Recruiting and Supporting Female Students

Minnerva Informatics 2018 Award Application

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Summary:
The School of Electronics, Electrical Engineering & Computer Science, Queen's University Belfast, are pleased to report two initiatives:

(1) The **Teacher Upskilling and Pupil Outreach** initiative was established with the aim of enhancing the teaching of Computing across Schools in Northern Ireland so that more students feel better prepared to choose Computing related subjects for further study. We focussed some of this training to female only schools.

(2) The **EEECS Grit and Grace Programme** was developed to support our female students and enhance their university experience as research shows better experiences influence retention.

We are very proud of these initiatives and the feedback received.

An indication of whether the nomination can be considered as a runner up (if it does not win the award) and be included as an exemplar of best practice in future Informatics Europe applications. YES

We will describe two initiatives that directly align to the theme of the Minnerva Informatics 2018 award.

(1) Recruiting Female Students through Teacher Upskilling and Pupil Outreach
There is somewhat of a crisis in the education of computing graduates. As reported (e.g. Royal Society's report *Shutdown or Restart*) there are disconnects in the delivery of computing education between primary, secondary and tertiary level education. Pupils often have a poor understanding of what computing is about and teachers frequently lack the necessary skills to meaningfully teach programming. As a consequence, the computing discipline suffers from high levels of student dropout and high levels of graduate unemployment (Shadbolt Review). In addition, it is widely accepted that we need to try to increase the numbers of females electing to study STEM subjects for a multitude of reasons least of which is to try to balance female leadership roles within the STEM industries and there is compelling evidence that diversity unlocks innovation and drives market growth (Harvard Business Review). To overcome these issues and to try to enhance the numbers of female students electing to study with us, EEECS embarked on a journey starting in 2014 that continues today with plans for the future.

In 2014 the School was funded by the Northern Ireland Department of Education (DE) in conjunction with Invest Northern Ireland (INI) to deliver a £156,500 two-year programme of teacher upskilling. The goal of the programme was to equip teachers with the skills needed to successfully deliver A-level computing programmes. A total of 115 (64% female) teachers from 69 different schools (including 5 all girls' schools) and colleges completed the teacher training programme. The high ratio of female teachers on the course was important to us from the perspective that female students will look for role models. So we hoped that by equipping teachers with the skills to teach computing, we would encourage more female students to consider it for further study as they could look towards their teacher as a direct role model in the area. Feedback from the teachers on the course has been very positive. In 2015, EEECS were further awarded an $18,180 Caterpillar Foundation Grant to deliver a series of six Code Schools. The QUB EEECS Code School was run in 11 Schools within Northern Ireland, reaching over 1000 pupils with the initial year group presentations and with 200+ attending the secondary schools six week programme. Before the QUB Code School 33.9% of pupils expressed an interest in a computing career. After the workshop this increased to 44.9% of pupils and further increased to 59.1% for those pupils who attended the six-week afterschool club. Building upon these hugely successful initiatives in terms of uptake and feedback, the School knew that more needed done in this area. We as a School wanted to facilitate a more joined-up education system that better supports computing teachers and provides a sustained flow of female pupils who can progress onto degree level computing study and, ultimately, into valuable areas of employment. To ensure this could happen we really needed to address the challenge that most GCSE teachers lack the necessary skills to teach programming and consequently female pupils often have a poor understanding of what computing is about. Therefore we lose females even before they can make those important A-Level choices.

In 2017 the School successfully gained additional funding of $192k from the CME Foundation (http://www.cmegroupfoundation.org/) to deliver a further two-year programme of teacher upskilling in and female pupil outreach activities. The defined objectives were to:
- Upskill GCSE computing teachers (those teaching pupils aged 14-16) so they can confidently and capably teach coding skills to their pupils;
- Inspire and encourage pupils aged 11-14 to study computing with a focus on female students and those from economically or socially disadvantaged backgrounds.

The project was delivered through Spring/Autumn 2018 and will continue through to 2019. Upskilling courses took place over a period of ten weeks. The schoolteachers attended a weekly interactive, lab-based, evening teaching session at EEECS that helped to build and reinforce their coding skills. In total four upskilling courses were run for 40-45 teachers. The Code School Pupil Outreach (from Autumn 2017 to Autumn 2019) involves students aged 11 to 14, targeting those from disadvantaged social/economic backgrounds and females by way of helping to reduce the gender divide in computing. Each Code School

combined an interactive presentation and workshop that was delivered to the whole year group in each school. The Code School was then run across six consecutive weeks as an afterschool club. During the initial weeks of the club the pupils learnt basic coding skills using fun and interactive coding using mobile devices and programmable drones. The final two weeks culminated in the pupils gaining hands-on experience in the programming languages commonly used in the Digital Technologies GCSE, thereby helping them make informed decisions about their future GCSEs. Ongoing evaluation of the programme is taking place but again feedback from all involved has been amazing.

(2) Supporting Female Students through the EEECS Grit and Grace Programme:
Having recruited female students to study on one of our STEM pathways it became a priority of the School to support them as much as possible. Research suggests that lack of self-confidence is one of the most significant factors preventing females from progressing and applying for leadership positions within the Science, Engineering and Technology Sectors. A substantial body of research exists that attributes the concept of self-confidence to career outcomes:

- a key contributing factor in the construct of personal resilience (Bleidorn, 2016);
- a predictor of both work place performance and desirable employee attitudes including: job satisfaction, organisational commitment, and psychological well-being (Avey et al., 2011);
- a differentiating trait in an effective leader (Northhouse, 2010);

To address this issue and help develop all females within the School (undergraduate, postgraduate and staff) EEECS made a decision to prioritise investment in initiatives that will truly help. The school engaged the services of the William J Clinton Leadership Institute at QUB to design, develop and deliver a highly engaging and participative leadership programme to 30 students during January through to March 2018. The main aim of the Program was to:
"upskill female scientists and engineers within EEECS with the knowledge and behaviours necessary to confidently and successfully navigate their future leadership journey".
The programme was delivered as four modules in four days staggered over a three-month timescale. Each module was carefully designed to achieve the aim and bring the female cohort on a journey of self-discovery so that they could understand their abilities and what contributions they can make rather than focus on what they cannot do or achieve. It was also important to build up the spirit of collegiality within the cohort so at the end of each module the participants committed to meeting in Peer Learning Groups in advance of their attendance on the next Module.

In **Module 1**, participants were challenged to consider, "who am I". They were asked to consider the physiological differences between the male and female brain; the impact of previous life experiences; strengths and weaknesses; the formation of personal values; and their "leadership brand". In **Module 2**, they explored the concepts of personality and behavioural preferences. By exploring their MBTI personalised reports, we also wanted everyone to gain awareness of their own preferences as well as a greater understanding of how to work with those with different preferences. In **Module 3,** participants were encouraged to broaden their awareness of the impact of their own choices, attitudes and behaviour. An invited inspirational guest speaker then explained her own leadership journey. Our speakers for this year were a current female staff member and a female graduate from our School. Finally, in **Module 4,** the complexity of leading oneself and others through change and transition was explored. The programme ended with a celebration event in the form of a Graduation Dinner. This **Graduation Event** celebrated the learning and growth each individual experienced and was a very positive experience for all involved. At the event we also announced the winner of the **Rachel Stanford Scholarship.** This was a scholarship gifted to our School by a recent graduate who after reading "Lean-In" was inspired to help other females on their journey. After learning of our plans to run the Grit & Grace program she wanted to gift the Scholarship to the person who engaged most with the program. The recipient, Rebecca Russel, was chosen through a combination of peer nomination by other students on the program and lecturer assessment. Rachel is now also personally mentoring Rebecca who has kindly written a supporting letter. Rebecca in turn is very enthused about being involved in our Peer-to-Peer female mentoring network which we explain in more detail in the Impact section.

Impact of Recruitment - Teacher Training & Pupil Code Camps: The actions we have taken to attract female undergraduate students have shown a clear impact, as there is a positive outlook for women studying the new Software Systems Development (equivalent to CS) A-Level. Implementation of this new A-Level was directly supported by our Teacher Training and Upskilling Programme. In 2016, 28% of A-Level candidates were female. Furthermore, 20% of females attained an A* and 52% attained A/A*. In contrast, 2% of males attained an A* and 26% attained an A/A*. The top three candidates in Software System Development in 2016 were female, two of whom are currently studying Computer Science within the School. We expect to see our continued efforts in the area of teacher upskilling and pupil outreach reflected in our pipeline of students and hope to see a corresponding rise in females studying Computer Science with us. There has been a growth of 190% in the numbers of pupils taking an A level qualification in computing between 2015 and 2016. We hope to see impact from this activity in our 2018/19 undergraduate intake.   Response from the teachers involved in this training has also been incredible. Below are some snapshots of feedback.

- *"The training that I received at QUB to help me deliver SSD, teaching C# at 'A' Level was invaluable. The quality of teaching was excellent, including 1st class resources to allow me to continue to practice outside of our lab sessions. Using excellent quality resources from the QUB course has given us confidence within our Computing Department to reuse and produce a set of resources for delivering the content to our 6th form students."* **Ruth Foster, Head Computing, Wallace High School**
- *"The teacher training course provided by QUB remains the only reason I am able to deliver the course in school today. Students simply won't pick the course if teachers aren't equipped to teach it properly. If students don't pick it, the education system will not produce the workforce the industry needs to sustain itself in Northern Ireland."* **Errol Martin, Computing Teacher, Friends School**
- *"Due to the lack of any other training being available this was my one source of help, support, guidance and advise and without this training the job as a teacher to deliver this course wouldn't have been possible. From the initial training, the QUB staff have continued to support me over the last three years and support my continued development."* **Karen Stuart, Belfast Royal Academy**

In terms of impact on student numbers, combined there has been an overall growth in the number of pupils taking a level 3 award in computing or ICT by 14.7% between 2013/14 and 2015/16. Whilst this is welcome, the overall growth in the number of pupils taking computing related courses (206%) is considerably more significant as this type of qualification will prepare students with the thinking, problem solving and programming skills needed to succeed in further and higher study or within employment in this area.   Whilst assessment of the impact from the 2017 initiative is still ongoing we are hopeful that:
- Through upskilling and supporting approximately 140-to-160 GCSE teachers we will enable a considerably larger number of the 201 post-primary GCSE awarding schools and colleges in Northern Ireland to offer the programming variant of GCSE in Digital Technologies.
- We can establish a positive appreciation of coding in approximately 600 11-to-14 year-old pupils, disproportionately involving female pupils and those from disadvantaged backgrounds.

In addition, while the code school was initially targeted at secondary schools we also had an opportunity to run a compressed version of the programme to a large number of primary pupils. This was a full day event hosted by a non-selecting secondary school and proved highly successful with over 120 pupils attending.   The feedback from the event was excellent.

(2) Grit & Grace: Whilst verbal feedback was immensely positive from all the participants on the program, it was very important to thoroughly evaluate the program before committing to enrolling another cohort of students this coming year. To do that we used Kirkpatrick's 4 levels of evaluation. Level 1 – Reaction, Level 2 – Learning, Level 3 - Behaviour and Level 4 – Results. A summary of these are included:

Level 1 - Reaction	Level 2 – Learning
➢ I think that this course was great for building trust and developing confidence. ➢ A really great course! Helped me with my confidence massively but also got to meet a great bunch of girls! ➢ I really enjoyed getting to know the girls and think the group was just right size to be open and honest with. ➢ Now I know what to work on to become a woman with grit and grace. ➢ This was such an enjoyable course, the depth of every element has really helped me learn and develop. ➢ Thank you for the opportunity to be a part of the Programme. It's been so very useful and the knowledge I gained will help me change my life.	*'What key learning did you take away from this module'* ➢ Confidence and self-belief. ➢ Confidence is something that can be developed ➢ Be more confident in my myself and my ability. ➢ I should be more willing to speak out. ➢ Deeper insight into personal strengths and weaknesses. ➢ It is important to know one's core values and align them with the job and find the right space to nourish my ambition. ➢ To be more willing to speak out. ➢ Be yourself and stick to your core values. ➢ You do not know yourself as well as you think you do; the conscious and unconscious; everyone perceives environments differently.
Level 3 – Behaviour *'What actions will you commit to taking as a result of participating on the module'* ➢ Challenge myself more. ➢ Being more honest about who I am. ➢ Speaking up in meetings and having my say. ➢ Be more present in life with friends, family etc. ➢ Focusing on how my strengths can be used better as well as developing my weaknesses. ➢ Self-reflection on the negatives and working on the positives.	**Level 4 – Results** ➢ A year 1 student being informed of, applying and securing a place on a China initiative. ➢ A year 1 student who couldn't look anyone in the eyes on the first day as she was so shy, being voted by her classmates as one of the 3 potential candidates for the scholarship award. ➢ 2 students being successful at job interviews. ➢ 1 student being sponsored and mentored by the Scholarship provider.

In terms of a return on investment, both the qualitative and quantitative evaluation results confirm that the EEECS Grit & Grace Leadership Programme was successful at achieving its purpose in:
"upskilling female scientists and engineers within EEECS with the knowledge and behaviours necessary to confidently and successfully navigate their future leadership journey".
Looking ahead to next year, we will introduce mentoring into the program whereby previous participants will act as mentors to new entrants on the program. It is worth noting that each of the current cohort that were asked to consider mentoring were incredibly enthusiastic about being involved with a female peer-to-peer mentoring network. Whilst the School does run a successful student peer mentoring network, it is across the whole School and as such is heavily male dominated. Research suggests female entering their first year at University can flourish and have a better sense of belonging if mentored by a female peer. We will also extend this mentoring to work in partnership with other organisations such as Women'stec to help promote their #notjustforboys employability programme. It is also pleasing that the graduated cohort from Grit & Grace have planned a number of meet-ups.

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