

Effective Supports for Women Computer Science Academics: Practice-based Insights in an Irish Context

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Abstract

This paper focuses on the under-representation of women computer science faculty and describes an intervention programme called Athena SWAN which has been recently embraced by many Irish third level institutions as part of their efforts to promote gender equity. It details four practice-based initiatives that have been recently implemented within the University of Limerick as part of this programme that have proven effective, outlining the processes undertaken and their practical outcomes. In doing so, it highlights the importance of this intervention process but also draws attention to the need for wider cultural change in supporting gender equity and removing the workplace barriers that impede advancement and retention of women computer science faculty.

Keywords: Women in computer science, Athena Swan, Workplace barriers

1. Introduction

While much attention has focused on improving gender equity within higher education and research, women remain vastly under-represented within the fields of science, technology, engineering, mathematics and medicine (STEMM), particularly within senior and leadership based roles (Ovseiko et al., 2017; Bismark et al., 2015). This under-representation is particularly notable in the case of Computer Science, where women constitute less than 10% of most computer science faculties, in what has been called ‘the shrinking pipeline’ (Camp, 1997).

Gender equality is essential for organisations seeking to create an environment that allows for sustainable and inclusive growth (OECD, 2017). It ensures individuals have equal visibility, rights, responsibilities and access to opportunities. Public higher education has long been recognised as an

important vehicle for increasing equity (Tierney, 1997) and one which can also benefit universities and society more broadly, as well as the individual. However, the absence of adequate numbers of women faculty has significant consequences, resulting in a dearth of role models, mentors and advisors for both junior female faculty and female students. Moreover, at the senior faculty level, where that under-representation is more pronounced (Bain and Cummings, 2000) this results in shortage of such role models to mentor junior colleagues, hence impeding their career success. Research (Bain & Cummings, 2000) has shown that, relative to men, women are tenured and promoted at far slower rates than men, are promoted less often and have higher rates of attrition from academia.

Addressing this disparity requires an intensive review of the state of gender equity within Computer Science departments and research institutions, accompanied by the implementation of policies and practices that remove workplace barriers which continue to impede advancement of women. One initiative which has emerged recently as offering practical and focused support for removing such barriers is Athena SWAN (Scientific Women’s Academic Network). This is a framework and accreditation charter specifically designed to support gender equality within higher education and research. Initially the framework encouraged a strong commitment to advancing the careers of women within STEMM based institutions, however it has recently been expanded to support the career progressions of women across all disciplinary areas by tackling the persistence of unequal gender representation within senior academic, professional and support-based roles (Advance HE, 2023). It focuses on a number of key areas linked to career advancement within higher education, specifically gender representation, career development and student progression into academia and research (Advance HE, 2023).

In Ireland, the Athena SWAN initiative has emerged as an influential means of supporting gender equality and advancing gender representation within third level educational institutions, particularly as many national funding bodies now require universities to have achieved this accreditation as a pre-requisite condition when seeking research funding. Athena SWAN represents a strong and practical support with potential to remove workplace barriers for women, including women in Computer Science (CS). However, it is not a panacea for all gender inequity. This paper starts with a discussion of Athena SWAN and then using four case studies (each of which represent different categories in which women study or work). It outlines both the opportunities and challenges facing organizations, institutions and individuals seeking to address the gender gap and advance women in CS's representation and progression in academia. Addressing the absence of women within this context will not only bolster diversity and inclusion, but further promote scientific innovation and growth, by providing women the opportunity to not just pursue but thrive within their chosen academic or senior professional careers.

2. Athena SWAN in Ireland

The Athena SWAN charter framework was launched in Ireland in 2015, with all universities, institutes of technology and many higher education communities embracing the initiative (Advance HE, 2023). Athena SWAN (Advance HE, 2020), initially focused on academic women in STEMM careers, but has, in recent years, expanded to include all staff and students of all genders in all disciplines. Awards are presented at institution and sub-unit (normally schools or departments) level, and are set up over three stages, Bronze, Silver and Gold, which are progressively better than each other. Achievement of an award is testament to an institution's commitment to address systemic inequalities and provide an inclusive workplace culture for all. To achieve an Athena SWAN award, submissions for awards are assessed by a nationally appointed cross-disciplinary panel. The starting point for any submission is establishing a Self-Assessment Team (SAT)ⁱ who organize discussion, data collection and analysis. In developing the submission, they must reflect on the analyzed data to undertake a self-assessment of the current status of gender equality. They then identify what actions can be taken and develop an action plan. Once an award is achieved, the SAT oversees the action plan implementation.

As of April 2023, in Ireland, one academic institution, University of Limerick (UL), and four sub-units have received Athena SWAN Silver awards, with

another 18 academic institutions and 95 sub-units having received Athena SWAN Bronze awards. (Advance HE, 2023). Of the four sub-units that have received Silver awards, three are STEM (Science, Technology, Engineering & Mathematics) schools/departments - School of Engineering, University of Galway, Department of Physics, University of Limerick and School of Agriculture and Food Science, University College Dublin. These figures illustrate the serious and concerted attention currently being given to equality, diversity and inclusion initiatives in Irish higher education.

To illustrate how Athena SWAN provides an important mechanism for women working and studying in CS academic disciplines in Universities, we have chosen to discuss four case examples taken from a University of Limerick sub-unit (department and research centre) which has received Athena Swan bronze accreditation since 2021. Each case study represents the different academic categories in which women work and study: Principal investigators, Non-tenured researchers, Doctoral students and Undergraduate students. The sub-unit presented is the Department of Computer Science and Information Systems (CSIS) and Lero – the Science Foundation Ireland Research Centre for Software in the University of Limerick, referred to as CSIS-Lero. Science Foundation Ireland (SFI) is the largest Irish funding agency for STEM, and, while Lero is a national research centre, it is headquartered within CSIS, and so they achieved a joint award. The cases relevant to women working and studying CS academic disciplines are:

- Principal investigators: Grant funding differences
- Non-tenured researchers: Career development for early career researchers
- Doctoral students: Increase the number of females registered
- Undergraduate students: Interdisciplinary courses.

The relevant Athena SWAN submission is available for viewing at CSIS-Lero (2021). We are at the 'action taking' implementation stage of these initiatives, and, given that they are based on data analysis during the Athena SWAN submission, are confident that the outcomes will be successful.

Overall, within UL, there is excellent support for Athena SWAN (Connolly & Richardson, 2023) and gender equality initiatives. For example, twenty-five percent of STEMM professors in UL are women. UL proudly hosts a nationally recognized annual International Women's Day Conference, that is organized by the HR Division, opened by the UL President, supported by local companies and regularly

over-subscribed. A conference to celebrate International Men’s Day has also been organized annually since 2019.

When developing Athena SWAN submissions, apart from internal data analysis, there are two particular processes which are of interest. First, in Ireland, we have set up Athena SWAN networks at a national level. These networks allow for discussion about improvements which are being made to support gender equality through Athena SWAN actions. Furthermore, they ensure that people are working together, through, for example, reviewing and giving feedback on pre-submissions for each other, thus giving support nationally. This means that those submitting from CS sub-units have access to expertise in other relevant sub-units throughout the country. Second, there is a requirement by Athena SWAN to benchmark the analysed data against other similar sub-units. In the case of CSIS-Lero, benchmarking was undertaken against:

- Sub-units internal to UL
- School of Electrical Engineering, Electronics and Computer Science at the University of Liverpool, U.K. who were of similar size to the UL CSIS department
- Comparison with the Irish Higher Education Authority statistics for Information and Communication Technologies, Software Application Development and Analysis, and Database and Network Design and Administration
- Comparison with figures from the Higher Education Statistics Agency, U.K.

These processes are very important in ensuring that there is learning across institutions and sub-units at a national and international level.

In the statistics mentioned in the next section, we recognize that we are presenting only female/male statistics. When writing Athena SWAN submissions in UL, our process is that, unless we have greater than five people identifying as other than female/male, we do not disaggregate their data. In the CSIS-Lero case, one participant identified as non-binary and two participants did not state their gender.

3. Case studies

3.1. Principal Investigators: Grant funding differences

Science Foundation Ireland, the Irish funding agency for STEM, which had been founded in 2000, has

recognized that few women were applying as Principal investigators (PI) for funding awards in STEM disciplines. Therefore, it was important that, when analysing CSIS/Lero data, we would review grant recipients. PIs are mainly academics, as the grant system in Ireland is such that, in the majority cases, the tenured academic is the person who submits the grant proposal.

We analysed Lero grants received between June 2016 and June 2020, by the number of grants received per female and male PI per year, and the value of these grants. When viewed in the aggregate, 38% of grant holders in Lero are female. We further broke this down by the various funding bodies as shown in Table 1.

Funder	Number grants per person		Value ratio
	F	M	M:F
Overall: All funders	3.6	3.4	2.2
EU	0.7	0.6	3.4
SFI	0.4	0.1	5.1
Industry	0.7	1.5	2.3
Enterprise Ireland	1.1	0.8	5.8
Other Irish Exchequer	0.1	0.2	7.1
Other International	0.3	0.04	5.0

Table 1. Grants received by Female (F) and Male (M) Principal investigators, June 2016-June 2020.
EU – European Union, SFI – Science Foundation Ireland¹

Surprisingly, although female PIs (FPI) and male PIs (MPI) received approximately the same number of grants over this 4-year period, the value that MPIs received was 2.2 times that of FPIs. Obviously, this is a concern for the individual women who are applying for grants, as this would indicate that they are not reaching their potential. Additionally, the research centre’s female talent is not performing at the same level as the male talent, which is of concern to Lero overall. An important measure for Lero is the amount of industry funding received, and we can see from the table that not only are MPIs receiving twice the number of grants from industry than FPIs, but the value of these grants for MPIs is 2.3 times that of FPIs. Considering SFI, the funding body within Ireland (equivalent to National Science Foundation in the USA or National Sciences and Engineering Research Council), FPIs are actually receiving a greater number of grants than MPIs (0.4:0.1). However, on average, each MPI received 5.1 times the value in funding than each FPI.

¹ The number of PIs and grants in Lero is not publicly available.

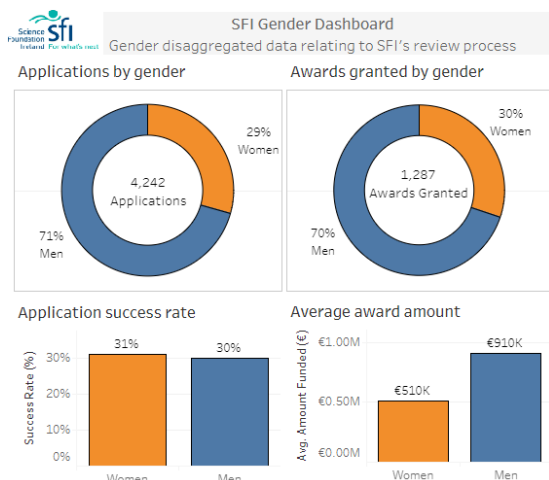


Figure 1. Data from Science Foundation Ireland showing performance of PIs nationally by gender

Figure 1 (SFI, 2023) illustrates the FPI an MPI SFI grant performance nationally. FPIs nationally have a similar application success rate to MPIs, and the average award amount to FPIs is 56% of the average award amount to MPIs, which is slightly higher than in the case of Lero. This discrepancy is not just a problem for Lero, but a national problem. Figure 1 also illustrates that SFI are receiving twice as many applications from MPIs than from FPIs.

The action that was derived from analysing the Lero and SFI data was to “Commission a report to identify reasons why women are not receiving similar grant amounts to men and take actions based on the results” (CSIS-Lero, 2021).

Undertaking this investigation, CSIS-Lero carried out a qualitative study to identify differentiating factors that influence males and females when applying for research funding, interviewing four FPIs and four MPIs across all career levels with in Lero. Each interviewee was asked a consistent set of questions, including:

- Have you ever been on a grant proposal as a team member (with someone else from your institution leading your institution’s grant application)?
- How do you think you could improve your chances of being invited into a consortium?
- What deters you from applying: fear of failure, time, lack of knowledge, administrative burden?

They were probed on their answers, so that any information given was then supported by qualitative responses. While all 8 respondents had PhD qualifications, all the MPIs had completed their PhD directly after their undergraduate degree, while only one FPI had done so. The other FPIs had spent time in industry before returning to academia. Thus, the FPIs had fewer years of experience in completing research

and in applying for grants – ultimately showing a ‘research career lag’ in comparison to their MPI colleagues. This career-lag seemed to have further effect. The FPIs had taken up academic posts later in their careers than the MPIs. The MPIs interviewed spoke about the importance of building networks with industry partners early in their careers, and, given the career-lag identified, the amount of significant industry networking was also much less for the FPIs interviewed. MPI’s research profile was higher - their average citations and average h-index respectively were almost 4 times and 2 times that of the FPIs. In addition, MPIs had a strong connection with industry partners which was not as evident for FPIs. We also noted that MPIs were more likely to be grant co-ordinators. All PIs have been invited to join consortia, but while all the MPIs interviewed participated as partners, only 50% of the FPIs did so.

Ultimately, the purpose of this study was to understand grant application processes. The data shows no evidence that FPIs had a lesser success rate than MPIs. FPIs just applied for a lesser value of grant. This raises the question as to why that should be the case? Our study shows that the confidence, academic seniority and strong network developed at early-stage career and subsequent years as discussed in the previous paragraph, are potential explanations for why MPIs apply for higher grant values. As a consequence, CSIS-Lero are now working towards the implementation of new actions as a result of undertaking this study. These include targeted actions such as:

- Educating students on the impact of career choices.
- Creating a structured forum where PIs can be exposed more formally to industry partners and giving support to FPIs in maintaining these industry links
- Introducing mentoring programs which focus on funding and the development of grant proposals
- Holding focused workshops on the importance of building one’s reputation as an expert and on the type of grant application likely to be more successful.

Female focused mentorship programs (such as those cited above) play an important role in supporting the professional development and career progression of women in academia, often serving as an intervention to advance female equity in the academic workspace (Meschitti and Lawton-Smith, 2017). For example, increased knowledge (House et al., 2021; Morley, 2013), improvements in self-confidence (Grisso et al., 2017; Pfund et al., 2014) enhanced networking capabilities (House et al., 2021) and professional skills development (Gardiner et al., 2007) - such as those

required for grant writing - are just some of the benefits associated with female mentoring schemes in the literature. Fostering a supportive advisory and mentoring relationship synonymous with organised mentoring schemes has the potential to significantly bolster FPI's (particularly early career academics) skill sets and further advance their career and research trajectories.

3.2. Non-tenured researchers: Career development for early-career researchers

We consider 'researchers' to be those people who have completed PhD studies, and are now working as post-doctoral researchers, research fellows or senior research fellows within CSIS-Lero. There is currently no promotions process for researchers in UL, which is, in fact, the national situation in Ireland. There are efforts at national level to address this situation, but they need to be implemented at local level – in this case, in CSIS-Lero. The Irish Universities Association (IUA) / Technological Higher Education Association (THEA) Researcher Career Development and Employment Framework (IUA/THEA, 2022) is the preferred national model for researchers. In addition, UL has a Human Resources Vitae course (UL, 2023a) - the Researcher Development Programme which includes detailed modules on developing a career strategy. In addition to this, UL requirement is that all staff members (including researchers) with a contract of longer than 10 months must have an annual Performance and Development Review (PDR) with their line manager, which for researchers is the project PI. This should provide researchers with feedback on their performance as part of a discussion regarding career development. In line with the strategic objectives of the sub-unit, CSIS-Lero, and the university, UL, individuals' goals and objectives in should be set.

Participating in the Athena SWAN submission process allowed CSIS-Lero to analyse how successfully the process outlined by HR is being implemented for researchers. In the first instance, from our researcher survey, the number of researchers who have been offered and have participated in PDRs with their PIs. Out of 19 male researchers offered PDRs by their PIs, only 6 (32%) male have accepted the review. Four female researchers were offered and accepted their reviews. However, 2 (23%) female researchers were not offered reviews. While the numbers of female researchers is lower, it is of concern that a significant percentage of male researchers are not accepting the offer of PDR and that some female researchers are not being offered a review. In fact, further study has allowed us to understand that those who have completed reviews have had career plans developed.

The other aspect of career development that we reviewed was training. We have found that no CSIS-Lero researcher had participated in any training course on developing a career strategy and only one female researcher has attended leadership training. However, the introduction of the Advanced Learning in Evolving Critical Systems (ALECS) fellows' scheme (Lero, 2018), where fellows must attend at least four courses per annum has caused a change in this in more recent years.

A further important source of personal development for researchers is through attendance and presentations at conferences and networking events. Female researchers are less likely to look for support to cover their time to attend personal development events, but when their male counterparts requested support it was granted. All CSIS-Lero researchers in Lero are funded and attend, through their grants, at least one conference per year. Therefore, we did not expect that anyone should have to cover their costs. Female researchers have looked for and received financial support but 33%M have not/rarely looked for this. Administrative support is provided for when researchers request it. Two researchers (1F, 1M) have completed UL's Graduate Diploma in Teaching, Learning and Scholarship, and have since been offered permanent academic positions. Focus group discussions have revealed that lack of teaching experience is a barrier to researchers progressing into academic positions, so we need to encourage researchers who are building towards an academic career to complete this course.

Overall, our Athena SWAN report pointed to the need for researchers to undertake PDRs with their PIs, the value of which would be two-fold. Firstly, a fair and actionable evaluation of performance would allow for the effective development of key skills in line with job or research tasks and ensure that researchers would be fully supported in identifying career plans, training plan or personal development resources. Secondly, for the PI providing the feedback, the potential to create a culture of recognition and advancement affords them the opportunity to enhance key leadership and communication skills and foster meaningful and attainable change. Significantly, our study found that while PDR's were very effective in supporting the career aspirations of male researchers, female researchers required additional training, support and mentorship to advance their professional development. In order to implement this change, a session exploring the development and implementation of PDRs was undertaken with Lero researchers nationally. Round table discussions were also conducted, providing a useful guide for PI's leading the PDR practice.

Lero has also received funding from the European Union for a further research fellow project, SyMeCo

(UL, 2023), Science Foundation Ireland and the European Commission’s Marie Skłodowska-Curie Actions (MSCA) COFUND programme, which will support career development for female and male research fellows.

3.3 Doctoral students: Increase the number of females registered

Doctoral students in CSIS-Lero are normally supervised by at least one and up to three academics and/or researchers. Once registered, it would be normal, though not prescribed, to meet some of their supervisors at least every fortnight. Overseen by the UL Graduate School progress is monitored annually through the doctoral student presenting their research progress to a gender-balanced CSIS-Lero committee (gender-balanced) of at least two people.

CSIS-Lero students participate in national and international conferences and summer schools, presenting their work orally and by poster, normally funded by research projects. We found no evidence of gender discrepancy in opportunities to present and all CSIS-Lero PhD students have the opportunity to present their research by poster in the annual national Lero summit. Additionally, six students are selected to present at a doctoral symposium and, since 2013, the panel comprises both a female and male internationally recognized researcher. Students also participate in Lero industry days and other relevant external events.

Doctoral students are funded based on IUA rates and so there no gender differences. Ninety percent of students are funded by research grants, some through Lero, and female and male are equally likely to be funded through these grants.

July 2018	F	M	Total	%F
CSIS	2	5	7	28%
Lero@UL	6	28	34	17%
Total July 2018	8	33	41	19%
July 2019				
CSIS	4	14	18	22%
Lero@UL	4	22	26	15%
Total July 2019	8	36	44	18%
July 2020				
CSIS	5	17	22	23%
Lero@UL	1	18	19	5%
Total July 2020	6	35	41	15%

Table 2. Students registered for Doctoral studies in CSIS-Lero 2018-2020

Table 2 shows the numbers registered in CSIS-Lero shown are for July each year, as PhD students can graduate at any of four annual boards. What we have noted is that the percentage of women who are registered for doctoral studies is consistently below 20% of the total number, with only 15% registered in July 2020. In CSIS-Lero, courses from which women could feed into doctoral studies are 1st and 2nd.1 honours undergraduates (26% female), and MSc courses (34% female). In addition, we can see from Table 3 that the percentage of PhD enrolments which would include other CS courses apart from those in CSIS-Lero, shows that UL indeed has a much lower percentage of female doctoral students than 6 other Irish Universities². In comparison, 35% MSc CS research students nationally, out of 2,166 are female, while 45% of those in UL, out of 233, are female.

PhD Enrolments 2018-2019	F	M	Total	%F
University of Limerick	9	37	46	20%
Dublin City University	21	33	54	39%
Maynooth University	8	17	25	32%
Trinity College Dublin	35	57	92	38%
University College Cork	4	8	12	33%
University College Dublin	30	74	104	29%
Total	107	226	333	32%

Table 3. Students 3 for Doctoral studies in seven, then existing, Irish Universities, 2018-2019, in subjects Information and Communications Technologies, Software Application Development and Analysis, and Database and Network Design and Administration (HEA, 2023)

These numbers are of concern, particularly as there is an effective drop-off in numbers between undergraduate/taught postgraduate students to MSc students to Doctoral students. To alleviate this issue, actions have been identified for CSIS-Lero. In the first instance, CSIS-Lero have undertaken to gender-proof advertisement and to publish case studies of CSIS-Lero female PhD students and graduates. This can be seen in Lero, 2021, where 8 out of 15 people profiled are women, 2 of whom are doctoral students, 2 of whom are industry-based doctoral graduates and 4 of whom are academics. When interviews were undertaken with current doctoral students, it was recognized that, in the main, the female students had been approached personally by PIs to consider progressing to further study. Linking qualified students to PIs should improve the numbers taking up on doctoral studies. Additionally, obtaining bursaries during undergraduate studies has been shown to increase female students’ confidence,

² Since these figures were collected, the Irish Government has established a further 5 Universities.

and thus may support their progression to further study. With this in mind, CSIS-Lero have run workshops where female academics have supported female students when applying for available bursaries. The importance of this same gender support intervention has been confirmed in a recent study (Wu et al, 2022) which found that same gender peer mentoring can have a significant and long-lasting positive impact on young women’s STEM career engagement. Advice from female mentors was found to be particularly effective as they understood barriers and constraints far more intuitively than male mentors.

3.4. Undergraduate students: Interdisciplinary courses

There is international concern over the low numbers of women taking up CS courses. The CSIS-Lero Athena SWAN analysis has identified that women are, in fact, more likely to participate in courses which are interdisciplinary.

Code	Years	Course title
LM121	1 only	BSc in Computing Technologies (Common Entry) – feeding into CSIS courses LM051 or LM110 or a third non-CSIS course in Year 2
LM110	2, 3, 4	BSc in Computer Games Development (enrolment through Common Entry)
LM051	2, 3, 4	BSc in Computer Systems (enrolment through Common Entry)
LM122	1 only	BSc in Creative Media and Interaction Design (Common Entry) from 2017-2018 – feeding into CSIS courses LM113 or LM114 in Year 2
LM113	2, 3, 4	BSc in Digital Media Design (enrolment through Common Entry)
LM114	2, 3, 4	BSc in Music, Media and Performance Technology (enrolment through Common Entry)

Table 4. List of courses available in CSIS. LM122, LM113 and LM114 are interdisciplinary courses.

	F	M	Total	%F
LM121 Year 1	14	114	128	11%
LM110 Year 2, 3, 4	10	92	102	10%
LM051 Year 2, 3, 4	17	129	146	12%
Total	41	335	376	11%
% of CSIS total	46%	73%	68%	
LM122 Year 1	24	44	68	35%
LM113 Year 2, 3, 4	24	39	63	38%
LM114 Year 2, 3, 4	15	41	56	27%
Total	63	124	187	34%
% of CSIS total	54%	27%	31%	
Total UG	104	459	563	18%

Table 5. Registrations on CSIS courses which are listed in Table 4.

As shown in Table 5, 34% of students registered on LM122, LM113 and LM114, the CSIS interdisciplinary courses are female. In UL, from 2017-2019, the interdisciplinary BEng – Biomedical Engineering (30%F) are significantly higher than on UL’s non-interdisciplinary BEng – Mechanical Engineering (15%F). From INGENIC (Irish Network for Gender Equality in Computing) discussions, we also know that, in Ireland, female enrolment on interdisciplinary courses in higher education institutions averaged 37% in 2017-2018. Additionally, 2020-2021 figures indicate that Computing courses with other topics, such as languages, business and psychology, are enrolling approximately 50%F students. This evidence encourages CSIS-Lero to actively investigate the introduction of another interdisciplinary undergraduate course within the department. The variance in women’s choice of CS programmes and their preference for interdisciplinary STEM programmes is not just an Irish phenomenon. For example, Research by Ng and Fergusson (2020) into Australian students’ STEM engagement found that courses that contain an emphasis on interdisciplinarity, creativity, innovation, and entrepreneurship, have the potential to increase girls’ engagement with STEM. From a CSIS perspective, when potential options are examined, it is clear that there is expertise in teaching Health Informatics and Digital Health Transformation. Academics also have conducted internationally-recognised Digital and Connected Health research. In addition, in 2021/2022, 76% of those enrolled in Health and Welfare courses nationally were female (HEA, 2023). Consequently, this would seem to be one possible option for the development of an interdisciplinary course.

4. Challenges in Enacting Change

Athena SWAN has been a highly effective mechanism that provides a proven and systematic way of advancing workplace gender equality at the micro-level. However, it should not be viewed as a cure for all gender equity ills and attention needs to be paid to ensure that it is enacted in a way that does not accidentally reinforce inequity. For example, Caffrey et al (2016) examined the effectiveness and impact of an Athena SWAN program using data gathered from five departments within a UK medical school. They found that the implementation of Athena SWAN principles was viewed by staff as a predominantly positive initiative that created the necessary social space to address gender inequity and highlighted problematic practices. However, they also found that gender inequity was unexpectedly reinforced through enactment of the initiative, with female staff assuming a disproportionate amount of responsibility for Athena SWAN work, which may negatively impact the career progression of those women. Clearly, unless recognition is given for the workload that is involved in enacting these programs, they can unintentionally reproduce inequality. A further finding related to the fact that staff considered the impact of the program to be weakened by broader institutional practices (such as inconsistent or limited workshare opportunities), national policies (e.g., the need to extend the duration of paid paternity leave) and societal norms (including expectations that women still shoulder more responsibility for childcare within the home) – issues which clearly extend beyond the remit of the Athena SWAN initiative. Later work of Ovseiko et al. (2017) also found that Athena SWAN was limited in its ability to improve gender equality in the absence of broader institutional and societal changes. Areas highlighted by these researchers included entrenched power and pay imbalances, enduring lack of work–life balance in academic medicine, concerns regarding the sustainability of positive changes, concerns that achieving the award could become an end in itself, and resentment about perceived positive discrimination (i.e., the perception that women are benefiting from favorable treatment to the detriment of men). These researchers concluded that Athena SWAN needs to be accompanied by structural and cultural changes in the university and society. The work of both Ovseiko et al. (2017) and Caffrey et al (2015) points to the need for careful management of how gender equality initiatives are enacted at the organizational level. Specifically, they clarify that for sustainable workplace gender equality changes to be achieved, a symbiotic, mutually reinforcing approach where national policies underpin organizational initiatives and the success of those initiatives in turn stimulates further national

gender equity policy development is required. Third, they recognize that cultural and societal change is dependent on state and organizational level incentivization to increase participation of men in unpaid family caring work, something that extends beyond the scope of higher education policy and micro-level initiatives. Such intentional incentivization does however achieve critical social change. For example, countries such as Sweden have implemented a progressive 16-month paid parental leave policy that stipulates that the father must take some of that leave and it cannot be transferred to the mother. Moreover, that leave is available up to eight years post-birth. This has resulted in a cultural shift in which a more equal sharing of caring responsibilities has now become the norm rather than the exception, resulting in a more gender-equal society.

5. Conclusion

A dramatic cultural shift in relation to gender equality, diversity and inclusion has taken place in higher education institutions in Ireland over the past 10 years. That shift encompasses how these issues are prioritized and mainstreamed and is predicated on a basis of accountability directly related to funding recognition. The implementation of national requirements has ensured that equality is now a priority action and the responsibility of the Governing Authority, President and Executive Committee in each institution. Gender equality, diversity and inclusion is no longer something that exists on the sidelines – it has become central to education policies.

As a result of this culture shift, individuals throughout the higher education system are now more aware about what they can and cannot do from an equality perspective. When setting up research discussion panels or organizing research speakers, a conscious effort is now made to ensure that these events are gender balanced. When marketing materials are being developed, individuals consider the images and pictures, ensuring that no grouping is unfairly or unequally represented. These actions are not governed by rules and regulations – rather, there is a management focus on equality issues which has heightened awareness. We see these actions happening in all departments, regardless of discipline and this is replicated internationally. For example, the steering committee of International Conference on Software Engineering, the flagship conference for the researchers in that community, has appointed Diversity and Inclusion co-chairs for this conference since 2022. In 2023, there are two related tracks - Studies on gender in

SE and Diversity and inclusion in SE – with some of the papers belonging to the ICSE Technical track.

Athena SWAN has played and continues to play an important role assisting universities and their academic units in addressing the barriers to workplace advancement for women computer science faculty, as well as the broader Management Information Systems disciplinary area. This is evident in the culture change within CSIS-Lero in UL departments due to Athena SWAN implementation. There is a recognition that the recruitment and promotion systems have been set up to support women and men equally, and this has resulted in an improvement in the numbers of senior female computer science academics at Associate Professor and Full Professor level, and both of UL's Senior Academic Leadership Initiative professors appointed in 2021 have been in STEM disciplines. People think about equality and how it can be actively implemented, and the environment has changed to support early career academics, both men and women. Staff are now afforded the opportunity to be mentored and to discuss their career plans and issues. From the potential student perspective, marketing materials now include cohorts of female students, women working in CS are shown telling their story on web pages and we run workshops for younger women showcasing CS as a diverse and interesting career. For current students, we now bring in women working in STEM to give talks and our external examiner pool is gender balanced. Students have set up a Women in STEM society which is active in, for example, organizing talks and STEM industry visits. Increasingly, individuals are ready to speak out about equality, to talk about the issues and to provide support to those who need it, regardless of their circumstances.

Although the case studies outlined in this paper differ, one particularly important theme appears to pervade each of them - that is the role of female-female focused mentorship, specifically its positive effect in encouraging women to pursue doctoral studies, increasing the confidence of female PI's to apply for large grants and encouraging STEM academics to advance in their careers. This confirms the value of same gender STEM mentorship.

Clearly, Athena SWAN has significant potential to advance and embed gender equality changes. However, the ability of policy and organizational initiatives to effect sustainable workplace gender equality is likely to remain bounded and localized unless they are accompanied by change at the cultural and societal level. Achieving this will require intentional development of gender equality state policies that incentivize men to assume more responsibilities in relation to unpaid family caring work. Countries and organizations that engage in such incentivization strategies are less likely to suffer talent shortages of

women computer science professionals and more likely to become destinations of choice for those seeking gender equal workplaces and societies.

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