



An investigation of the impact of an industry-focused gender intervention on the self-perceptions and career aspirations of female undergraduate students in the STEM disciplines

A Research Report by

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Introduction

The Irish Central Statistics Office (2017) estimates fewer than 25% of STEM workers are female. Internationally, the gender gap problem is often portrayed as a "leaky pipeline", with low female participation in second-level STEM subjects leading to similarly low participation rates in third level STEM college courses and STEM-related careers. Ireland has the highest gender gap in Europe for the number of students graduating in sciences, mathematics and technology (20%). There is a need to develop initiatives that promote females pursuing STEM careers. In 2016, Johnson and Johnson partnered with University of Limerick and nine other higher education institutions around the world (e.g., Caltech, Massachusetts Institute of Technology, Rutgers-New Brunswick Honors College, and The University of Tokyo) in a bid to address the challenges faced by women in STEM. The partnership between the University of Limerick and Johnson and Johnson Ireland - the WiSTEM²D program – is a research-based initiative aimed at identifying the barriers female students face at third level and developing a program to target these barriers. The WiSTEM²D program at UL establishes peer networks across STEM courses, develops connections with female industry role models, facilitates site visits to industry, and provides financial support in the form of student scholarships. Following their engagement with the WiSTEM²D program, the first cohort of participants set up a WiSTEM society. The WiSTEM society holds various social events that connect female STEM students across university departments and also runs industry site visits. The society currently has more than 250 members.

This report examines the impact the WiSTEM²D program had on students who participated over the first three years.



Research Questions

The research was guided by the following research questions:

- (1) What changes are there in WiSTEM²D participants' perceptions of their abilities, knowledge and understanding of STEM careers, and career aspirations?
- (2) How do WiSTEM²D participants experience the university learning environment, the specific elements of the program (intervention), and their interactions with the WiSTEM²D society?
- (3) To what extent do participants change their perceptions of barriers to learning and future careers in STEM?

This report outlines the methodological steps taken in the research study while highlighting a number of important findings. The report also discusses the importance of industry gender interventions such as the WiSTEM²D Program and makes some recommendation regarding STEM education promotion.



Methodology

Bronfenbrenner's (1989) Ecological Systems Theory was used to conceptualise and identify the influences of the WiSTEM²D program on the participating students. According to this theory there are different spheres of influence on an individual within a particular situation. These influences interact with each other, creating a complex web of effects that may be different for each person. In this study, the spheres of influence were hypothesized to be society, university, family and peers, and the individual learner.

A case study approach was used to investigate the perspectives of the students who had engaged with the WiSTEM²D program in 2016 (n=21) and 2017 (n=30) and those who were in the third year of the program at the time in 2018 (n=30).

Two cohorts participated in the study. The first cohort were students in the WiSTEM²D program in 2018. Pre and post surveys were used to measure these participants' experiences *before* and *after* they engaged with the 2018 program (RQ1). These surveys investigated students' confidence, knowledge of STEM and STEM careers, and career aspirations. Focus group discussions were used to investigate (i) these students' perceptions of their university learning environment, (ii) their experience of WiSTEM²D site visits and mentoring *during* their engagement with the program, and (iii) how their involvement in the WiSTEM²D society has influenced their development (RQ2). The second cohort of participants included all students who had previously engaged with the WiSTEM²D program (2016 and 2017). Telephone interviews were conducted with a sample of this cohort (n=51) to investigate their perceptions of barriers to learning and future STEM career aspirations (RQ3).



Findings

Overall, the findings provide evidence that the WiSTEM²D program has a powerful impact on the female participants' development as well as their feelings and future career decisions as young professionals in STEM. The findings highlight the need for interventions like the WiSTEM²D program and the importance of this program for the continued retention of females in STEM in higher education and following onto a STEM career. The findings, which are both qualitative and quantitative, highlight the impact of the WiSTEM²D program in the following themes: confidence levels, career aspirations, experiences of Higher Education and in STEM, and STEM career knowledge. The following is a summary of some of the main findings.

Pre vs Post Surveys

Students showed increased levels of **confidence** when comparing before and after participation in the program. In the pre survey, 7% described themselves as confident or comfortable asking questions in a lecture. There was a substantial change in female students' responses in the post-survey, with 57% of the female students indicating that they are confident with asking questions in lectures. Although it is not possible to make causal attributions based on these data, it is likely that the program contributed to the rise in female students' confidence levels.

Focusing on **career knowledge**, in the pre survey, 67% of participants did *not* know what is involved in industry jobs for which they will be applying. In the post survey, 23% of the participants remarked that they are *not familiar* with industry jobs and opportunities available to them when they are jobsearching. This is a dramatic change in participants' level of career knowledge. As the program deliberately provided this kind of STEM career information, it is likely that it contributed to the growth in students' knowledge around STEM and STEM careers over the course of WiSTEM²D program.



Focus Groups and Telephone Interviews

Students were asked about their confidence levels, reasons for applying for the program, the mentoring aspect of the program and their view of the program now that they had completed. Students said that they thoroughly enjoyed their time on the program and found that the networking connections they made, both in industry and with their peers, was an opportunity they would not otherwise have had. Students appreciated the speakers and events they attended throughout the course of the program along with the stories and experiences they heard. Students described themselves as empowered by many of the role models they met.

One aspect each participant mentioned was the **mentoring** and the help this provided them with in relation to their soft skills such as interview tips, co-op placement, CV skills and applications. They felt these were connections that were especially useful for them as young professionals in STEM. Students also remarked on the skills they developed throughout workshops and with the team projects which are applicable to their lives with academic and career aspects.

Students commented that if the program had been open to their male peers, they would not have applied for it themselves, due to their perception that male peers had more confidence, were better at "showing themselves up" and thus more likely to win a place on the program. This is an interesting finding, since even after winning such a prestigious award, meeting such empowering females in STEM and completing the program, female students still feel somewhat incompetent compared to their male peers. This may be a reflection of their experience in STEM and at Higher Education to date where many of the girls are in male dominated environments.

The participants mentioned how their **confidence** had grown with speaking and putting themselves into situations they wouldn't have done before the program. Throughout the telephone interviews and the focus groups, each student commented on the positive impact of the program on their skill set as well as their confidence in relation to future STEM career aspirations. Each student was keen to follow a STEM career pathway. All of those who have completed their college course in higher education, who were participants in the telephone interviews have gone on to a **STEM career**. This is



a very positive result from the WiSTEM²D program and the results show the need and importance for initiatives like this program.

Overall findings

It is clear from the findings presented that the WiSTEM²D Program had a positive impact on the female students who participated over the three years – 2016, 2017 and 2018. A substantial increase in confidence was observed from both surveys and interviews. The female students mentioned they had an increase in their self-belief in STEM because of the speakers and role models they met over the course of their WiSTEM²D Program.

Students developed knowledge about STEM and STEM careers over the course of the program. It was clear from the pre and post survey responses that there was a great knowledge growth around STEM career positions and what these positions involve. This is a clear recognition of the effect role models and networking can have on female students' progression.

Overall, students acknowledge the importance of the WiSTEM²D Program as they commented several times over the course of the focus groups and telephone interviews how it was "positive" and "made their college experience". Many of the students mentioned they had a very close group of friends from the WiSTEM society and WiSTEM²D program which shows there are great advantages to initiatives similar to these in this study.



Conclusion

This study makes significant and unique contributions to the existing literature on gender initiatives in the STEM disciplines in higher education. This study is the first to focus on the WiSTEM²D Program and identify factors that influence students in STEM as well as the experiences in higher education and impact of the program on these female students. While this study focuses on an Irish sample, the variables under investigation derive from a literature that spans several countries. The constructs examined should be applicable to understanding processes inherent to all single-sex programs. Continued investigation of these factors may elucidate the impact of single-sex programs and inform interventions to increase the retention of women in STEM.

The participants in this study seem to have experienced the gender gap in similar ways to other women in STEM, as reported in the literature, but have developed and enacted sophisticated coping mechanisms that have helped them to achieve success thus far.

This study aimed to shed light on the need for gender interventions in higher education to support female students while providing opportunity for both personal and career knowledge growth. The results presented indicate that there is a great need in Ireland for interventions to aid and support female students as they progress through third level in education, particularly those in STEM Programmes where they are often in male dominated environments and can feel isolated or experience self-doubt.

In 2019 iteration the program engaged with 555 students. Of these students, 400 were post-primary school students, 20 were WiSTEM²D Program alumni (2018/19) while the remainder were undergraduate students.

The WiSTEM²D program encompasses the need to break down barriers and does this successfully as the findings demonstrate in this study. Helping students to learn about the importance of equity in STEM classrooms and careers and providing female students with opportunities to grow both professionally and interpersonally with their confidence and self-belief may led to higher retention of



females in STEM programs in higher education and continue to STEM careers. The study results provide insight into the lived experience of female students and knowledge about the positive impact of the program on these female students. The program shows that the opportunities presented to female students leads to growth in their STEM knowledge around global issues as well as professional and personal development.

The findings of this study suggest the following recommendations:

- Encourage more industry and higher education partnerships similar to the WiSTEM²D
 Program.
- Initiate discussions with policy makers to target primary and post-primary education to implement STEM career lessons.
- Provide mentors and outreach opportunities for undergraduate and graduate students, female and male, to act as role models for those younger students who are interested in STEM.

It is important this gender equity issue is tackled, and strategies are implemented to ensure the economy and workforce develops in a prosperous manner. Johnson and Johnson make a valuable contribution globally in their commitment to gender equity in the STEM workforce. The outreach activities, funding and credibility deriving from the WiSTEM²D program all aid in the encouragement, recruitment and retainment of women in STEM for the future.



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