Accessibility of Work-Integrated Learning in Engineering, IT, and Computer Science for Students with Disabilities

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***Abstract*—Universities put significant resources into supporting students with disabilities on campus. However, this support from universities can be limited off-campus. With universities and governments strongly advocating for the inclusion of Work-Integrated Learning (WIL) placements in all programs, particularly in technical areas such as engineering, IT, and computer science, students with disabilities are increasingly expected to leave campus to attain their degree. In these arrangements the expectations are unclear and greatly vary, with most employers taking full responsibility for students on a day-to-day basis. Although engineering, IT, and computer science industries have become more open to and inclusive of diverse workforces in recent years, student WIL experiences can vary dramatically between employers and this can leave students vulnerable to the culture and accessibility of the workplace they undertake WIL activities in. Additionally, many programs require students to find their own placements, which is challenging given the reportedly low employment opportunities available to people with disabilities. In this paper, we recommend that students with disabilities need to be considered more than they currently are in the design of WIL placement programs and that programs could provide greater support to these students to ensure the positive outcomes associated with WIL are equitable for all students. It is also suggested that work needs to be done to bring students with disabilities into the conversation through co-design and participatory research in order to understand what their experiences are like in WIL and how universities and employers can better support them to reach their goals.**

***Keywords*—Engineering Education, computer science education, accessibility, disability, inclusion, work-integrated learning**

I. Introduction

My research into the experience of students with disabilities in education and the workforce was originally motivated from my own personal lived experiences in education and the workplace as a person with a disability myself. However, knowing and working with a diverse range of people with disabilities I hear all too often that my experience is not unique. Having seen through research the widespread challenge not only in Australia but more broadly, my work is now balanced with a drive to see genuine inclusion in our teaching practices and in industry.

From government statistics and the research literature we know that people with disabilities are under represented in the workforce and not through lack of desire to work, with employment percentages depending on the country of between two-thirds or even as low as one-third the percentage for the general public [1], [2], [3]. We also know that discrimination happens in hiring, retention, and a lack of reasonable adjustments in the workplace [4], [5] (Further details on disability in the workplace are provided in Section II).

Similarly, we know that people with disabilities are underrepresented in further education, in Australia for example the percentage of people with a disability in higher education is less than half that of the percentage of Australians with a disability [6], [7]. As with the workplace we also see that people with disabilities experience other barriers even once in higher education such as a lack of support to access inaccessible systems and procedures within the institutions [8] (Further details on disability in higher education are provided in Section III).

Work-Integrated Learning (WIL), is the intersection between work and study and sees students placed in an authentic work context as part of their studies. WIL is increasingly included in higher education programs to improve students' career related skills, professional networks and ultimately graduate career outcomes [9], [10], [11], [12]. WIL is an area of increasing interest to governments, higher education institutions, and researchers (Further details on WIL are provided in Section IV).

Given the information above it is clear that there is a shortfall in supportive jobs for people with disabilities, that there is a shortfall in supportive places at university for people with disabilities, and that many degrees, particularly engineering, IT, and computer science now require students to find an industry placement. Therefore, what is the experience of students with disabilities in this space? How are students supported in finding placements, how are students supported

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while on placement and how do these students feel about their placements? What is the experience of students with disabilities in finding and working in WIL internship placements?

This paper investigates the intersection of employment and higher education in WIL for students with disabilities in order to develop a greater understanding of the unique benefits and challenges of WIL for these students and what part it could play in improving employment outcomes for them (and in fact likely all students as we know affirmative actions usually benefit all involved). Through this investigation we hope to inspire further work in this area.

II. Disability in the Workplace

It is well known that people with disabilities face discrimination in their everyday lives. In particular they face lower labour market participation rates and lower incomes. In Australia 48% of working-age people with a disability are employed compared with 80% employment for people without a disability [1]. Not only are there lower overall employment rates for people with a disability, even for those that are employed there are lower rates of full-time employment, especially for women with disabilities likely due to intersectional barriers [1].

These statistics are not unique to Australia: internationally, Canada's employment rate for persons with a disability is 47.3% compared to 73.6% of persons without a disability and it is estimated as many as 411,600 Canadians with disabilities are unemployed but have the potential to work [2]. Naturally this impacts the incomes of Canadians with disabilities with the Canadian Survey on Disability finding Canadians with disabilities have significantly lower median incomes compared to the general public [13].

Likewise in the United States of America the employment rate for working-age people with a disability is even lower at 29.1% compared with 70% for people without a disability [3]. It should be noted that these numbers are lower due to impacts from COVID-19, however, in 2019 prior to COVID-19 the rates were still only 30.9% and 74.6% respectively [3].

These figures clearly show the employment disparity between those with and those without a disability across Australia, Canada, the US, and likely other nations as well. Governments and NGOs have both identified this as a priority issue but clearly there is more to do in improving the labour market outcomes for people with disabilities.

Beyond the direct impact to people with disabilities there also exists a missed opportunity for employers. Lunn and Ross [14] found that computing employers often focus on a limited set of skills when conducting a hiring process, often unaware or ignoring other benefits that hiring people of colour and a diverse range of gender representation can bring to the workplace. There are likely similar benefits from hiring people with disabilities that employers are unaware of and may disregard a qualified candidate with a disability in favour of another candidate with a less visibly diverse background. One area that many organisations find difficult is ensuring accessibility of their products, increasingly this is a legal requirement not just a moral one and so companies are required to do more in this area. A business opportunity exists in this area where having a diverse staff that includes people with disabilities would benefit the company. While not all people with disabilities are experts on general accessibility their lived experience can help identify gaps in accessibility for company products.

However, even once employed, people with disabilities suffer further discrimination in the workplace including a lack of support. The most common forms of discrimination people with disabilities face is in terminations and in refusal of reasonable adjustments, but it also includes discrimination in areas such as interpersonal behaviours and institutional neglect [4], [5]. Finding a supportive workplace as a person with a disability is still a barrier for people with disabilities despite the progress that has been made in this area over recent years.

III. Disability in Higher Education

Much has been done to increase interest in engineering, IT, and computer science in diverse students such as women and people of colour, as well as more recently some intersectional work such as work with women of colour. It is not the intent of this paper to diminish the great work being done in broadening participation in the commonly targeted demographics, particularly the intersectional work now being undertaken is an important area of work for the field. However, while some programs exist to encourage people with disabilities—largely programs for "all"—this is a less targeted demographic and needs greater consideration.

Upon completing high school there is significantly less that can be done to increase interest in and encourage diverse students to join an engineering, IT, or computer science degree and instead we move to the idea of support and retention. As most research into support and retention of diverse students has focused on women, people of colour, and international students, there is a clear opportunity for research into the support and retention of students with disabilities. And although there are some examples of intersectional research that includes consideration of people with disabilities such as research for people of colour with a disability (e.g. [15]), these are few in number.

Disability is recognised as an area of importance for broadening participation in higher education as this group remains largely underrepresented: only 6% of Australian college students identify as having a disability to their institution of higher education compared with the national percentages of people with disabilities at 18.3% [6], [7]. However, many researchers either focus on other areas of participation, are hesitant to collect the data needed about disability, or struggle to design research for disability [16]. This exacerbates the issue of disability being one of the lesser researched areas of participation in engineering, IT, and computer science. We know far less about experience, participation, barriers, and other areas for disabled higher education students in engineering, IT, and computer science than we do other key demographics such as women or people of colour.

Of particular concern in engineering, IT, and computer science, students with disabilities are often not supported effectively in these fields [7] [17] including a lack of support in navigating university structures designed without students with disabilities in mind [8]. While more recent research would be beneficial, this lack of support has even been shown to extend to active discouragement for students with disabilities from joining engineering, IT, and computer science in the first place [18]. Research has investigated the underlying reasons for this lack of support with some indications that a lack of attention from researchers to effectively address the needs of students with disabilities in engineering, IT, and computer science is a key gap [8], [19].

One area where higher education and educators have the ability to increase interest and participation as well as retention is that of the transition from high school to tertiary education. This is of increasing interest to researchers with recent studies showing that areas such as alignment of curriculum between high school and higher education and clarity of course sequences are key areas for improvement to help diverse students transition to and stay in engineering, IT, and computer science higher education [20], [21].

As an institution it is important to realise that while there are common barriers to entry and common roadblocks leading to higher levels of drop out from diverse students such as students with disabilities, these are also unique to the institutional context. Institutional and educational reform incorporates the beliefs of the participants, and is contextualised to the institution [22]. Therefore the first step in addressing diversity and supporting diverse students—whether that is women, people of colour, students with disabilities, or any diverse demographic—should be a thorough review of the institutional context. Brodley et al. [23] reports on the Center for Inclusive Computing's institutional reviews as part of their grant program and shows that while there are common problems, and perhaps some common mechanisms for addressing these, there really needs to be a custom approach for each institution to truly improve diversity sustainably.

A key area for diversity in engineering, IT, and computer science is increasing the visibility of the benefits and the struggles of diverse cohorts among all people in engineering, IT, and computer science. By increasing the awareness of benefits and struggles we can motivate the majority to consider how their actions impact diverse people as well as how not supporting diverse people is to the detriment of all involved. [24] is an example of how this work can be carried out in higher education, with deliberate planning of the facilitator, students can be encouraged to consider diversity and create a more welcoming environment for diversity.

There is much that can be done in engineering, IT, and computer science to dismantle old paradigms and develop new ways of working that support all students, with some calling for a complete re-imagining of how we teach [25].

IV. Disability and Work-Integrated Learning

Work-Integrated Learning—also referred to as experiential learning, cooperative education and work-based learning—is the intersection of employment and learning. While this paper largely looks at WIL from an internship and work placement perspective, in practice WIL can encompass all learning activities that incorporate authentic workplace environments and/or industry participation. WIL is an activity where students are linked with industry in authentic ways to develop skills as a professional in-context [26]. WIL has been shown to build graduates' career-related skills and their professional networks [9], [10] and is considered pivotal to preparing graduates for future career success [11], [12]. Ultimately, WIL is widely attributed to improving graduate employment outcomes [27].

However, there is a challenge of concern with WIL, particularly in regard to WIL placements and internships: given that WIL is the intersection between employment and learning and that people with disabilities suffer discrimination, lack of support, and lower outcomes in both employment and learning, does WIL, could WIL, help these issues? Or could the intersection between employment and learning in fact be a compounding issue for people with a disability? Are people with disabilities considered in the development and execution of WIL programs themselves or is it assumed that the purported benefits of WIL will be felt by all students without intervention?

WIL placements have the potential to be transformational experiences for students but there is increasing evidence that there is a divide between those who can access quality placements and those that cannot, which sees many of the diverse groups such as people with disabilities that could benefit significantly locked out [28], [29]. There are a number of factors influencing a lack of WIL opportunities for diverse communities including having less social capital [28], [29] and a limited number of places overall [30].

There is evidence that the structure of WIL programs also plays a large part. Where WIL is elective—which is common outside engineering or health—it is not uncommon for institutions to stipulate academic criteria for students to join WIL programs, where only the best performing students (academically speaking) can participate. This not only exacerbates inequity, as people from diverse backgrounds may have been disadvantaged in their education and may not meet these criteria [31], but also serves to give the best opportunities to those who need them the least given they are already high performers and often have superior social capital and networks compared to diverse students [32].

As an aside, there is research suggesting academic success and job performance in new graduates do not always correlate, with employers increasingly putting less emphasis on grades and more on cultural fit among other metrics [33]. Therefore, the idea of an academic criterion to join a WIL program may hold little value and is potentially inequitable [34].

This paper poses discussion points at an opportune time, as there has been an increasing emphasis on making WIL

more inclusive, with research on the experience of various demographics including international students, students with disabilities, and lower-socioeconomic background students (e.g. [35], [36], [37]). However, there is still more to be done in both research and implementation.

Online internships [38] have been a common mechanism for dealing with COVID-19 and their flexibility shows promise for people with disabilities but they are largely seen as a lesser experience to face-to-face placements. These appear to be a potential option going forward but should not be seen as the default or only option for people with disabilities.

V. Recommendations

- Institutions should be actively encouraged to consider disability at all levels and bring people with disabilities into these conversations through co-design and participatory research. Academics in the inclusion space should push for and drive these conversations.
- Reiterating past work from RESPECT, inclusion research is a shared learning experience and academics should not be afraid to jump into disability research and this research should be encouraged and supported.
- The emerging field of Work-Integrated Learning should see further research in its impacts on students with disabilities both positive and negative.

VI. Conclusion

Work-Integrated Learning (WIL), the intersection of work and study, is increasingly being seen by governments and higher education institutions as a key strategy to attract students, improve graduate outcomes, and students' career success. We know students with disabilities face significant barriers to entering and staying in both education and employment yet there has been limited research on improving their outcomes in these areas. Therefore, there are still significant questions left to answer in regard to the benefits and barriers to students with disabilities in this space. Does the intersection of work and study increase barriers for students with disabilities? Do these students even have access to WIL programs or is program design leaving them locked out? And where students with disabilities can access WIL, are they receiving the same benefits as other students?

Students with disabilities need to be considered more in the design of WIL placement programs and the accompanying support structures. Programs should provide greater support to these students to ensure the positive outcomes associated with WIL are equitable for all students. More work needs to be done to bring students with disabilities into the conversation through co-design and participatory research in order to understand what their experiences are in WIL and how universities and employers can better support them to reach their goals. Future research in broadening participation needs to focus on this cohort in engineering, IT and computing education research and in particular look deeply into the benefits and barriers to these students in accessing WIL.

References

[1] Australian Institute of Health and Welfare, "People with disability in Australia 2020," Australian Institute of Health and Welfare, Australia, Government Report, 2020.

[2] Statistics Canada, "Labour force status for adults with and without disabilities," 2017. https://www150.statcan.gc.ca/t1/tbl1/e/tv.action?pid=1310034701 (accessed Feb. 24, 2022).

[3] Office of Disability Employment Policy, "Disability Employment Statistics," U.S. Department of Labor, 2021. https://www.dol.gov/agencies/odep/research-evaluation/statistics (accessed Jan. 27, 2022).

[4] P. M. Robert and S. L. Harlan, "Mechanisms of Disability Discrimination in Large Bureaucratic Organizations: Ascriptive Inequalities in the Workplace," The Sociological Quarterly, vol. 47, no. 4, pp. 599–630, Sep. 2006, doi: 10.1111/j.1533-8525.2006.00060.x.

[5] K. M. Graham, B. T. McMahon, J. H. Kim, P. Simpson, and M. C. McMahon, "Patterns of workplace discrimination across broad categories of disability.," Rehabilitation Psychology, vol. 64, no. 2, pp. 194–202, May 2019, doi: 10.1037/rep0000227.

[6] P. Koshy, R. Seymour, and C. U. National Centre for Student Equity in Higher Education (NCSEHE), "Student equity performance in Australian higher education: 2007 to 2014.," 2015.

[7] I. Cunninghame, D. Costello, and S. Trinidad, "Issues and Trends for Students with Disability Review of," Curtin University, 2016. Accessed: Feb. 24, 2022. [Online]. Available: https://www.ncsehe.edu.au/wp-content/uploads/2016/08/Issues-and-Trends-for-Students-with-Disability-Review-of-NCSEHE-Funded-Research.pdf

[8] E. Kimball, R. Wells, B. Ostiguy, C. Manly, and A. Lauterbach, "Students with Disabilities in Higher Education: A Review of the Literature and an Agenda for Future Research," in Higher Education: Handbook of Theory and Research, vol. 31, M. B. Paulsen, Ed. Cham: Springer International Publishing, 2016. doi: 10.1007/978-3-319-26829-3.

[9] T. Thune and L. A. Støren, "Study and labour market effects of graduate students' interaction with work organisations during education: A cohort study," Education + Training, vol. 57, no. 7, pp. 702–722, Sep. 2015, doi: 10.1108/ET-10-2014-0126.

[10] R. Tiessen, K. Grantham, and J. Cameron, "The Relationship Between Experiential Learning and Career Outcomes for Alumni of International Development Studies Programs in Canada," Canadian Journal of Higher Education, vol. 48, no. 3, Art. no. 3, Dec. 2018, doi: 10.47678/cjhe.v48i3.188187.

[11] P. Cretchley et al., "The impact of work integrated learning on student work-readiness: Final report 2014.," 2014.

[12] D. Jackson and N. Wilton, "Developing career management competencies among undergraduates and the role of work-integrated learning," Teaching in Higher Education, vol. 21, no. 3, pp. 266–286, Apr. 2016, doi: 10.1080/13562517.2015.1136281.

[13] S. P. Morris, G. Fawcett, L. Brisebois, J. Hughes, and Statistique Canada, "A demographic, employment and income profile of Canadians with disabilities aged 15 years and over," Statistics Canada, 2018. Accessed: Feb. 24, 2022. [Online]. Available: http://publications.gc.ca/collections/collection_2018/statcan/89-654-x/89-654-x2018002-eng.pdf

[14] S. Lunn and M. Ross, "Ready to Work: Evaluating the Role of Community Cultural Wealth during the Hiring Process in Computing," in 2021 Conference on Research in Equitable and Sustained Participation in Engineering, Computing, and Technology (RESPECT), May 2021, pp. 1–11. doi: 10.1109/RESPECT51740.2021.9620686.

[15] S. Ashford-Hanserd, S. Singh, A. Muoneke, and P. Eaglin, "Teachers' Perceptions of Barriers Influencing African American and Hispanic Students with Disabilities' Participation in K-12 Computer Science Education," in 2021 Conference on Research in Equitable and Sustained Participation in Engineering, Computing, and Technology (RESPECT), May 2021, pp. 1–4. doi: 10.1109/RESPECT51740.2021.9620628.

[16] B. Blaser and R. E. Ladner, "Why is Data on Disability so Hard to Collect and Understand?," in 2020 Research on Equity and Sustained Participation in Engineering, Computing, and Technology (RESPECT), Mar. 2020, vol. 1, pp. 1–8. doi: 10.1109/RESPECT49803.2020.9272466.

[17] J. Ryan, "Learning Disabilities in Australian Universities: Hidden, Ignored, and Unwelcome," J Learn Disabil, vol. 40, no. 5, pp. 436–442, Sep. 2007, doi: 10.1177/00222194070400050701.

[18] R. J. Alston, T. J. Bell, and J. L. Hampton, "Learning Disability and Career Entry into the Sciences: A Critical Analysis of Attitudinal Factors," Journal of Career Development, vol. 28, no. 4, pp. 263–275, Mar. 2002, doi: 10.1177/089484530202800403.

[19] E. Spingola, "Literature Review on Disability Participation in the Engineering Field," in 2018 ASEE Annual Conference & Exposition Proceedings, Salt Lake City, Utah, Jun. 2018, p. 30776. doi: 10.18260/1-2–30776.

[20] L. A. Lyon and J. Denner, "Chutes and Ladders: Institutional Setbacks on the Computer Science Community College Transfer Pathway," ACM Trans. Comput. Educ., vol. 19, no. 3, p. 25:1-25:16, Jan. 2019, doi: 10.1145/3294009.

[21] T. Domina and E. Ruzek, "Paving the Way: K-16 Partnerships for Higher Education Diversity and High School Reform," Educational Policy, vol. 26, no. 2, pp. 243–267, Mar. 2012, doi: 10.1177/0895904810386586.

[22] C. Henderson, A. Beach, and N. Finkelstein, "Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature," J. Res. Sci. Teach., vol. 48, no. 8, pp. 952–984, Oct. 2011, doi: 10.1002/tea.20439.

[23] C. E. Brodley, C. Gill, and S. Wynn, "Diagnosing why Representation Remains Elusive at your University: Lessons Learned from the Center for Inclusive Computing's Site Visits," in 2021 Conference on Research in Equitable and Sustained Participation in Engineering, Computing, and Technology (RESPECT), May 2021, pp. 1–4. doi: 10.1109/RESPECT51740.2021.9620552.

[24] C. Murphy, A. Mushakevich, and Y. Park, "Incorporating Readings on Diversity and Inclusion into a Traditional Software Engineering Course," in 2021 Conference on Research in Equitable and Sustained Participation in Engineering, Computing, and Technology (RESPECT), May 2021, pp. 1–5. doi: 10.1109/RESPECT51740.2021.9620660.

[25] J. J. Ryoo, J. Margolis, and A. Scott, "Begin Again: Why CS Education Must be Reimagined," in 2021 Conference on Research in Equitable and Sustained Participation in Engineering, Computing, and Technology (RESPECT), May 2021, pp. 1–2. doi: 10.1109/RESPECT51740.2021.9620565.

[26] S. Billett, "Realising the educational worth of integrating work experiences in higher education," Studies in Higher Education, vol. 34, no. 7, pp. 827–843, Nov. 2009, doi: 10.1080/03075070802706561.

[27] P. Silva et al., "The million-dollar question: can internships boost employment?," Studies in Higher Education, vol. 43, no. 1, pp. 2–21, Jan. 2018, doi: 10.1080/03075079.2016.1144181.

[28] N. Lloyd, "AAEE18_Lloyd_107-107-400-Lloyd-Natalie.pdf," presented at the AAEE2018 Conference, Hamilton, New Zealand, 2018. Accessed: Feb. 22, 2022. [Online]. Available: https://opus.lib.uts.edu.au/bitstream/10453/132865/1/AAEE18_Lloyd_107-107-400-Lloyd-Natalie.pdf

[29] M. Paull, N. Lloyd, S. A. Male, and T. Clerke, "Engineering work integrated learning placements: the influence of capitals on students' access," Journal of Higher Education Policy and Management, vol. 41, no. 5, pp. 534–549, Sep. 2019, doi: 10.1080/1360080X.2019.1646382.

[30] PhillipsKPA Pty Ltd, "Engaging Employers in Work Integrated Learning: Current State and Future Priorities," Report to the Department of Industry, 2014. Accessed: Feb. 28, 2022. [Online]. Available: https://www.phillipskpa.com.au/dreamcms/app/webroot/files/files/PhillipsKPA_WIL%20Research%20Report.pdf

[31] D. Peach et al., "Building institutional capacity to enhance access participation and progression in Work Integrated Learning (WIL): Final Report" 2016.

[32] M. Tomlinson, "Introduction: Graduate Employability in Context: Charting a Complex, Contested and Multi-Faceted Policy and Research Field" in Graduate Employability in Context: Theory, Research and Debate, M. Tomlinson and L. Holmes, Eds. London: Palgrave Macmillan UK, 2017, pp. 1–40. doi: 10.1057/978-1-137-57168-7_1.

[33] AAGE, "2017 AAGE Employer Survey". Camberwell, VIC: Australian Association of Australian Employers 2017.

[34] C. Patrick, D. Peach, C. Pocknee, F. Webb, M. Fletcher, and G. Pretto, "The WIL (Work Integrated Learning) report: a national scoping study [Final Report]," Queensland University of Technology, Brisbane, QLD, Dec. 2008. Accessed: Feb. 28, 2022. [Online]. Available: http://www.altc.edu.au

[35] D. McAuliffe, J. Boddy, V. McLennan, and V. Stewart, "Keeping the door open: Exploring experiences of, and responses to, university students who disclose mental illness," Journal of Social Inclusion, vol. 3, no. 1, Art. no. 1, Jun. 2012, doi: 10.36251/josi.46.

[36] L. Leon, "Achieving successful Work Integrated Learning (WIL) for students with disabilities: The challenge of social inclusion," in Proceedings of ACEN National Conference 2010, Perth, Australia, 2010, p. 580.

[37] J. Blackmore, C. Gribble, L. Farrell, M. Rahimi, R. Arber, and M. Devlin, "AUSTRALIAN INTERNATIONAL GRADUATES AND THE TRANSITION TO EMPLOYMENT," p. 36.

[38] A. Isvik, V. Cateté, D. Bell, I. Gransbury, and T. Barnes, "Infusing Computing: Moving a Service Oriented Internship Program Online," in 2021 Conference on Research in Equitable and Sustained Participation in Engineering, Computing, and Technology (RESPECT), May 2021, pp. 1–5. doi: 10.1109/RESPECT51740.2021.9620644.