

# Shooting for the Stars: How a STEM Initiative has Evolved to Address Gender Challenges in Work and Education

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**Abstract**—There are fewer women than men in Science, Technology, Engineering and Mathematics (STEM). To address this imbalance, numerous STEM intervention programmes have been implemented worldwide. These programmes are aimed at helping girls and women to reach their full potential in terms of school and work.

Planning and implementing a STEM intervention programme is a complex process. There are many different stakeholders, and their needs can be varied and evolving. This paper discusses STEM interventions, and it presents our experience with a specific intervention, the University of Limerick-Lero/Johnson & Johnson WiSTEM<sup>2</sup>D (Women in STEM, Manufacturing and Design) programme. This programme has evolved based on the learnings identified in areas such as participant group dynamics, invited speaker engagement and presentation delivery, and teamwork-centered activities. Such learnings can be applied across a range of STEM fields, including software engineering. We believe that initiatives, such as WiSTEM<sup>2</sup>D, which support and promote gender equality in STEM<sup>2</sup>D fields, and specifically Computer Science (CS) education and industry, are of key importance. Our review of the programme has identified three primary lessons: (1) individuals did not benefit as strongly as those working in groups (2) online events allow for more speakers and greater transfer of knowledge and (3) working in teams provides the students with the opportunity to socialise with other women in a work environment.

**Keywords**— *Female, Gender, Intervention, STEM, Students, WiSTEM<sup>2</sup>D.*

## I. INTRODUCTION

From 1901-2019, there were 616 Nobel Laureates in Physics, Science, Medicine and Physiology, of these only 19 were women [1]. In the United States of America in 1970, 38% of all workers were women, but in STEM (Science, Technology, Engineering and Mathematics), women only accounted for 8% of workers. By 2019, this figure had increased to 48% of all workers and 27% of STEM workers

[2]. Internationally, there is a clear gender gap in STEM and, while in some countries, such as Oman, Myanmar, Morocco, Mauritania, Benin, and Gambia, the gap is smaller, for most there still exists a gap in genders of between 60-70% [3]. Having a gap to close between genders in STEM can be reduced by applying a range of targeted interventions at all stages of the female STEM career journey.

In terms of gender equality in Ireland, in 2018 25% of the people with careers in STEM were women [4]. Looking at the figures in different STEM disciplines, however, this number varies. The number of women engineering graduates in 2018 was 13% [5]. While there has been an increase in the number of students choosing STEM disciplines in college or university, the number of female students is still low. In 2019 a study by University College Dublin (UCD) showed that 19% of female students were choosing STEM disciplines, while for male students the figure was 40% [6]. More women than men also leave STEM careers [7]. In the United States of America in 2015, 50% of the total college-educated workforce were women, but only 28% of the total science and engineering workforce were women [8]. When exploring the representation of women within STEM departments in academia these gender disparities are worse [9]. Specifically looking at software engineering, stark figures are showing that in Ireland in the seven years prior to 2021, only 18% of women graduate with an Information and Communications Technology qualification and of the CS (Computer Science) courses only 20% of graduates are women [10].

There are many intervention programmes globally which aim to increase the number of women studying STEM subjects, but, due to the global nature of the problem, there is no one size fits all approach that can be applied. The WiSTEM<sup>2</sup>D (Women in Science, Technology, Engineering, Mathematics, Manufacturing and Design) programme from Johnson & Johnson (J&J) is one such intervention. It aims to increase the number of women in STEM<sup>2</sup>D and to improve the retention of those women already in STEM<sup>2</sup>D. Our experience has shown that initiatives such as WiSTEM<sup>2</sup>D need to evolve and change to meet the needs of its participants.

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The WiSTEM<sup>2</sup>D programme is divided into 3 different pillars that address youth (school), university (undergraduate and scholar), and professional (post-graduate) periods of STEM engagement. The importance of each of these pillars is that they address key points in a STEM journey from school to university, and then to a STEM career. This paper briefly describes these 3 pillars and discusses the university pillar in detail. By awarding and sponsoring girls and women within STEM disciplines at important points in their education and careers, the WiSTEM<sup>2</sup>D programme encourages the development of the female STEM<sup>2</sup>D talent pipeline. While the WiSTEM<sup>2</sup>D programme is open to all STEM<sup>2</sup>D subject areas, in this paper we present lessons learned that are transferrable to software engineering.

## II. BACKGROUND

Internationally, many interventions aim to empower girls and women in STEM<sup>2</sup>D. In Ireland, where CS education at second level was only introduced in 2018, and to date is not available in all schools, one such example is *CodePlus* (Coding for Girls), a CS intervention programme that provides workshops and talks [10]. CodePlus has been successful in promoting CS to girls and to schools that are considering introducing it as a mainstream subject. Lero – the Science Foundation Ireland Research Centre for Software runs CodePlus computing camps for female Transition Year (TY) students in collaboration with Irish universities – University of Limerick (UL) Trinity College Dublin (TCD) and University of Galway. (Note: Transition Year (TY) is a one-year programme that forms the first year of a three-year senior cycle, for further information see [11]).

*DigiGirلز* from Microsoft gives girls the chance to learn about careers, connect with Microsoft employees, and take part in workshops [12], while *Girls in Tech* aims to address the gender gap and has a global reach in over 50 countries [13]. These programmes have European chapters which provide connections between countries [12].

*Girls in STEM*, a project funded by the European Commission and Erasmus+ programme, aims to encourage girls to follow STEM careers [14]. Like other programmes, it provides support and opportunities to explore careers in STEM.

Multiple researchers have shown that effective mentoring can help students overcome barriers that hinder their success [15, 16]. Mentoring can have a positive impact on students' STEM-related career interests, knowledge, and confidence [17]. The success of programmes is that they engage students early and facilitate teamwork. Additionally, students can explore creativity, problem solving and collaboration.

A literature review in 2020 examined STEM interventions conducted internationally and found that they have been aimed at adolescents and up, are once-off in nature, and try to change beliefs [18]. In that review, the authors found that interventions should be more inclusive, start earlier, be longer-term, and seek to change the structures and systems that produce the barriers to women entering STEM disciplines and careers. The literature already cited has shown that there are areas that can work to encourage more girls and women to pursue STEM such as early and long-term engagement, and mentoring. The WiSTEM<sup>2</sup>D programme, through its 3 pillars, impacts girls and women at different periods of STEM<sup>2</sup>D engagement from school and university through to careers.

The programme includes industry mentoring, workshops, talks and site visits.

The objectives of this experience paper are to present how the WiSTEM<sup>2</sup>D university programme run at the University of Limerick, Ireland, has changed over the duration of its delivery due to lessons learned during its implementation. Section III introduces the WiSTEM<sup>2</sup>D programme. Section IV discusses the university pillar of the programme. Section V describes the youth, and professional pillars. These pillars connect to the university pillar as interventions provided at different points in the educational cycle. Section VI discusses the learnings identified when running the university programme and Section VII discusses how they are related to software engineering. Section VIII presents the conclusion.

## III. WiSTEM<sup>2</sup>D INTERVENTION

In 2015, the healthcare multinational Johnson & Johnson (J&J) launched WiSTEM<sup>2</sup>D, an intervention programme for youth, university, and professional women in STEM<sup>2</sup>D. The overarching aim of WiSTEM<sup>2</sup>D is to support girls and women in pursuing STEM<sup>2</sup>D education and careers. The programme provides bursaries and mentoring, with the aim of helping girls and women to grow and develop by preparing and aligning them to careers in STEM<sup>2</sup>D [19]. The programme is global due to its reach through partnerships in countries such as Ireland, Japan, Brazil, and the United States of America.

The university pillar of WiSTEM<sup>2</sup>D focuses on undergraduate (described in detail in Section IV) and scholar students. From the undergraduate perspective, the WiSTEM<sup>2</sup>D programme includes elements which are mentioned positively in literature such as mentoring (cited in Section II). Another element included is that groups of students research issues affecting women in STEM<sup>2</sup>D. From the scholar perspective, the university pillar funds university researchers, offering funds to early to mid-career women working within a STEM<sup>2</sup>D university department. Participants apply to take part in the programme via a yearly global application call. Each university/institute can support up to 6 applicant submissions per year. There are various parts to the application, but the starting point is a 1000-word essay detailing the proposed scholar's research. The successful recipients receive a three-year research award and the recipient's achievements are showcased at a symposium.

In 2016, the undergraduate element of the university pillar was launched in Ireland at the University of Limerick (UL). For the past 7 years, UL has received funding from the J&J WiSTEM<sup>2</sup>D programme and for the past 3 years, matched research funding for the project has been provided through Science Foundation Ireland by Lero – the Science Foundation Research Centre for Software. All the authors have been involved in the programme at various stages during this time. Since the Irish launch in 2016, the programme has also expanded to other Irish universities - University College Cork (UCC), University of Galway, Munster Technological University (MTU) and Trinity College Dublin (TCD). This has enabled the WiSTEM<sup>2</sup>D programme in Ireland to support more than 400 female students over the last 7 years.

Since its introduction in Ireland, the WiSTEM<sup>2</sup>D programme has changed and evolved significantly. This change and evolution were facilitated by the feedback received from the participants on their needs and from the programme team. Currently, mainly because of the recent Covid-19 pandemic, the programme is now hybrid, including

a mixture of in-person and online events. There have also been changes in the number of recipients and the types of awards presented.

#### IV. WiSTEM<sup>2</sup>D UNDERGRADUATE UNIVERSITY PILLAR IN UL AND OTHER UNIVERSITIES

The WiSTEM<sup>2</sup>D undergraduate university pillar has been developed for women who are studying undergraduate courses. Workshops, mentoring, and site visits are integral to the programme, and uniquely in UL, student groups have undertaken research projects on topics relating to women in STEM<sup>2</sup>D. As the J&J programme delivered to undergraduates in Irish universities is growing, there has been an active choice recently to streamline and coordinate task dates with the other universities as much as possible.

In UL, the programme is managed by a team from both UL and J&J. The programme is announced each year with a press release from J&J for each university. Female undergraduate students of STEM<sup>2</sup>D subjects entering the 2nd, 3rd, or 4th year of their studies in UL are eligible to apply. The closing date for applications is the same for each university. In UL, interested students self-select for consideration by applying to the programme. The programme team runs workshops for interested students to attend and it is a forum where students can ask questions. Past participants of the programme are in attendance to share their first-hand knowledge of the experience of being part of the programme. There are a number of these workshops provided and the format is both in-person and online. Once the call closes, applications are shortlisted, and the shortlisted candidates are invited to be interviewed by panels comprised of UL and J&J staff who jointly decide which students are to receive the awards. During the programme's lifetime, approximately 15% of the WiSTEM<sup>2</sup>D recipients have been students on computing courses run by the Departments of Electronic & Computer Engineering or the Department of Computer Science & Information Systems.

An awards ceremony is held for the chosen recipients in each University. The dates of the awards ceremonies are coordinated and J&J issue press releases for the programme. The recipients of each bursary award are presented with a bespoke art piece specially commissioned by J&J. Workshops for the recipients are organised and there are opportunities to network and meet people from other STEM<sup>2</sup>D backgrounds.

Awards were presented in one of two categories: individuals or teams. Winners of the teams' awards embarked on relevant research projects as members of interdisciplinary groups. These research projects are related to WiSTEM<sup>2</sup>D topics. The importance of the students carrying out research in teams relating to WiSTEM<sup>2</sup>D topics has many advantages in terms of their learning, building longer-term research projects, general advantages of group work, and the input from the J&J interaction design team. Additionally, considering and researching WiSTEM<sup>2</sup>D topics allowed the students to understand the global nature of being a woman in STEM<sup>2</sup>D and the various initiatives, benefits and issues associated with this.

The advantages of group work for the students were very positive as it enabled them to meet with other WiSTEM<sup>2</sup>D bursary recipients from other courses. Without WiSTEM<sup>2</sup>D, the probability of such a meeting occurring is low. The students worked together to use their individual and collective skills in the research projects. The research projects required

that the students create a video and a poster. To support this task, two J&J personnel provided a workshop on interactive design.

The ability of the students to build longer-term research projects allows for more in-depth analysis and for further research projects to be proposed and implemented. For example, one project was on the need for student-led mentorship in second-level education. Based on the findings made by the student project team and relevant feedback from the programme team, in 2023 there will be a student-led mentorship programme rolled out that will include past and present WiSTEM<sup>2</sup>D participants as mentors within second-level schools. Results from several of the students' research projects were published at various conferences both nationally and internationally, for example, the All-Ireland Conference of Undergraduate Research and the ACM Celebration of Women in Computing womENCourage conference.

The individual recipients received one-to-one mentoring whereas the teams each had a single group mentor. The recipients from 2020-2022 had to deal with the programme changing from in-person to virtual due to the impact of the COVID-19 pandemic. This greatly impacted those recipients as they could not access networking or face-to-face meetings. The programme team were creative in how they delivered the programme that had to change radically due to the outside uncontrollable forces presented by COVID-19. On the plus side, the virtual environment meant that the number and types of speakers could be expanded. The availability of speakers increased as there were no longer travel requirements. Extra workshops were added to help the recipients cope with this new way of working.

During our implementation of the WiSTEM<sup>2</sup>D programme in UL over the past 7 years, we recognized that changes needed to be made to certain aspects of the programme, while also retaining others. While the discussion in this section relates to STEM<sup>2</sup>D in general, many of the points we make are directly relevant to software engineering and are specifically discussed in Section VII. For example, the areas identified earlier as important to an intervention namely, participant group dynamics, invited speaker engagement and presentation delivery, and teamwork-centered activities, are also important to software engineers. Gender equality is needed in STEM<sup>2</sup>D and, given the low figures still prevalent today, gender equality is specifically needed in software engineering. WiSTEM<sup>2</sup>D addresses these areas through the pillars of the programme described that address education and industry.

In the context of the current programme - mentoring is very important so it has been retained. Mentoring can aid success and is important for overcoming obstacles faced by students [16]. The research projects remain but are now condensed in terms of the time required by the students. Teamwork is important to the students who in feedback commented that they appreciate the chance to work with other women in STEM<sup>2</sup>D.

The programme mentors are J&J employees (men and women), from various levels of the organisation. Mentors volunteer to be part of the programme, are assigned to mentees and each mentor-mentee pair meets regularly. Effective mentoring can have a positive impact on students [16]. The feedback from the past participants of the programme was that mentors should not be too advanced in their careers. The

reason for this is that older mentors had less in common with the student mentees.

Until 2022, the programme was only open to 2nd and 3rd-year students. The number of places in 2021 was 16. The programme has expanded to include 4th-year students. The number and type of awards have also changed. In 2022-2023, there were 16 bursaries and 10 runners-up places awarded. This is an increase in the number of places from 2022. In previous years there were individual, and group places awarded, whereas now there are only group places given. The reason for removing the individual places was a result of feedback from the students and the programme team. The group element is considered to be more beneficial for the students. In 2022-2023 in UL, each of the 16 bursary recipients received a student award (bespoke artwork), a bursary, industry mentoring, career workshops, and J&J site visits. The 10 runners-up also have access to industry mentoring and careers workshops. This allows for the programme to have a greater reach. Lessons were learnt from the feedback received from both the students and the programme team. However, once awards are given, mentoring has become one-to-one, rather than one mentor to a group of students.

J&J site tours were a very popular part of the programme in previous years but during COVID-19 this obviously could not be facilitated. Photo stitching technology was utilised as a replacement. As in-person events are now permissible the plan is for the university recipients to have the opportunity again to visit various J&J sites. As J&J is a multinational company with many sites in Ireland, this allows for visits to, for instance, pharmaceutical, manufacturing, and biologic sites.

To help previous recipients to work on their research projects, support was provided by J&J and UL. The recipients created a video and a poster to address their research questions and present their projects to a panel of UL and J&J staff. Groups chosen by the panel in previous years had the opportunity to present at the UL International Women's Day event. In 2022, the winning team project was also given the opportunity to speak to school students about their research project at a WiSTEM<sup>2</sup>D Youth Pillar event. Once again, we see past participants as ambassadors of the WiSTEM<sup>2</sup>D programme. Activities such as these provide them with opportunities to act in this role.

Recipients are provided with workshops on various topics such as:

- **Soft skills:** Interview skills and Curriculum Vitae development were discussed.
- **Invited speakers':** Both men and women spoke at these workshops about their education and career paths.
- **Mentorship:** This provided practical details about mentorship, and what is expected of a mentor and a mentee.

For their projects, the recipients could also suggest a WiSTEM<sup>2</sup>D topic instead of choosing from the list of existing topics, provided that the chosen topics are related to issues faced by girls or women in STEM<sup>2</sup>D. This gave them the freedom to work on a topic that was of special interest to them. For the students, being part of the projects allowed them to gain a greater insight into issues that are not only specific to

them individually but issues that can be faced by many girls and women in STEM<sup>2</sup>D. Examples of the various topics the recipients worked on are listed in Table I. In 2022, the projects were changed as the student's feedback was that while the projects were very beneficial and the group dynamic was very useful, unfortunately, the time it took to complete the projects clashed with student university coursework. Therefore, in 2022 the research projects will be changed. The project work on STEM<sup>2</sup>D topics is being condensed into a shorter space of time. We plan that the students will participate in a hackathon-style event with all the current university recipients also attending at a J&J site. In previous years, students did not have the opportunity to meet recipients from outside of their university.

For the past participants of the programme, there is a LinkedIn Alumnus page. There was also a project undertaken by one of the recipient teams in 2020-2021 ("An investigation into how the availability of STEM subjects in single-sex schools affect college/career choices") that has identified that mentoring girls in second-level schools is important. Fig. 1 shows part of that winning team entry, a poster for use in schools. The students identified the need for a student-led mentorship programme within second-level schools. In 2022, we have developed a research project which includes the establishment and evaluation of this mentorship programme, which will be run by Lero. To choose the student mentors the application process will be the same as the WiSTEM<sup>2</sup>D programme. Interested past and present WiSTEM<sup>2</sup>D recipients will self-select and apply to be considered. Following this, there will be a shortlisting and an interview process will be undertaken.

To gather feedback on the impact of WiSTEM<sup>2</sup>D, the participants complete surveys at the beginning and the end of the programme. They also participate in focus groups which discuss the benefits and challenges of the programme.

TABLE I. EXAMPLES OF THE STEM<sup>2</sup>D PROJECT TITLES THAT WERE PROVIDED TO THE PROGRAMME PARTICIPANTS TO CHOOSE FROM.

Research Project Title
How could female 3rd-level STEM <sup>2</sup> D students be supported in laboratory sessions? As an example, is there an ideal laboratory structure that should be set up? [e.g., 1 female per group, mixed groups, all-female groups]. What other supports could be given?
How could second-level schools present a better image of STEM <sup>2</sup> D to their current students? How can the availability of STEM <sup>2</sup> D subjects be improved in second-level schools?
How could STEM <sup>2</sup> D be promoted as a career for girls to parents with a non-STEM <sup>2</sup> D background?
The usefulness of women in STEM interventions (in second and third level)
Influence of peers, teachers, families and industry as women in STEM <sup>2</sup> D
Transitioning into University as a woman in STEM <sup>2</sup> D
The self-confidence formula changing the way for women

In 2023 the programme team plan to have an event where all the university recipients will have the opportunity to meet. This will be on the same day as the hackathon-style event where the students will work in groups on a WiSTEM<sup>2</sup>D-related topic. Up to now the recipients from other universities have not had opportunities to meet in person. Virtual elements of the programme that were implemented during COVID-19 have also been retained, so it is now a hybrid version of the pre-2020 programme. This means that there is a mixture of events both in-person and online. For example, some universities held online interviews instead of in-person interviews.

WiSTEM<sup>2</sup>D is designed to be more than a one-off intervention. It is multidimensional and both J&J and UL are active in staying in touch with past participants who are seen as ambassadors for the programme. There is an element of pay-it-forward where the participants are encouraged to help those coming up behind them and to be a mentor or guide where needed.

In UL and other universities there is another aspect to the WiSTEM<sup>2</sup>D university pillar is the scholars' programme that is open to postdoctoral researchers. Within the university pillar, it is an opportunity that is extended to postgraduate researchers and there is a global call for applications. Over the past 2 years, UL postgraduate researchers have applied for this fund. There is an internal panel that decides who can go forward. Author 5 has been leading this within UL.

## V. WiSTEM<sup>2</sup>D YOUTH AND PROFESSIONAL PILLAR

The WiSTEM<sup>2</sup>D programme is a longer-term intervention – apart from the university pillar discussed in Section IV, there are 2 other pillars: the Youth and Professional pillars that happen before and after the University pillar. In Ireland, the WiSTEM<sup>2</sup>D youth pillar work with second-level school students. For example, they interact with Transition Year (TY) students to support them in STEM<sup>2</sup>D-related areas.

The youth pillar aims to spark enchantment with technology in young women and girls through creative problem-solving and play. Participants in the youth pillar are offered a variety of STEM<sup>2</sup>D-centered activities including workshops, speaker sessions, and site tours, giving them an opportunity to explore relevant post-secondary school options. Past winners of the university pillar have spoken at events to students.

Within the professional pillar, J&J Re-Ignite is a return-to-work programme for experienced professionals who have taken a career break of at least 2 years. The application process is similar to applying for a job with J&J or applying to a programme as a mature student. Having a career break is seen as an enhancement, not as a detriment. Re-Ignite is for people returning to the workforce such as after completing military service, continuing education, raising a family or many other professional or personal pursuits [20]. Applications are shortlisted and potential participants are interviewed. Successful applicants are given a place on the programme. Feedback is provided to new participants from past Re-Ignite participants. This helps them get back to their careers while appreciating their skills and life experiences [20]. Similar to the university pillar for undergraduates, Re-Ignite provides mentorship. The Re-Ignite programme also includes industry-specific training, projects, on-the-job learning, and a network of support, and after completing the programme participants are considered for a full-time role at J&J [20].

Through these various pillars, at different points in a student's STEM<sup>2</sup>D engagement from school to university and on through to careers, WiSTEM<sup>2</sup>D continues to be a long-term intervention.



Fig. 1. WiSTEM<sup>2</sup>D winning project poster 2021/2022.

## VI. LESSONS LEARNED

We have identified three primary lessons learned during our review of the WiSTEM<sup>2</sup>D programme: (1) individuals did not benefit as strongly as those working in groups (2) online events allow for more speakers and greater transfer of knowledge and (3) working in teams provides the students with the opportunity to socialise with other women in a work environment.

### A. Individuals did not benefit as strongly as those working in groups

Group dynamic was identified by the participants and the programme team as being very important. Previously there were individual and group recipients of the programme and when comparing their experiences, those participating in teams gained more in terms of working within multidisciplinary groups. For example, a team could be comprised of students from computer science, product design, mechanical engineering, and physics. This allows the students to gain multiple perspectives on the projects they were working on. STEM<sup>2</sup>D careers involve working together [21]. Multidisciplinary teams facilitate the development of software products [22]. Therefore, although individual bursaries were awarded to the 'top' students, they, lost out on this opportunity because they were not required to participate in the group projects.

### B. Online events allow for more speakers and greater transfer of knowledge

This was an unanticipated learning from the programme. Prior to COVID-19, all events were in-person to aid with student networking. During the pandemic, unfortunately networking obviously could not be facilitated in person so all events were online. Now that in-person events have resumed, a review was undertaken of the programme during COVID-19

which uncovered that these online events, while not being good for networking do provide more flexibility. More speakers were willing to attend an online event than an in-person event (as compared to previous years). Higher-level management staff who would typically be very busy could attend online events as there was no travel time included. This was not possible to get access to such people for in-person events for such reasons as busy schedules and different locations. The inclusion of a greater number and variety of speakers thus meant that students benefit from a greater knowledge base. The current programme is using a mix of in-person and online events to allow more flexibility. For example, the student interviews were all carried out online as the interview panels were based in different locations.

### C. Working in teams provides the students with the opportunity to socialise with other women in a work environment

Teamwork was a very positive aspect of the programme for the students. Getting to meet other women in STEM<sup>2</sup>D socially was a very positive experience. In industry, teamwork is common so getting first-hand experience as a student is invaluable. We also know that successful software projects require teamwork [23]. Typically, there are very few women in their courses, so the WiSTEM<sup>2</sup>D programme gives them a further opportunity to meet in a group setting with other women. This applies not only in STEM<sup>2</sup>D but in software engineering more specifically as typically women are in the minority in projects.

## VII. HOW THE LESSONS LEARNED CAN BE TRANSFERRED TO SOFTWARE ENGINEERING

When comparing software engineering to other STEM<sup>2</sup>D topics there are similarities and differences. All STEM<sup>2</sup>D topics require skills such as problem-solving and good communication skills. Software engineering differs from, for example, some science subjects where students typically work alone in laboratories.

All the lessons learned here can be applied to software engineering. Mentoring is important regardless of the topic. The students can manage their time with events that can be in-person or online, while at the same time having guidance from the programme team while undertaking their research projects. In industry, software engineering projects create software for multiple industries and software engineering graduates will need to be adept at working with cross-functional and cross-locational teams with diverse stakeholders.

Providing a group dynamic was beneficial to the students. In terms of software engineering, having multidisciplinary teams aids innovation and creativity. To enable product development, cross-functional teams gather people from different areas that have expertise in proposed innovation problems [22].

Having projects run in a hybrid manner is very good training for the students overall but particularly for the software engineering students who could work on multilocational and multidisciplinary teams when they enter industry. Multidisciplinary and multilocational teams have become a more normal way of working in the software industry [24].

Through WiSTEM<sup>2</sup>D, students get opportunities to work in teams with students from various STEM<sup>2</sup>D disciplines such as physics and mechanical engineering. Working together is commonplace in not only the software engineering industry but also more broadly in STEM<sup>2</sup>D careers. To have successful software projects both academia and the software industry recognise the need for and the importance of teamwork [23]. Engineering and CS professionals recognise that teamwork is an important skill [25]. One of the most important skills to be provided to information technology graduates is teamwork [26].

## VIII. CONCLUSION

The WiSTEM<sup>2</sup>D programme has changed and evolved to remain aligned with its aim of supporting girls and women globally to pursue STEM<sup>2</sup>D studies and careers. It also changed the delivery of the programme during COVID-19. J&J as a multinational organisation has a global reach and in a few short years, it has helped many girls and women in gaining and utilising the support to reach their full potential in STEM<sup>2</sup>D. The programme reaches girls and women at various ages when interventions are needed at different points in their STEM<sup>2</sup>D journey.

Gender equality is needed in software engineering and more broadly in a variety of STEM<sup>2</sup>D settings such as education and industry. WiSTEM<sup>2</sup>D addresses these areas through the different pillars or sections of the programme.

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