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Review of the education policy to reduce the gender gap in engineering education in Ireland

Sandra I. Cruz Moreno; Shannon Chance
Technological University Dublin, Ireland
Corresponding Author Email: Shannon.Chance@TUDublin.ie

Abstract

Context

This paper investigates European and national Irish education policy geared toward improving representation of women in engineering at the tertiary level of education in the context of the persistent underrepresentation of women in engineering and other Engineering, Manufacturing and Construction (EMC) fields.

Purpose or Goal

Our concern for general equity prompted the research questions: To what degree do current strategies at the European level aim to reduce the gender gap in engineering courses, and what has been enacted to counteract gender imbalance at the third level in Ireland?

Methods

This paper provides macro-level analysis by mapping out the public policies aimed at enhancing women's access to ECM courses in Ireland. Employing scoping review procedures, the study collects and critiques existing literature, seeking to establish connections and assess alignment between gender-related goals and policy levers.

Outcomes

We located and assessed eleven strategies and/or policies at the European and Irish levels.

Conclusion

Several current Irish policies are geared toward addressing the gender gap. Yet their gender-related effectiveness is hindered in two primary ways. First, the policies lack concrete actions to promote women's participation in STEM fields and only a subset of them acknowledge the gender gap as a significant issue requiring resolution. Second, although many of them identify the demand for engineers in the labour market, they do not explicitly address gender-related aspects of the existing gaps. As a result, the pursuit of this objective may inadvertently exacerbate the gender disparity rather than alleviate it by attracting men but not women.

Keywords— Gender gap; STEM education policy; women in engineering.

I. Introduction

Gender equality in engineering education goes beyond achieving a proportional enrolment of male and female students. To attain a meaningful representation of women in engineering education, women's active involvement in academia/research, and in leadership positions in higher education, is required (David, 2015). Nevertheless, the distribution of women students joining engineering programs at tertiary level serves as a preliminary indicator, providing some initial understanding of women's underrepresentation in this discipline.

Across all member countries of the Organization for Economic Cooperation and Development (OECD), in 2019 men represented 61% of the new entrants in the fields of Engineering, Manufacturing and Construction (EMC) (OECD, 2021). In the European Union, the second most common field of education in 2021 was EMC, which accounted for 15.8 % of all tertiary education students. However, almost three quarters (73.2 %) of all students in EMC were male (EUROSTAT, 2021). A similar distribution by sex is observed in Ireland where, despite the increase of women's enrolment in EMC programs in higher education over the last seven years, in 2021 only 23% of the graduates from these fields were women (Higher Education Authority, 2021).

Our concern for general equity lead to the research questions for this study: *To what degree do current strategies at the European level aim to reduce the gender gap in engineering courses, and what has been enacted to counteract gender imbalance at the third level in Ireland?*

II. Literature Review

A. Relevance of gender in STEM from a policy perspective

Policy makers sense that supporting women in engineering is necessary:

(1) to achieve gender equality (Clavero & Galligan, 2021; Rosa & Clavero, 2022) under the premise that a wider access to a variety of degrees for a diversity of students (in terms of gender, socioeconomic and ethnic background) will have long

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term benefits for both the students and their societal groups (Torotcoi et al., 2020). From this approach, gender equality is an intrinsic right to be addressed.

(2) to tackle the shortage of engineers by attracting people with new profiles into the workforce (Beede et al., 2011; Moloney & Ahern, 2022). In Ireland, a study on skills policy reported that 39% of the vacancies that were 'difficult to fill' in 2021 were associated with science, engineering and technology and were due to shortages of workers (OECD, 2023).

(3) to ensure better results from engineered solutions, by increasing diversity of viewpoints expressed in the design process. Research shows that having a diverse workforce with regard to race, ethnicity and gender (Hersh, 2000; Tannenbaum et al., 2019) leads to increased innovation, enhanced team effectiveness and organisational performance (Drew & Roughneen, 2004).

It appears that engineering, along with engineering education, is at the centre of questions of economic growth, innovative development, and social justice.

B. Enhanced access of women in STEM

Although across Europe a variety of policy frameworks have been developed to support female students undertaking engineering and other STEM (science, technology, engineering and mathematics) courses in higher education, little research has been published regarding the effectiveness of such 'access policies' in achieving increased participation by women in engineering higher education. Even where increases in women's STEM participation have been documented, such increase could be a result of context rather than of specific policy instruments. It is worth noting that a study by the European Commission (2008) reported higher proportion of women in STEM sectors but indicated these sectors were also characterized by lower budgets, reduced salaries or experiencing a male 'brain drain'. This implies that women may be filling positions that are not sufficiently attractive to men, perpetuating that certain fields of science are perceived as more masculine than others, and the higher paying, more illustrious STEM fields are still male dominated. More recent research is consistent with those findings and further indicates that the gender disparity in STEM is worsened by a tendency for female STEM graduates to exit the field during the early stages of their careers (Delaney & Devereux, 2022).

C. Gender and education in Ireland

The low proportions of females pursuing STEM careers in Ireland may result from gender stereotypes as well as the historical education systems and structural constrains that still prevail in Ireland, such as single-sex schools where subjects originally provided where different for boys and girls (Kelly et al., 2019; Kiernan et al., 2023). A gender-related disparity in educational offerings persists today, where the Leaving Certificate constitutes the final exam of the Irish secondary school system and is used as a university matriculation examination (on par with the SAT in the United States, for example) (DFHERIS & HEA, 2022, p. 17). Unfortunately, students in all-girls schools frequently lack access to as wide a range of STEM-related coursework as students in all-boys schools are offered in preparation for the Leaving Cert (often including technical graphics, physics, chemistry, and woodworking), and this represents a major barrier in exposing female students to Engineering and Technology subjects and helping them prepare to enter engineering and some other technical fields at third level (Kiernan et al., 2023).

III. METHODS

This paper reports macro-level analyses: following a scoping of the literature on gender dimensions of STEM higher education, the lead author mapped currently existing public policies aimed at enhancing women's access to ECM courses in Ireland. Employing standard scoping review procedures (Arksey & O'Malley, 2005), the authors sought to establish connections and ensure coherence between the research problem statement (concerning women in engineering within the tertiary education sector) and policy instruments in Ireland (that were implemented to address this issue).

For the identification and characterization of policy related to the research question, we looked for European or Irish National policy frameworks in a variety of formats. For the purpose of this paper, we agreed to include policies plans, strategies, and policies reviews established to increase women recruitment, persistence and/or graduation rates in Engineering or STEM fields or to reduce gender gap in Engineering or STEM higher education programs. We selected the websites of relevant government institutions, European and international organisations and navigated their homepages to access to their documents. As the search strategy aimed to map the present policy context, any policy document prior to 2010 was excluded.

The authors located and assessed eleven strategies and/or policies at the European and Irish levels. Documents identified and analysed at the EU level included (1) the Gender Equality Strategy 2020-2025, the European Skills Agenda, and (2) the European Strategy for Universities. National policies considered in this study include (3) Ireland's National Skills Strategy 2025, (4) the National Strategy for Women and Girls 2017-2020, (5) the National STEM Education Policy Statement 2017-20126 and (6) its Implementation Plan, (7) the National Strategy for Higher Education 2030, (8) National Review of Gender Equality in Irish Higher Education Institutions, (9) the Gender Action Plan 2018-2020, (10) the National Development Plan 2021-2030, and (11) the National Access Plan for Higher Education 2022-2028.

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IV. Findings

A. Commitments to gender equality in STEM at HE

1) Policy instruments in the EU

Despite the existence of an extensive policy framework within the European Union (EU), there remains a persistent gender imbalance between women and men across various sectors, occupations, and fields of study within STEM disciplines. Among the European initiatives to tackle this issue, the Gender Equality Strategy 2020-2025 (European Commission, 2020b) acknowledges, firstly, that women remain underrepresented in higher paid professions, and secondly, that the choice of educational and professional paths is constrained by stereotypical gender norms. The Gender Equality Strategy adopts a dual approach by promoting targeted measures, such as an EU-Wide communication campaign combatting gender stereotypes, and strengthened 'gender mainstreaming', a term that means incorporating a gender perspective consistently throughout every phase of policy formulation (United Nations Economic and Social Council, 1997) .

The European Skills Agenda, another current policy instrument, emphasizes the urgent need to increase the number of graduates from STEM tertiary education to foster innovation across Europe. Regarding the gender disparity, however, the initiative only suggests raising attractiveness of STEM studies and careers to involve girls and women "by encouraging a cross-disciplinary and innovative teaching-and-learning approach in schools, vocational education and training and higher education" (European Commission, 2020a, p. 13). Gender is not a central focus in this Agenda; it appears as an aside.

Finally, the European Strategy for Universities, introduced in 2022, prioritises increasing the gender balance of both students and academic staff as well as the overall reservoir of skills and competences in STEM within the region (European Commission, 2022). With this initiative, the European Commission committed to developing a European framework for diversity and inclusion and providing in the future a roadmap to address the underrepresentation of women in STEM fields through, which would include a manifesto on gender-inclusive STE(A)M education (whereby art is included). The current strategy also encourages universities across the region to implement institutional change such as developing and adopting gender equality plans.

Although these strategies function as guidelines for member states to articulate their national policies, serving as non-binding tools to address gender disparities in higher education within STEM fields, they could result in superficial efforts that fail to address the underlying issues because their compliance depends on the willingness of stakeholders to implement the suggested policies.

2) Ireland's national strategies

In general, the higher education policy landscape in Ireland aligns with the European framework. Ireland's National Skills Strategy 2025 states that careers in STEM need to be promoted, particularly to women. Main measures comprise raising public awareness of STEM, increasing the level of uptake of STEM at second level and supporting retention of students in STEM disciplines (Department of Education and Skills, 2016).

Regarding the gender equality strategy, it has not been updated in Ireland. The National Strategy for Women and Girls 2017-2020 is the last initiative published and it was extended up to 2021. Key outputs considered to reduce gender imbalance in STEM were: (1) a National STEM Education Policy Statement 2017-2026; (2) a literature review on the critical barriers to girls' participation in STEM and on the effective interventions for addressing gender balance in primary and post-primary education settings; and (3) guidelines for promotion of STEM careers to young people and parents. The first two products have been published. They consider a variety of stakeholders and long-term partnerships among students, families, schools, industry and society to help ensure the outcomes put forth within this policy framework, but they emphasize early childhood and early adolescence (Department of Education, 2017a, 2020, 2022) with little direct implication for higher education. Perhaps more importantly, this policy instrument recognizes a need to seek structural changes (instead of focusing solely on changing girls' attitudes and beliefs). Recently, a Gender Balance in STEM Education Advisory Group was created to support the enaction of this plan (Department of Education, 2022).

Regarding policy for the tertiary level, the National Strategy for Higher Education 2030 (Department of Education and Skills, 2011), issued in 2011, expressed concern over the low students demand on STEM courses in higher education "when the importance of these disciplines for enterprise strategy is growing" (Department of Education and Skills, 2011, p. 36). The gender issue was not acknowledged in this document and inequality was understood as a condition of student's socioeconomic background only. In consequence, no action was proffered to address the gender gap in higher education.

The National Review of Gender Equality in Irish Higher Education Institutions served as turning point for the advancement of policy interventions to tackle gender inequality (Dunne et al., 2022). In that document, the Expert Group suggested that every Higher Education Institution (HEI) should develop a Gender Action Plan, and strive to earn an Athena SWAN award, which eventually would become a requirement for research funding. As a result, a Gender Action Plan 2018-2020 was established to promote gender equality in HEI, addressing staff issues mainly, such as recruitment procedures, leadership, governance and management, and gender awareness (Higher Education Authority, 2018). Although this Plan is an important step in tackling gender inequality, it does not specifically target STEM fields or involve direct actions to increase the number of women students in those disciplines.

B. Reshaping higher education landscape for STEM

At the current time, the Irish government is transforming its

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landscape of higher education by establishing a network of Technological Universities (TUs). These TUs are being formed by merging and expanding upon existing Institutes of Technology. The TUs are expected to align their programs with the specific needs of their respective region's sectors (OECD, 2022).

According to the National Development Plan 2021-2030 (Goverment of Ireland, 2021), the development of technological universities involves expanding their infrastructure through the Higher Education PPP programme to address increasing enrolments with a specific emphasis on areas of key skills needs, particularly in the STEM fields. Regarding the gender issues in HE: the Plan does not mention gender specifically for the sector, rather it acknowledges that gender equality is a national goal in alignment to the United Nations Sustainable Development Goals (SDG) and that each Minister is given the specific responsibility in implementing the SDG targets related to their sectors and ministerial functions.

As mentioned above, the Department of Education published the National STEM Education Policy Statement 2017-2026, accompanied with the STEM Education Implementation Plan 2017-2019 (Department of Education, 2017a, 2017b). Both instruments mainly focus on primary and secondary levels of education, although that influence is seen to extend to the areas of further and higher education. From the latest document, two annual indicators for success stand out. The documents ambitiously propose an (1) "Increased uptake of Leaving Certificate Chemistry, Physics, Technology and Engineering by 20%" and (2) "Increased uptake by females of STEM subjects by 40%" (Department of Education, 2017b, p. 4). However, a recent report of the progress in the plan implementation mentions that for the first indicator, "the increase is small", while for the second indicator, "the gender disparity in taking STEM subjects for examination is also clear" (Department of Education, 2023, p. 21). This suggests that the specific actions undertaken may require a longer period to yield the desired outcomes, additional steps need to be taken to achieve stated goals, or that the effectiveness indicators of these initiatives may need to be revised.

Regarding policies for higher education, the new National Access Plan for Higher Education 2022-2028 identifies three groups of students who are thus now formally understood as being underrepresented in higher education, and therefore prioritized. These three groups are persons who: (1) are socioeconomically disadvantaged; (2) are members of Irish Traveller and Roma communities, or (3) have disabilities including intellectual disabilities (DFHERIS & HEA, 2022, p. 22). These groups are targeted to measure the performance of the Plan, but the Plan itself does not specifically address specifically engineering or STEM education.

C. Gender policies constrained to HEI initiatives

Most education policies at both regional and national levels advocate a multidisciplinary or holistic approach within STEM curricula, aiming to raise the appeal of these disciplines and to reduce traditional stereotype barriers that affect women's engagement. However, there remains a lack of practical support or instruments for implementing these policies. Often universities are encouraged to implement institutional changes by fostering inclusive learning environments, setting access targets, or developing gender equality plans (European Commission, 2022; European Commission. Directorate General for Research and Innovation., 2023).

Universities in Ireland are mandated to establish equality policies, which encompass gender balance, as a key component. These regulations are framed by the Universities Act 1997 and the Technological Universities Act of 2018.

One of the HEI's initiatives to encourage girls into science, engineering and technology is focused on boosting mentorship through a program named 'Equality in Science and Technology by Engaged Educational Mentoring' (or ESTeEM) which aims to expand women students' depth of understanding regarding their career paths while providing a platform to network with fellow students (Devereux et al., 2022).

D. Gender gap in engineering education in Ireland

Claiming that Gender Equality Plans or the Athena SWAN awards have effectively achieved results in HEIs poses challenges, as changes in women's participation in STEM education are also result of broader social, political and economic factors that extend beyond specific policies (Drew, 2022). Nevertheless, according to HEA data (2021), there has been a gradual increase in the enrolment of women in EMC programs in Irish universities, rising from 16.6% in the academic year 2016/2017 to 21.2% in 2021/2022. It is worth noting that Muster Technological University (MTU) exhibited the most substantial growth in the proportion of female new entrants in EMC during this period. MTU's proportion of entrants into EMC who were women was 23.2% up from its previous level of 14.9%. In contrast, Technological University Dublin (TU Dublin) maintained the percentage of female new entrants at around 15%. University College Cork (UCC) and University College Dublin (UCD) have a more consistently increasing trend in the inclusion of women in EMC, with proportions of 40% and 36.8% in 2021/2022, respectively (see Table I). Complex factors may be at play here; for instance, women choosing to study in Dublin have may choices of multiple institutions for entering engineering, and TU Dublin is not the most prestigious of them (thus, highly prepared women are likely to choose UCD over TU Dublin). The emergence of TUs throughout the more rural areas of Ireland, e.g., Munster, may attract women who want to study engineering and live at, or closer to, home.

Another factor influencing student decisions could be that TU Dublin is larger in size than MTU and UCC. The size of the HEI appears to play a role in the representation of women in EMC studies: as the total number of students in the field increases, the proportion of women students tends to decrease.

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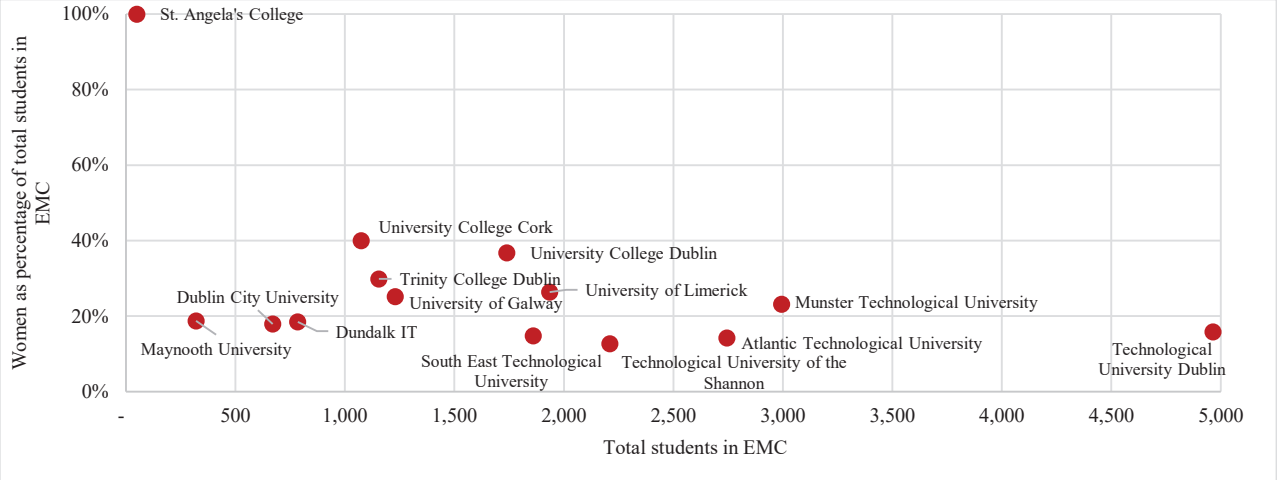
Table I. Women as percentage of total new entrants into Engineering, Manufacturing and Construction, by year

Institute/Academic Year	2016/2017		2017/2018		2018/2019		2019/2020		2020/2021		2021/2022	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Technological University Dublin	15.5%	4,950	15.4%	5,000	15.5%	4,905	16.1%	4,935	16.9%	4,945	15.8%	4,965
Munster Technological University	14.9%	2,650	16.1%	2,695	16.3%	2,795	18.7%	3,135	19.5%	3,055	23.2%	2,995
Atlantic Technological University	8.6%	2,160	10.3%	2,330	11.0%	2,315	12.2%	2,345	12.7%	2,565	14.2%	2,745
Technological University of the Shannon	8.5%	1,760	9.0%	1,830	10.5%	1,945	11.3%	2,125	12.0%	2,250	12.7%	2,210
University of Limerick	18.1%	1,710	22.7%	1,695	22.3%	1,705	23.3%	1,805	26.1%	1,860	26.4%	1,935
South East Technological University	11.8%	1,690	15.0%	1,605	16.2%	1,795	15.6%	1,830	14.8%	1,830	14.8%	1,860
University College Dublin	29.6%	1,505	32.7%	1,530	33.1%	1,540	36.1%	1,605	36.4%	1,595	36.8%	1,740
University of Galway	21.7%	1,130	24.3%	1,175	22.1%	1,130	24.2%	1,115	24.8%	1,190	25.2%	1,230
Trinity College Dublin	25.1%	875	26.9%	910	27.2%	975	27.2%	1,010	27.6%	1,070	29.9%	1,155
University College Cork	34.1%	865	34.6%	910	36.8%	925	38.8%	980	41.4%	990	40.0%	1,075
Dundalk IT	9.2%	595	10.8%	600	10.7%	560	12.8%	625	18.0%	750	18.5%	785
Dublin City University	16.5%	665	18.4%	570	20.8%	650	20.7%	605	20.4%	735	17.9%	670
Maynooth University	20.0%	275	19.4%	310	19.1%	340	16.9%	325	17.7%	310	18.8%	320
St. Angela's College	100.0%	40	90.0%	50	91.7%	60	100.0%	55	100.0%	65	100.0%	50
Grand Total	**16.6%**	**20,870**	**18.2%**	**21,210**	**18.6%**	**21,640**	**19.7%**	**22,490**	**20.5%**	**23,200**	**21.2%**	**23,740**

Notes:
(1) Women as percentage of total new entrants
(2) Total new entrants into Engineering Manufacturing and Construction (EMC)
Higher Education Institutions are ranked in descending order of female new entrants into Engineering, Manufacturing and Construction in 2021/2022
Data source: Higher Education Authority. (2021). *HEA Statistics.* https://hea.ie/statistics/data-for-download-and-visualisations/key-facts-figures/

Figure 1. Percentage of women students vs total undergraduate students in Engineering, Manufacturing and Construction, 2021/2022



Data source: Higher Education Authority. (2021). *HEA Statistics.* https://hea.ie/statistics/data-for-download-and-visualisations/key-facts-figures/

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Such is the case of the Technological University Dublin, the Atlantic Technological University (ATU), and the Technological University of Shannon (TUS), which each had more than 2000 newcomers in EMC in academic year 2021/2022, but women comprised less than 20%. In contrast, universities with a smaller number of students in EMC, such as UCD and UCC, have a more balance representation of women students (see Figure 1).

V. Conclusions

Our study focused on mapping the policy framework to promote the reduction of the gender gap in engineering education in Ireland at the tertiary level. As engineering is usually grouped with other disciplines, we conducted the policy analysis considering initiatives for STEM fields of education, which include engineering and other EMC fields.

European and Irish policy frameworks that promote STEM disciplines in higher education often advocate for gender equality not primarily for social justice reasons, but because of its potential to enhance economic competitiveness in the region and in the country (i.e., neoliberal economic reasons).

In Ireland, some key national strategies for higher education do not explicitly acknowledge the gender gap as a priority. Furthermore, despite the Athena SWAN charter becoming a key pillar of Ireland's strategy for gender equality in higher education (Drew, 2022; Dunne et al., 2022), universities are simply encouraged to enact the institutional changes, but the national strategies tend to prioritize primary and secondary levels of education. Accurately assessing the impact of various institutional gender policies to enhance women's participation in STEM education is problematic due to the measurement of explanatory factors (such as students' personal and family characteristics, educational systems and programmes, labour market, etc.), the context in which the institutions operate, and the availability of data. However, some Irish universities have successfully increased the share of women in EMC in the last six academic years. Further research is needed to explore their institutional policies, then identify and systematize good practices and lessons learnt – to serve as guidelines for others to accelerate women's access in engineering at higher education level in Ireland.

Ultimately, the gender gap in engineering goes beyond engineering higher education classrooms; the problematic gap extends into education leadership and engineering practice as well. This involves more research (1) on institutional initiatives to increase participation of women in decision-making of the tertiary level of engineering education; and (2) on the persistence of female engineering graduates to work in the industry sector.

References

Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology*, *8*(1), 19–32. https://doi.org/10.1080/1364557032000119616

Beede, D. N., Julian, T. A., Langdon, D., McKittrick, G., Khan, B., & Doms, M. E. (2011). Women in STEM: A Gender Gap to Innovation. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1964782

Clavero, S., & Galligan, Y. (2021). Delivering gender justice in academia through gender equality plans? Normative and practical challenges. *Gender, Work & Organization*, *28*(3), 1115–1132. https://doi.org/10.1111/gwao.12658

David, M. (2015). Women and Gender Equality in Higher Education? *Education Sciences*, *5*(1), 10–25. https://doi.org/10.3390/educsci5010010

Delaney, J. M., & Devereux, P. J. (2022). Gender Differences in STEM Persistence after Graduation. *Economica*, *89*(356), 862–883. https://doi.org/10.1111/ecca.12437

Department of Education. (2017a). *STEM education Policy statement 2017-2026*.

Department of Education. (2017b). *STEM implementation plan 2017-2019*.

Department of Education. (2020). *Review of Literature to Identify a Set of Effective Interventions for Addressing Gender Balance in STEM in Early Years, Primary and Post-Primary Education Settings*.

Department of Education. (2022). *Recommendations on Gender Balance in STEM Education*.

Department of Education. (2023). *STEM Education Implementation Plan. Phase 1 Enhancing Progress Report*. https://www.gov.ie/en/publication/055810-education-statistics/#latest-statistical-reports

Department of Education and Skills. (2011). *National Strategy for Higher Education 2030*. https://hea.ie/assets/uploads/2017/06/National-Strategy-for-Higher-Education-2030.pdf

Department of Education and Skills. (2016). *Ireland's National Skills Strategy 2025*. https://assets.gov.ie/137349/3b66360a-64f4-45db-881f-eb326950051e.pdf

Devereux, M., Heffernan, E., McKeever, S., Dunne, J., Shoemaker, L., & O'Leary, C. (2022). Reflections on Selected Gender Equality in STEM Initiatives in an Irish University. In F. J. García-Peñalvo, A. García-Holgado, A. Dominguez, & J. Pascual (Eds.), *Women in STEM in Higher Education* (pp. 69–83). Springer Nature Singapore. https://doi.org/10.1007/978-981-19-1552-9_4

DFHERIS, & HEA. (2022). *National Access Plan. A Strategic Action Plan for Equity of Access, Participation and Success in Higher Education 2022–2028*. Department of Further and Higher Education, Research, Innovation and Science. https://assets.gov.ie/233024/9771358b-667a-4172-867f-371d7e314f46.pdf

Drew, E. (2022). Navigating unChartered waters: Anchoring Athena SWAN into Irish HEIs. *Journal of Gender Studies*, *31*(1), 23–35. https://doi.org/10.1080/09589236.2021.1923463

Drew, E., & Roughneen, C. (2004). *Danger! Men at work: A study of the under-representation of women in third level engineering*. Department of Statistics, Trinity College Dublin.

Dunne, J., O'Reilly, A., O'Donoghue, A., & Kinahan, M. (2022). A Review of Irish National Strategy for Gender Equality in Higher Education 2010–2021. In F. J. García-Peñalvo, A. García-Holgado, A. Dominguez, & J. Pascual (Eds.), *Women in STEM in Higher Education* (pp. 21–49). Springer Nature Singapore. https://doi.org/10.1007/978-981-19-1552-9_2

European Commission. (2008). *Benchmarking Policy Measures for Gender Equality in Science*. Publications Office. https://data.europa.eu/doi/10.2777/55449

European Commission. (2020a). *European Skills Agenda*. https://ec.europa.eu/social/BlobServlet?docId=22832&langId=en

European Commission. (2020b). *Gender equality strategy 2020-2025*.

European Commission. (2022). *Communication on a European Strategy for Universities*. https://education.ec.europa.eu/document/commission-communication-on-a-european-strategy-for-universities

European Commission. Directorate General for Research and Innovation. (2023). *EU support to strengthen gender equality in STEM.* Publications Office. https://data.europa.eu/doi/10.2777/719121

EUROSTAT. (2021). *Tertiary education statistics*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Tertiary_education_statistics

Goverment of Ireland. (2021). *National Development Plan 2021-2030*. https://www.gov.ie/en/publication/774e2-national-development-plan-2021-2030/

Hersh, M. (2000). The changing position of women in engineering worldwide. *IEEE Transactions on Engineering Management*, *47*(3), 345–359. https://doi.org/10.1109/17.865903

Higher Education Authority. (2018). *Gender Action Plan 2018-2020. Accelerating Gender Equality in Irish Higher Education Institutions*. HEA. https://hea.ie/assets/uploads/2018/11/Gender-Equality-Taskforce-Action-Plan-2018-2020.pdf

Higher Education Authority. (2021). *HEA Statistics*. Higher Education Authority. https://hea.ie/statistics/data-for-download-and-visualisations/key-facts-figures/

Kelly, R., McGarr, O., Lehane, L., & Erduran, S. (2019). STEM and gender at university: Focusing on Irish undergraduate female students' perceptions. *Journal of Applied Research in Higher Education*, *11*(4), 770–787. https://doi.org/10.1108/JARHE-07-2018-0127

Kiernan, L., Walsh, M., & White, E. (2023). Gender in Technology, Engineering and Design: Factors which influence low STEM subject uptake among females at third level. *International Journal of Technology and Design Education*, *33*(2), 497–520. https://doi.org/10.1007/s10798-022-09738-1

Moloney, G., & Ahern, A. (2022). Exploring the lower rates of entry into undergraduate engineering among female students through the application of the reasoned action approach. *European Journal of Engineering Education*, *47*(3), 483–500. https://doi.org/10.1080/03043797.2021.2025342

OECD. (2021). *Education at a Glance 2021: OECD Indicators*. OECD. https://doi.org/10.1787/b35a14e5-en

OECD. (2022). *A review of technological university academic career paths, contracts and organisation in Ireland* (OECD Education Policy Perspectives 64; OECD Education Policy Perspectives, Vol. 64). https://doi.org/10.1787/2b7ee217-en

OECD. (2023). *OECD Skills Strategy Ireland: Assessment and Recommendations*. OECD. https://doi.org/10.1787/d7b8b40b-en

Rosa, R., & Clavero, S. (2022). Gender equality in higher education and research. *Journal of Gender Studies*, *31*(1), 1–7. https://doi.org/10.1080/09589236.2022.2007446

Tannenbaum, C., Ellis, R. P., Eyssel, F., Zou, J., & Schiebinger, L. (2019). Sex and gender analysis improves science and engineering. *Nature*, *575*(7781), 137–146. https://doi.org/10.1038/s41586-019-1657-6

Torotcoi, S., Gologan, D., & Kurysheva, A. (2020). What Works for Underrepresented Groups? Identifying Effective Measures for Enhancing Access to Higher Education in Europe. In A. Curaj, L. Deca, & R. Pricopie (Eds.), *European Higher Education Area: Challenges for a New Decade* (pp. 177–196). Springer International Publishing. https://doi.org/10.1007/978-3-030-56316-5_13

United Nations Economic and Social Council. (1997). *Definition of Gender Mainstreaming*. International Labour Organization. https://www.ilo.org/public/english/bureau/gender/newsite2002/about/defin.htm