take science/technology further and study it further" (Cardinal Pole School).

B. Impact of Ada Lovelace Events

The Ada Lovelace event brought together school students from a variety of schools and introduced them to a broad range of computing-related opportunities and organised speed networking opportunities with Computer Science PhD students and academics. Some feedback received from teachers after the event were: *"Thank you very much for a brilliant Ada Lovelace day, all the students had a great time, they asked me to convey their thanks for such a wonderful day. If there are more opportunities to bring students or staff for projects or any training sessions please let me know."* (Gladesmore School). *"I just wanted to say a huge thank you for the day you put together yesterday, the pupils hugely enjoyed it and more importantly the girls particularly saw Computing as an option for their GCSEs next year."* (UCL Academy)

C. Impact of Novel Learning Materials and Approaches

The EduTech projects led by Rae that were developed as packages of interesting technologies, case studies, and tutorials for school teachers and school students, developed by UCL CS students, are still in use by UK schools. This "give-back to schools" is highly motivating, especially for students coming to UCL from global communities. The novel teaching materials have now also been incorporated into the curriculum of many UK and International schools (Norway, Gibraltar, St. Lucia).

Rae was part of a Computer-Science team that instigated a 50:50 strategy to school-student participation: A strategy in which overall school-student participation must have an equal proportion of boys and girls. By 2014, Rae and the CS team were working with UCL Engineering Faculty to promote this scheme (50:50 Engineering Engagement Strategy) in UCL Engineering. By 2018 the scheme was implemented across Engineering Faculty's 134 STEM programmes, which annually connects over 6,000 young people and a network of 529 schools with 623 UCL Engineering staff and students. In 2018 the UC:50:50 scheme was chosen as a case study for the Gender Disparity in Engineering briefing [5] and formally recognised by EngineeringUK [6]. The scheme has since received national and international recognition from government, academia, industry, the EU Commission and UNESCO, in iUNESCO's International Institute for Educational Planning [7].

The success of Rae's original biorobotics programme was used as the basis for funding recently received by a major UK funding body [8] to support the development, delivery, and evaluation of public engagement activities in information and communication technologies (ICT) over the next two years. The project builds on the Department's success in delivering robotics outreach activities developed by Rae over the past 12 years.

D. Inspiring Early Career Researchers

Throughout her career, Rae has inspired and guided many PhD students, postdoctoral researchers and early career researchers on outreach activities.

Peter Wijeratne was a postdoctoral researcher at UCL (now a Lecturer in Computer Science and AI at Sussex University): *"Rae supported me on my first schools' outreach, which would have been terrifying without her! It was Rae's enthusiasm for teaching - and the clear care she had for the students themselves - that not only helped me enjoy that first outreach session, but has also given me a life-long appreciation of the benefits of outreach."*

Directly inspired by Rae's outreach activities, Peter went on to establish A-Comps (Apply competitively to STEM) [9] in the Department of Computer Science; A mentoring scheme which supports students from disadvantaged or under-represented backgrounds to enter higher education. In the first year of operation, 94% of students on the scheme received offers from UK's top Universities [10].

References

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Letters of Support

Supporting letter from Dr Rebecca McKelvey, founder of In2scienceUK.



Summary

For over 5 years Rae Harbird planned, coordinated and ran computer science summer schools that enabled hundreds of students from the most deprived backgrounds (identified by the charity in2scienceUK) to gain exciting insights into high level computer science research that empowered them to progress to further training, education and careers. This approach also enabled the charity to significantly scale and so supported many more hundreds of students indirectly. Rae Harbird's character, sense of fun and passion were a huge part of this success and together has added dividends to these young people who will become the computer science leaders of the future.

About In2scienceUK

In2scienceUK is a social mobility charity founded in 2011 with an aim to support young people (age 17) from low socio-economic backgrounds into science, technology, engineering and math. The programme offers students two week summer research opportunities at research labs across the UK as well as workshops and skills days to develop their knowledge on how to apply for further training, university and careers in STEM while nurturing their sense of belonging and confidence.

The challenge

Since the launch of the charity, although there were many researchers signing up to host students, these came from bioscience researchers. As a result the charity did not offer any computer science opportunities. Researchers highlighted that due to the nature of computer science hosting a student for two weeks was too intensive. As students were only 17, researchers were also concerned that they would not be able to access the content required for the projects they had.

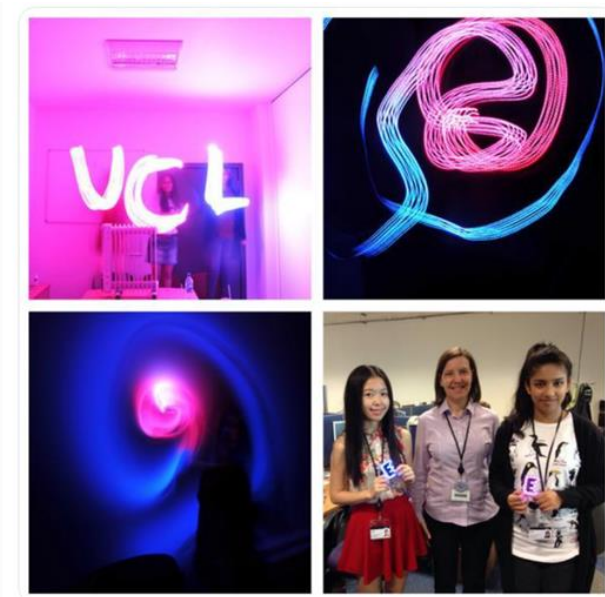
Rae Harbirds's work

I was introduced to Rae Harbird at UCL and after a short meeting she offered to plan, coordinate and run a two week computer science summer school during her summer holiday for 30 students. Using this model, she suggested that she could support many students at once to engage in high quality computer science research. Rae designed pre-reading and activities for the students to do before the summer school and she organised a group of support staff to be on hand to ensure all students, even those that struggled, could access the

work and progress on the project. In addition to teaching students through a number of hands-on projects coding and robotics she also organised for inspirational speakers from under-represented backgrounds to come in and share their learnings and journey with students. Rae also organised end of project presentations that students delivered to highlight their learning, progress and confidence.

Impact

Students found the computer science opportunities that Rae delivered not only highly inspiring, interesting and great opportunities to learn above and beyond the classroom but highly impactful with significant numbers progressing to computer science degrees.



Rae Harbird and two students during the 2014 Computer Science summer school

Sustainability

Rae delivered these summer schools every year for over five years supporting hundreds of students. The work highlighted her deep understanding of what students from underprivileged backgrounds need to succeed and the projects were all tailored to their interests. As this was an excellent model, the charity also scaled this computer science programme to many computer science departments in universities across the UK and as a result has supported significantly more young people to gain authentic research experiences that they would not have the connections and financials to organise themselves.

In summary the work, drive and passion that Rae Harbird put into these high impact activities not only supported the students that directly benefited from the programme which impacted their lives in many positive and tangible ways, but also the charity's ability to support many more students interested in computer science across the UK by improving the scaling model of the charity as a whole.

Dr Rebecca McKelvey

July 12th 2023