Observations of Computing Students on the Homogeneity of their Classrooms

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ABSTRACT

This paper aims to provide some insight into the experiences and challenges faced by a cohort of homogeneously male final year students in a third level computing degree programme. It looks at their perceptions of how this homogeneity impacts them. Despite a large volume of research into the gender imbalance in STEM, studies of the male perspective have largely been absent from the literature.

The study originally intended to examine their perceptions on how the gender imbalance impacted their education. However, the resulting research gave voice to a number of concerns. This work focuses on the concerns surrounding the industry they are entering, as well as potential outcomes of the imbalanced learning environment. This work in particular seeks to look at how the normative masculinity experienced by the students in third level that could be seen to disadvantage or hurt women also constrains the men experiencing them.

CCS CONCEPTS

• **Social and professional topics** → **Computer science education**; *Men*; • **General and reference** → *Empirical studies*;

KEYWORDS

Education, Gender, Computer Science, Social Inclusion, Experiential Research

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1 INTRODUCTION

This work examines the experiences of male students in computing degree programmes in the absence of female students, specifically the male students' perceptions of the impact this has had on them. It is part of a wider body of research that examines the experience of being a male student in the absence of many, or indeed, any women in an educational environment. Despite a large volume of work in the area of the gender imbalance in STEM subjects, and computing specifically, studies of the male perspective on the area have been largely absent from the literature.

The observations of undergraduate students in a homogenous computing degree programme are the focal point of the research, and how they understand the impact of the gender imbalance has on them. Due to the lack of opportunities afforded to these students to collaborate with women, this work can only describe the impact of their absence as constructed by the male students. The gender-imbalanced experiences of the male participants are in line with the industry that they will enter, as only 4% of the industry in their branch of computing is female [6]. The findings are reflective of the students' experiences and observations during their time as undergraduates, as well as the fears they face as final year students about entering the industry.

2 BACKGROUND

In treating men and boys as 'the shadowy other', a term introduced by Marcus Weaver-Hightower [38] in his work on masculinity in schools, they have been largely ignored in pedagogical studies. Yates' [41] observation of nearly two decades ago remains valid;

> And yet it is also true that the great bulk of empirical qualitative work on gender, pedagogy, subjectivity and schooling in the past two decades has studied girls rather than boys.

Emphasis in the research field has been largely on practice-oriented responses to concerns surrounding the attraction and retention of women in STEM fields [1, 2, 8, 10, 14, 19, 20, 23, 40].

The American National Council for Research on Women identified that entering a postsecondary institution does not guarantee success for female students because of the additional psychocultural challenges they are faced with [36]. Furthermore, even when women do succeed at third level, there are significant issues with the attrition rate of women in the workplace. According to the Anita Borg Institute, there are certain key barriers that need to be addressed, which include

> the lack of opportunities for recognition and advancement, the challenges of integrating work and life demands, and the isolation and unconscious biases women often experience in a male dominated workplace [16]

The McKinsey Global Institute make a compelling economic case for gender equality, stating that closing the gender gap could deliver an increase in global GDP from $12Tr to $28Tr in 2025 [39]. This

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aligns with a prevailing view in technology in particular that while gender inequality is a pressing moral and social issue, addressing the gap also represents an opportunity to fill some of the skills shortage in the technology sector [12].

3 RESEARCH METHOD & PROCEDURE

This research follows the line of theoretically oriented research, focusing on the subject positions, rather than classroom level interactions [38]. This approach mirrors the approach of gender and education studies [22, 28]. The purpose of this wider study was to examine how male students experience their masculinised world, and how they construct the absent female.

3.1 Sample and procedure

Four focus groups were conducted with volunteers drawn from a number of final year computing degree programs that had been identified as being heterogeneous with respect to gender. The data set that is subject to analysis here is two of the resulting groups that were homogeneous (i.e. all male), and the participants came from a degree program that only had male students in their current year, in addition to the literature from the corpus. This analysis focuses on their experiences. The focus groups lasted approximately one hour each, and were conducted by the researcher in the presence of an independent third party. The interviews were recorded with participants' permission, and transcribed with the individuals anonymised. The transcriptions were later coded to facilitate an understanding of the themes present [15]. All quotes follow the standard format of 'P: A L: 1' referring to Participant A speaking in Line 1 of transcripts. The focus groups describe the individuals' insights and observations, however, as they were conducted face-to-face with a female lecturer, social desirability bias is possible [31]. Indeed, one participant commented,

> It is interesting that the girl is doing the research
> P:A L:170

While the interviewed groups were entirely comprised of male students for the last two years of their degree, in the first year there was 10% female students, in second year 5% and by the end of second year the group was entirely male. This group can be deemed to be representative of the year on year trends of the course, with less than 9% of graduates over the last eight years' female, and half of these years containing no female graduates at all.

3.1.1 Thematic Analysis . A 6-phase approach to thematic analysis is taken as the foundational method for this qualitative study [5]. It is a method for identifying and analysing patterns in qualitative data that works with a wide range of research questions, from those about people's experiences or understandings to those about the representation and construction of particular phenomena in particular contexts; a) code for as many potential themes/patterns as possible (time permitting); b) it can be used to analyse different types of data, from secondary sources such as media to transcripts of focus groups or interviews; c) it works with large or small data-sets; and d) it can be applied to produce data-driven or theory-driven analyses [9].

4 DISCUSSION

4.1 Positioning the research

Gender is central to this research. In this instance, while acknowledging that gender is non-binary, participants were not invited to examine or discuss their own gender identity or expression. The emphasis is placed on the non-trans male students experience, and it does not attempt to produce a comparison between female students experiences in similarly imbalanced environments (e.g., nursing or primary education). The aim is to give voice to the variability of their experiences, not to generalise the experience. It is, however, a piece of feminist research, which can be

> ... about men but also about gender - as a system, individually embodied and institutionally embedded, and as a set of practices, independent of the actors' struggles to accomplish it ... 'do' feminist theory by exploring masculinity as an important dimension of gender relations, hierarchy, inequality, and power [17]

The feminist approach supports the aim of this work, which is to

> seek a methodology that will support research of value to women, leading to social change or action beneficial to women [13]

An understandable question at this point might be "What has masculinity to do with feminism?" [33]. A potential response could be that it is essential, that women continue to work on masculinities. This is not just to maintain a crucial critical dialogue with men but to understand women, gender in its co-constructions, and themselves [24].

4.2 Education and Societal impact

The decision to focus on the perspectives of men alone, and not men in comparison to women, was in part due to the lack of women in the groups. It also aligns with the concern identified by Parsons and Ward who urge that the gap in feminist research approaches has potentially far-reaching implications as students may go on to possess a lack of understanding about the gendered nature of their educational experience [26].

Work looking at examination of gender roles (and the consequential economic and work force challenges) identifies how the use of enrolment and test scores are limiting as initial indicators of equality [41]. Rather, the prevailing view is that the economic and social outcomes of education are seen as stronger indicators of parity.

The primary motivation for the research is the concern arising from women's underrepresentation in science that encompasses not only the obvious inequities for women, but also the potential lost opportunity for society as a whole. The emphasis on participation as numerical balancing act of ratios and percentages fails to look at the social outcomes of education [18]. Education reflects, implements, challenges, and sometimes destabilises values in society and can have extraordinary power which can be harnessed to help bring about gender equality.

> Education is supposed to move the society in the direction of its ideals [29].

It behoves the third level institutions to question the ideals and norms that are presented to those it purports to educate, with both

educators and learners aware that the expansion of education alters the way people perceive membership and authority in society [34].

4.2.1 The Classroom. Hegemonic masculinity has been widely used in education studies to understand classroom life, and teachers' identities within the classroom [11]. The ideal institution can be described as

> A just community with a commitment to heterogeneity and diverse opportunities in the curriculum and social activities, and an honouring the individual person [4]

'Socializing agents' - the people with whom students come into contact with are key in developing identity and ego during the college years.

> It is the diversity of individuals (particularly other students) that developmentally challenges students' conceptions of themselves and that requires adaptation and commitment to certain attitudes, values, beliefs and actions [27].

Chickering and Reisser developed four axioms aimed at encouraging growth along the identified developmental vectors and helping students to develop the capacities for living and working in the twenty first century [7]. The scope of the axioms is to

> Recognize significant dimensions of individual difference between students' [with emphasis on] the importance of age, gender, and ethnicity as dimensions of individual difference that have serious consequences for the way students experience particular content. [..] The consequences are not subtle.

The students' themselves identify the importance of diversity for their learning, and lament it's absence

> [...] you feel like it would be great to have like different genders, different race, different everything, [...] because it's a lot of white male in the room, do you know what I mean? A whole lot of white males. P:F L 472-478

4.2.2 Student Faculty Relationships. The importance of student faculty relationships in aiding students in developing their competence and sense of competence should not be underestimated [7]. When combined with Ridgeways' theory of construction of competencies, it can be argued that the treatment of female students by faculty in gender imbalanced classrooms impacts on the male students in how they go on to construct their female classmates [32]. The natural question is what happens when there are no female students? In a male homogeneous group, the construction given by a lecturer to male students of 'women' could be seen in this context as having wide reaching implications. The students in the focus groups were final year students. This was the first conversation any of them had had about the gender imbalance in their own class. It behoves lecturers to consider what message this could send to students by ignoring it, as it could be seen to normalise the environment, which is a normalisation that they carry forward into industry.

Later, where students' describe their inability to contribute to a discussion on gender equality in a classroom environment, they seem aware that the absence of women in the classroom can have long-term consequences, which could result from

> old fashioned views ... [having] learned not to think of girls in an academic environment [21]

They propel this into the future, and observe that it will have an impact

> I think that the main thing is having women in the class would have taught me better or how to interact with them in the workplace when I get out. P:B L: 1010

One student seemed to view the wider inclusion of women in the industry as a self-fulfilling positive prophecy.

> I'd like to see more women in the industry because it would actually probably help the industry to grow further ... open to more demographics ... and then they'd be more interested P:E L:1261

This positivity belies the true nature of the gender chasm in computing, and the causes;

> The role socialization plays, both at an early age and once again in a collegiate setting, in developing gendered participation in and attitudes about the domain of computing cannot be under-emphasized in explaining the continued presence of the gender gap. [37]

Third level institutes have a significant role to play in bridging the divide, but must reflect on how they also contribute to the issue.

4.2.3 Building Technology . Digital products are more attractive to male than to female users [25]. This is most often a subtle, but present, factor in how technology is created [35]. Indeed, one aspect of Selwyn's work contends that they types of technology focused on by these students is software and hardware were specifically designed for men and produced by men[35]. This aligns with the student's perceptions;

> '...you hear a lot about how there's a gender bias in products being made, they are being geared towards men. And you really see it when there is a room full of men creating demographic for another group of men and they want you to market it to someone and guess who they are going to like? They are going to like their own demographic P:D L:357-362

They describe the difficulty in creating work that appeals outside of the expected demographic, as

> It's very easy to target towards men. There's a lot of things to reference it from. P:F L:684

However, when asked if they identify with what they are, as part of this demographic, being marketed with, all participants responded in the negative;

> No, not at all P:F L:694
> I hate it P:G L:696
> It's not representative'P:H L720

The students were cognisant that the resulting technologies are created within a hegemonic masculinity, which is often at odds with alternate forms of masculinity that students would like to invest in [30]. Students further questioned the hegemonic masculinity in a

second focus group, where they describe discussing their research topics

> .. you went up and said it in front of the whole class and like our panel of lecturers were the ones who gave you feedback but it was like open to the class if they wanted to say anything. But I think what was interesting with that was because of all the lecturers on the panels are also males, so theres absolutely no female input in that room at all. P:F L:520-527

5 CONCLUSION

The current status quo of gender imbalance in computing has not always been the case; this trend represents an about-turn in STEM subjects' representation in general, although computing has been impacted the most severely in the downturn of participation [3, 37]. Having looked at the experiences of final year computing students, insights have been garnered into the impact that this homogeneity has had on them. It has focused primarily on their reflections on the classroom experience as well as the resulting technological impact.

The study originally intended to examine their perceptions on how this impacted their education. The students themselves gave voice to a number of the wider societal concerns associated with the gender imbalance in computing. The tenor of their experience is that the normative masculinity present in computing has not been positive for them, and has left them with a lasting sense of uneasiness.

The limitations of the current study are the scope and scale of the work. The initial work was carried out on final year students in one third level institute. Current research is looking at the experiences of the lecturing staff teaching these groups. The students from this focus groups will also be reinterviewed, for their insights into how this has impacted their transition to the workplace. Future work would aim towards a wider sample group, expanding into other third levels.

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