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Perspectives and Experiences of Gender Inclusion for STEM Programs Through an Intersectional Lens

Zou Xinyi

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Dissertation submitted in part-fulfilment of the requirements for the degree of Master of Science in Education (Digital and Social Change)

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Abstract

Background

STEM is becoming increasingly important in determining a country's economic and social progress. Despite decades of research and advocacy, women remain underrepresented in STEM education and professions. Such STEM gender gaps, with certain regional and subject differentiations, nevertheless remain as global issues further exacerbated by the COVID-19 pandemic. Informal educational initiatives on GIFSTEM (gender inclusion for STEM) emerged as part of the solution. In recent years, they also have attracted increasing partnership and investment interests from the public and private sectors. However, relatively little evidence exists to demonstrate how the impacts of GIFSTEM initiatives are experienced by different participants, particularly those outside the US. There are also increasing questions about the monolithic framing of gender in these programs.

Research Design

This research evaluates the experiences of learners and project leaders of GIFSTEM organizations in a range of geographical settings through an intersectional lens. In this qualitative study, data is collected through 13 individual online semi-structured interviews. Participants represent two groups, those who are learners (both past and present), and those who are project organizers and leaders of different GIFSTEM organizations.

Findings

Data from interviews show that learners find GIFSTEM programs helpful in three ways: community, networking-mentoring, as well as a broadened understanding of possible paths in STEM education and professions. Depending on their intersectional identities, learners also experience two barriers, heightened visibility and feelings of exclusion due to identity metrics other than gender, that make them feel uncertain about remaining in STEM. Furthermore, learner participants feel that GIFSTEM programs do little, sometimes even the opposite, in mitigating these issues. Project leader interviews demonstrate that, depending on the specific programming goals, different numerical metrics are used, in combination with qualitative data from individual participations, for impact measurements of their affiliated GIFSTEM organization. Project leaders also have to make a series of pragmatic considerations in the process of developing and implementing a sustainable GIFSTEM organization. For instance, decisions regarding target learner demographics, program contextualization, and navigating

relationships with commercial partners. In the end, individual GIFSTEM organizations must make strategic and difficult decisions depending on their operational contexts to reach their respective end goals.

Acronyms

- GIFSTEM: gender inclusion for STEM
- GIFT: gender inclusion for Tech (a specific subset of GIFSTEM initiatives)
- CS: Computer Science
- EE: Electrical Engineering
- FAANG: An acronym describing five prominent American technology companies: Facebook(Meta), Amazon, Apple, Netflix, and Google (Hobbs, 2022).

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Introduction

STEM disciplines are increasingly crucial in determining a country's economic and social growth (Hammond et al., 2020). Although research on the underrepresentation of women in STEM education and professions, described as the 'STEM gender gaps' has been active for several decades, the issues remain. With varying degrees of differences depending on the geographical context and the specific STEM subject, the STEM gender gaps nevertheless are global (Alam & Tapia, 2020; Bello et al., 2021). The COVID-19 pandemic has also disproportionately affected women in science and engineering compared to their male counterparts, influenced by factors such as social gender roles (OECD, 2020; Zheng & Walsham, 2021; Gandolfi et al., 2021).

In response, GIFSTEM organizations (gender inclusion for STEM), informal educational initiatives, blossomed as one solution to the STEM gender gaps. Outlined by Petrucci (2020), GIFSTEM programs typically adopt one or more strategies (1) Provide mentorship, networking, or community support to women interested in or currently involved in CS education or/and careers (e.g. Africa Summit on Women, Girls in Technology). (2) Deliver skill training and development services to individual learners (e.g., Code First Girls) or in a group environment (e.g. Code.org). (3) Equip individual learners with anti-discrimination resources in their study and work contexts (e.g., Project Include, Girl Up) or some relief of structural gender difficulties for learners who desire to study or work in the area (e.g. British Council scholarships for women in STEM).

The increased number of GIFSTEM programs, in addition to public and private interests in them, foster rich academic research that evaluates them. Convertino (2020), for instance, examines the experiences of women of color CS students of the Grace Hopper Celebration, one of the largest GIFSTEM conferences globally, in the US. The author also observes the tendency in dominant literature which uses the 'women in STEM' umbrella without inner differentiations, thereby ignoring the specific needs of learners with multiple underrepresented identities.

Against this backdrop, this research adopts intersectionality as a framework and investigates perceptions and experiences by learners and project organizers of GIFSTEM organizations in different contexts. This research stem from several questions: What do we mean when we say 'gender inclusion in STEM'? What groups of learners are included, and subsequently, excluded? How do other identity metrics interact with 'gender' in these informal educational spaces for learners? What are the considerations that go into the

development and implementation of GIFSTEM programs, and what are the challenges project leaders face?

This paper starts with a comprehensive review of relevant literature (Chapter 2), from the 'STEM gender gaps' to motivations behind public and private interests in the topics. The review also presents common strategies adopted by GIFSTEM organizations, informal educational efforts to bridge them, as well as four gaps in current literature that evaluates GIFSTEM initiatives. Then, the intersectional lens and research questions are introduced. Chapter 3 proceeds to outline methodological considerations of this qualitative study, including the choices of online semi-structured interviews, sampling of both learners and project leaders, data gathering, analysis and presentation. Next, in Findings (Chapter 4), seven themes corresponding to the three research questions are presented. Lastly, the Discussions chapter further develops the themes and explore their implications for future research on GIFSTEM, finishing with two suggestions for GIFSTEM organizations.

Chapter 1: Literature Review

> "*The economic and social prosperity of countries depends on the state of science, technology, engineering, and mathematics (STEM). Yet, women and girls continue to be underrepresented in STEM studies and careers... Beyond the wage gap that comes with women being underrepresented in STEM jobs, the gender gap in STEM is an inefficient allocation of labor and talent, and a missed opportunity for economies*." (Hammond et al., 2020, p. vii)

In this chapter, I first present the STEM (science, technology, engineering, and mathematics) gender gaps as an international phenomenon with regional variations, as well as the contributors to the issue. I next present informal education GIFSTEM (gender inclusion for STEM) initiatives and some common strategies such organizations adopt. Then, the political, as well as economic, incentives behind policymakers and the private sector in investing and partnering with GIFSTEM programs, are laid out. Finally, I present four gaps in current GIFSTEM literature, the research questions of this study, as well as intersectionality as an underpinning theoretical framework.

1.1 The STEM Gender Gaps: An International Phenomenon

1.1.1 Statistics: STEM Gender Gaps in Education and Professions

The state of a country's economic and social development increasingly depends on STEM (Tas, 2011). Despite decades of writing and advocacy, women continue to be underrepresented in STEM education and professions (Margolis & Fisher, 2002; Beyer, 2014; Sax et al., 2017). The phenomenon, known as the 'STEM gender gaps', varies between countries and different STEM disciplines and is a topic of worldwide debate (Hammond et al., 2020; Bello et al., 2021).

Globally, women represent 35% of all students enrolled in a STEM discipline in higher education (Alam & Tapia, 2020). Even when enrolled, there is a higher exit rate for women in STEM than in other disciplines (UNESCO, 2017). There are, of course, regional differences in the data (Bello et al., 2021). For instance, more than half of graduates of STEM disciplines in Latin American countries such as Peru and Honduras are women (The World Bank, 2020). However, even in countries with a more balanced gender ratio of STEM higher

education degrees, women are less likely than men to enter, and more likely to leave, STEM professions (Hammond et al., 2020).

Of all AI (Artificial Intelligence) professionals globally, only 22% of them are women (World Economic Forum, 2018). In the 73 countries where data is available, only eight have reached gender parity of STEM professionals: Algeria, Azerbaijan, Kazakhstan, Kyrgyzstan, Mozambique, North Macedonia, Sri Lanka and Trinidad and Tobago (Bello et al., 2021). In most countries, women often make up less than 20% of the STEM workforce (UNESCO, 2015; PWC, 2017; Schwab et al., 2019). The gender pay gap, a phenomenon in many other sectors, also applies in STEM careers, even in countries where gender parity is reached in the industry (Belgorodskiy et al., 2012; Segovia -Pérez et al., 2020).

Evidence also suggests that the COVID-19 pandemic is disproportionately affecting women in science and engineering compared to their male counterparts (Bello et al., 2021; Zheng & Walsham, 2021; Gandolfi et al., 2021). For instance, Viglione (2020) found women researchers[1] are posting preprint at a slower rate and starting fewer new projects than their male peers. Furthermore, despite female scientists being at the forefront of COVID-19 response (OWSD, 2020; OECD, 2020), they are globally underrepresented in public pandemic commentary (Carr, 2020; The Expert Women Project, 2020; Yang & Liu, 2021). With the STEM gender gaps exacerbated by COVID-19, more scholars have started to examine the underlying factors, as well as potential solutions, to the issue.

1.1.2 Contributors to the STEM Gender Gaps

Statistics demonstrate that the gender gaps in STEM education and professions are a global issue with regional variations. Researchers attribute the phenomenon to a 'chilly climate' (Sandler & Hall, 1986; Britton, 2017) which deters women to enter and remain in STEM disciplines and the workforce (Belgorodskiy et al., 2012). Since the early 2000s, there is a growing body of literature on the contributors to the STEM gender gaps, albeit most studies on the topic focus on high-income countries with a relatively small sample (Hammond et al., 2020).

The most prominent branch of evidence suggests that the phenomenon is influenced by gender stereotypes and biases (Leaper & Brown, 2008; Moss-Racusin et al., 2012). For example, Kerkhoven et al. (2016) found that men are more likely to be depicted as science

[1] Data on research occupations is often used as a proxy indication of STEM career gaps (Hammond et al., 2020; Myers et al. 2020; Padayachee et al., 2022).

professionals than women after analysing two online databases for STEM educational materials. Such biases contribute to a lower sense of belonging and self-confidence in STEM among women (Cheryan et al., 2009; Robnett, 2016; Piatek-Jimenez et al., 2018).

Gender stereotypes also extend beyond education settings to the workplace (Metcalf, 2010; Funk & Parker, 2018). There are also other factors, such as lack of childcare support, absence of female role models, and feelings of isolation in the workplace, which block women from entering, remaining, and progressing in STEM-related professions (Ahuja, 2002; Christou & Parmaxi, 2022).

In conjunction with research on the contributors to the STEM gender gaps are efforts to bridge them. GIFSTEM (gender inclusion for STEM) programs have emerged as a potential solution to the issue (Petrucci, 2020). The increased amount of GIFSTEM initiatives internationally is accelerated by both the public and private sectors (Quartz, 2015; Fotopoulou, 2019; Savchuk, 2019). Before presenting common frameworks of GIFSTEM initiatives, I first unpack the political and economic motivations behind such growing interests.

1.2 Motivations Behind Public and Private Efforts to Bridge the STEM Gender Gaps

1.2.1 Policies for Gender Equality in STEM

There have been an increasing number of policies in countries around the world that try to recruit and retain more people, including women, to enter and remain in STEM education and professions (Kong et al., 2020). Since the early 2010s, more countries have adopted gender-differentiated policies to address structural barriers (e.g. gender bias) that prevent women from studying and working in STEM disciplines (OECD, 2015).

One motivation behind such policies is to promote gender equality. It has been demonstrated that technologies tend to mirror pre-existing social biases and structures of inequalities (Noble, 2018). From a social justice perspective, women must be decision-makers and designers in technologies' formations and evolvements (UNESCO, 2016; Fotopoulou, 2019). Furthermore, research shows that women's genuine participation in technological development can facilitate their financial and political empowerment (Everts, 1998; Pascall, 2012; Kamberidou & Pascall, 2019). For instance, Denton-Calabrese et al.

(2021) found significant improvements in women's self-concept after learning digital skills, in addition to all participants gaining opportunities for social mobility and financial security.

1.2.2. Economic Incentives: The Digital Skills Crisis and Market Push for Diversity

In addition to gender equality, there is another important reason why there are growing interests from the public and private sectors in bridging the STEM gender gaps. STEM-related fields could provide solutions to global challenges such as the climate crisis and income inequality emerge (Tas, 2011). Amid the risks of a global economic recession, STEM education has arisen as an efficient method for countries to increase their international competitiveness and foster economic growth (Guyotte et al., 2014; Li & Chiang, 2019). Strong nation-building incentives are behind policies which encourage participation in STEM education and professions, which could then stimulate the economy and enhance social mobility (Quartz, 2015).

This is also against the backdrop of a digital skills crisis (Kamberidou & Pascall, 2020), where there is a global high demand for STEM professionals (Gordon, 2013; Marginson et al., 2013). Increased engagement in STEM promotes the development and sustainment of national economies while equipping citizens with in-demand skills to thrive in changing climates (OECD, 2010). For LMICs (Low- and Middle-Income Countries), the implementation of gender and STEM policies can translate to advancements in the global economy (Tas, 2011). For HI (high income) countries, such policies help maintain their 'leading' positions in the global arena (Selwyn, 2013).

There are also increasing investments from the private sector, particularly Tech (technology) companies, in efforts which bridge the STEM gender gaps (e.g. GIFSTEM programs) (GBN, 2016; White, 2021). While the gender equality incentive remains, there is an additional economic incentive behind this phenomenon: There are financial incentives and repercussions for companies to invest in gender diversity. Savchuk (2019), for instance, investigated 49 announcements by Tech companies in the U.S. between 2014-2018 and found causational relationships between a company's gender diversity status and its share prices. The study also demonstrated a higher increase in stock prices if a company's gender diversity level bests that of industry leaders such as Google (Savchuk, 2019). White (2021) also observes a tendency for Tech companies to invest in GIFSTEM organizations after receiving public backlash regarding the lack of internal diversity. For example, Facebook made a $250,000 donation to Girls in Tech (Girls in Tech, 2021) just months after criticisms of its

lack of internal diversity (Guynn, 2020). The increased investments in GIFSTEM initiatives make better understanding of their outcomes and learners' experiences imperative.

1.3 Efforts in Informal Education to Bridge the STEM Gender Gaps

While there have certainly been significant efforts to bridge the STEM gender gap in formal education (Rosser, 1995; Tam et al., 2020; Husain, 2022). This research primarily focuses on GIFSTEM initiatives in informal education contexts[2], often non-profit organizations, that have tried to remedy the issue for two decades. In the beginning, informal educational GIFSTEM initiatives emerged to supplement the formal STEM education of students with accessible and quality learning resources (Maxey & Hynes, 2021). Some GIFSTEM initiatives then evolved to provide both educational and professional development resources (Christou & Parmaxi, 2022).

As outlined by Petrucci (2020), GIFSTEM informal educational programs typically adopt one or more of three strategies: (1) Provide mentorship, networking, or community support to women interested in or currently involved in CS education or/and careers (e.g. Africa Summit on Women, Girls in Technology, The Grace Hopper Celebration). (2) Deliver skill training and development services to individual learners (e.g., Code First Girls) or in a group environment (e.g. Code.org). (3) Equip individual learners with anti-discrimination resources in their study and work contexts (e.g., Project Include, Girl Up) or some relief of structural gender difficulties for learners who desire to study or work in the area (e.g. British Council scholarships for women in STEM).

The three approaches are not mutually exclusive. In practice, many GIFSTEM programs adopt both, if not all, of them to address the numerous causes that make it difficult for women learners to enter and remain in STEM education and professions (e.g. Neythri, Black Girls Code, I am the CODE).

With the increase of GIFSTEM programs comes academic discussions on their impact evaluations (Bilimoria & Liang, 2014; Britton, 2017; Tao, 2018; Miles et al., 2022). For instance, Darke et al. (2002) conclude that while there is evidence to support the effectiveness of the GIFSTEM initiative they examined, the extensiveness of such good practices across different organizations is unclear. Watermeyer (2012), in their study on learners' perceptions

[2] Specifically, out-of-school programs. For studies on similar contexts, see Achiam & Holmegaard (2017) and Rushton & King (2020).

of an informal STEM outreach program in the U.K, argues that GIFSTEM programs, while having the benefit of community-building, could also reinforce existing gender biases.

Since 2020, there has been a new wave of literature which evaluates GIFSTEM organizations through critical perspectives (Agommuoh & Ndirika, 2020; Tildesley et al., 2021; Paganini et al., 2021). Convertino (2020), for example, utilizes qualitative methods to explore how women CS students of color in a southwestern U.S. university navigate their intersectional identities in GIFSTEM, specifically GIFT (gender inclusion for Tech). Petrucci (2020) examines how individuals of minority genders, specifically women and non-binary people, in the Tech industry experience gender-inclusive meetup groups through a postfeminist lens. Bayaga (2022) adopts a decolonial intersectional framework and examines the career interests of double underrepresented (race and gender) participants in GIFSTEM programs in the U.S.. There are, however, four gaps in the current literature on GIFSTEM programs.

1.4 Gaps Within Current GIFSTEM Literature

1.4.1 Difficulty of Evaluation and Need for More Qualitative Evidence

> *"More research is also needed to recognize and understand how gender interacts with other axes of experience to rearticulate the very terms of legitimacy and intelligibility in CS".* (Convertino, 2020, p.604)

Convertino (2020) notes that the current landscape of GIFSTEM literature has insufficient qualitative studies that evaluate learners' experiences. The author calls for more research that utilizes qualitative methods to examine various intersections of different learners which affect their perceptions of GIFSTEM programs. Friedensen et al. (2021) also comment on the lack of qualitative research on how learners of various underrepresented identities experience STEM learning environments, including informal education communities: "As of yet, limited qualitative evidence is available to understand how MIoSG [minoritized identities of sexuality and/or gender] students make meaning of these experiences across disciplines" (p. 337).

1.4.2 Need for Breadth of Geographical Reach

> *"More research is needed to better understand the influence of national context… It is important not to assume results will be similar across contexts, as the main driver of inequalities by characteristics such as gender and social background are not the characteristics themselves, but the systems of power that create and sustain them."* (Mooney & Becker, 2020; p,278)

There is an additional need for research which examines GIFSTEM initiatives beyond the U.S. context. Ozkaleli (2018), exploring gender diversity organizing in Turkey, comments on the "liberal Western" tendencies in dominant literature on diversity and inclusion in organizations (p.140). There are some GIFSTEM studies outside of the U.S.. For instance, In South Africa, Bayaga (2022) conducts a qualitative study which explores correlations between underrepresented learners of STEM disciplines and their interests in pursuing STEM careers, specifically focusing on metrics of gender and race. In Ireland, Mooney & Becker (2020) utilizes quantitative methods to investigate the intersectional link between the sense of belonging, gender identity, and minority status of undergraduate CS students at University College Dublin. They found a decreased sense of belonging among students who identify both as a woman and a minority, while students who identify as a woman but not a minority had a sense of belonging equivalent to those who identified as men (Mooney & Becker, 2020).

This research seeks to present a range of spatial contexts in which learners experience such initiatives (Mcmaster & Cook, 2019). Learner participants of this research also come from a range of contexts currently underrepresented in literature (Vitores & Gil-Juárez, 2016).

1.4.3 Need for Voices of GIFSTEM Project Organisers

> *"There is a scarcity of research that examines the experience of CS teachers… research that centers their perspectives in grappling with their teaching practices and role in the educational experience of their students."* (Johnson et al., 2020, p.2)

Most studies on GIFSTEM organizations tend to not include the accounts of program organizers. Johnson et al. (2020) point out that current research on the CS gender gaps primarily focuses on students with little consideration for how the identities of the organizers of CS education initiatives shape the program structures and deliveries. Similarly, Tefera (2017) observes the dominant discourse rarely "consider[s] teachers' social and emotional needs" (p.677).

This research includes personal accounts from 5 POL (project leaders and organizers) of different GIFSTEM programs. It presents the relationship between their intersectional identity and the program agendas, thereby exploring how POL's lived experiences influence their programming designs and priorities.

1.4.4 Need for An Approach Which Does Not Treat Women as A Homogenous Category

> *"Existing scholarship… has the potential to reify the silencing and erasure of individuals if scholars and practitioners are not considering within-group specificities when examining collective, shared ontological experiences... we call for the use of nuanced-intersectional approaches to examine and unpack the experiences and needs of individuals within the WOC [women of colour] umbrella term in STEM"* (Miles et al., 2022, p. 233)

Miles et al. (2022) critically examined research using the umbrella term 'women of color' in STEM in the U.S. and illustrated that specificity is needed when conducting research with underrepresented groups in STEM. Echoing this sentiment, Convertino (2020) advocates for more research on different GIFSTEM learners: "Social isolation, exclusion, and connection are contextual, contingent, and intersectional experiences that cannot be collapsed into a single, monolithic meta-narrative" (p. 604). Tefera (2017) also observes that the experiences and needs of women with disabilities are often ignored in GIFSTEM research and organizations (p. 685).

The danger of treating 'women' as a homogenous group with little to no inner differentiation is not recent (Butler, 1990) nor unique to GIFSTEM literature (Smooth, 2013). More research that accounts for the nuanced and multifaceted experiences of different learners is needed, particularly in light of compounded inequalities since the COVID-19 pandemic (Myers et al. 2020; Hammond et al., 2020; Bello et al., 2021).

1.5 Research Questions

It is against this backdrop that this study sets out to address the following research questions:

- RQ1: What are the benefits of GIFSTEM (gender inclusion for STEM) programs perceived by different learners?
- RQ2: What are the barriers learners feel like they face when considering STEM-related professions/postgraduate studies, and to what extent are they mitigated by GIFSTEM programs?
- RQ3: What are the (a) aspirations of (b) challenges for different GIFSTEM organizations?

The increased interest from both the public (Jr & Sawyer III, 2014; Patterson et al., 2020) and the private sectors (GBN, 2016; Writer, 2021) in programs that try to recruit and retain women in STEM education and professions present opportunities to analyze their contributions in bridging the STEM gender gaps (Dobbin & Kalev, 2016). By addressing these research questions, this study adds to the discourse on GIFSTEM initiatives by presenting their perceived benefits by learners in a cross-cultural context, as well as project leaders' considerations when developing programming. Using intersectionality as conceptual underpinning, this research presents personal accounts of learners and project leaders on their experiences participating in and organizing GIFSTEM programs.

1.6 Intersectionality and The Evaluations of GIFSTEM Programs

The concept of intersectionality originated from the wave of Black Feminist Criticism in the US (Hooks, 1981; Lorde, 1984; Crenshaw, 989). It was initially used to reveal how African American women experience compound effects of multiple systematic marginalizations due to different metrics of their identities such as race, class, and gender (Crenshaw, 1991). It seeks to illuminate the interwoven nature of various axis that compose one's identity, which makes them inseparable on an individual level (Davis, 1983). Often with a focus on marginalized groups, intersectional approaches analyze the relationships between one's experiences due to different social categories their identity encompasses and broader systems of power and oppression.

GIFSTEM education programs have a premise which highlights 'gender' as the defining feature of individual learners (Faulkner, 2009). The emphasis on 'gender' being the primary metric of one's identity is not just evident in GIFSTEM programs but in the wider male-dominated field of Tech (Cheryan & Plaut, 2010). It is, therefore, useful to analyze the experiences and perceptions of learners and POL of GIFSTEM programs through the lens of intersectionality. It opens up opportunities to explore how the gender of learners and POL interacts with other dimensions of their experiences when participating in and organizing GIFSTEM education programs.

Several empirical studies on GIFSTEM programs have adopted intersectionality as an analytic framework due to the complex contributing factors that result in the underrepresentation of women in STEM education and professions (Good et al., 2012; Lewis Ellison et al., 2020; Walt & Barker, 2020). However, they tend to have a U.S. focus, perhaps due to the framework's American origin. Charleston et al. (2014) conducted a case study which explores the importance of social networks at the intersections of race and gender in African American women's persistence in STEM degrees and careers through surveys and focus group interviews. O'Brien et al. (2015) analyzed 1,772,133 surveys filled out by first-year students of an American higher education institution between 1990 and 1999, comparing data from African American students and European American students. They found a positive relationship between a student's gender and race and their tendency to major in a STEM subject (e.g. African American women students are less likely to major in STEM than their European American men and women counterparts) (O'Brien et al., 2015). Ro & Loya (2015) conducted quantitative research which evaluates self-assessed learning outcomes by women and minority students in engineering. In the study, the only instance where a minority group assessed their skills to be higher than their White counterparts is Latinx students in self-rating their leadership skills (Ro & Loya, 2015). Tao (2018) also utilized quantitative methods and found significant racial and ethnic differences in earning gap in academic STEM fields in the U.S, despite overall improvements in earnings by gender compared to previous studies. These studies on gender gaps and STEM education and professions illustrate that it is essential to indicate specific intersections when analyzing the topic. Otherwise, as Ireland et al. (2018) point out, there runs the risk of experiences of intersectionally marginalized women in STEM education and professions being hidden.

This study adopts intersectionality as a theoretical framework with acknowledgement of its limitations. As the concept travels beyond the feminist scholarship and influences wide-ranging studies, including education studies, there nevertheless is very little consensus on

how to apply intersectionality as a method (Luft & Ward, 2009; Bilge, 2013; Nash, 2017). One common critique of intersectionality is its potential application which either treats metrics of one's identity as fixed and their intersections as separable (Mehrotra, 2010), or dissolves and deconstructs social categories altogether (McCall, 2005). The pitfall for the former application of intersectionality is it can be used too prescriptively, while the latter has limited capacity to conceptualize the lived experiences of individuals, for whom the effects of social categories that compose their identities shape their lived experiences (Dill & Zambrana, 2009; Nash, 2017).

There is also the temptation, as Harris & Patton (2019) notes, among education scholars to use intersectionality as an "ornamental buzzword to express their familiarity with (the popularity of the) theory" (p.359). An intersectional approach that is mindful of such limitations is layered: It considers both the existence of social categories on a macro level and how they manifest in individual experiences on a micro level. It further considers the dynamic and fluid nature of intersections as they affect identities and agency (Martinez Dy et al., 2014).

The framework of intersectionality provides a theoretical lens to analyze how different learners and POL perceive and experience GIFSTEM programs. It presents the possibility of the co-existence of privilege and injustice experienced by one individual (Martinez Dy et al., 2014). An intersectionality lens, as Dill & Zambrana (2009) point out, "explores and unpacks relations of domination and subordination, privilege and agency, in the structural arrangements through which various services, resources, and other social rewards are delivered" (p.5). While the specific focus of intersectionality as a theoretical framework can vary significantly depending on the context and discipline (Mirza, 2009; Pei et al., 2021), this research adopts it not as a descriptive formula, but as a grounding orientation (Jiang & Gong, 2019). It utilizes the space that intersectionality opens up which treats different metrics of one's identity as interconnected (Dill & Zambrana, 2009).
This study aims to explore how GIFSTEM initiatives in informal education are perceived and experienced by project leaders and learners. The next chapter explores the methodological considerations to address the three research questions through an intersectional lens.

Chapter 2: Methodology

> *"Future research* [on the STEM gender gaps] *needs to delve deeper into these correlations between parameters, adding a comprehensive qualitative dimension to the massive amount of quantitative data already gathered and analysed"*. (Miller, 2017, p. 54)

This research adds to the existing literature by exploring how learners with cross-cultural backgrounds experience GIFSTEM programs with an intersectional framework. It uses semi-structured online interviews with 13 participants, 5 PLs (past learners), 4 CLs (current learners), and 5 POLs (project organizers/leaders) of GIFSTEM programs (one participant is both a PL and a POL). Following a qualitative approach, and in sensitivity to the feminist traditions from which intersectionality arose, I first explore my subjectivity and positionality as a researcher, and how this has informed the methodological design of this study.

2.1 Subjectivity and Positionality

There is no consensus on what constitutes rigorous qualitative research. Some scholars advocate for the minimization of subjectivity as its defining feature (Merton, 1979; Babbie, 1986; Haase & Myers, 1988). Others argue for qualitative research which does not try to be 'objective', where the researchers instead present their process of interpretation, making visible their positionality (Ammon-Gaberson & Piantanida, 1988; Caretta, 2015; Spencer, 2017).

Epistemologically, I resonate with the argument that objectivity does not equate to neutrality. Even qualitative research which tries to minimize subjectivity is not value-free. They can be underpinned by ideologies that "aspir[e] for objective, universal, and timeless knowledge, the very idea of complex and changing interdependence and co-relations—the very essence of being insofar as there can be any—are not tolerated" (Birhane, 2021, p. 3).

This research is also more aligned with the latter approach which calls for the analysis of the researcher's subjectivity (Caretta, 2015). I acknowledge that my perspectives on the topic are grounded in my experiences and could shape the findings of this research (Somekh, 2006). All learner participants have been exposed to different expectations of various metrics of their identity; multiple sets of "universals" and "truth regimes" (Chakrabarty, 2007, p. 42) that entail different, sometimes conflicting, expectations of being a 'girl' or 'woman' (Butler,

1990). For example, in South Korea, organizations related to gender equality often have to strategically pivot and alter their projects to avoid anti-feminist backlashes that can sometimes be violent (Kim, 2017). But in the context of the US, particularly at the height of "Facebook feminism" (Faludi, 2013, p. 1) individual women are encouraged to step up and "lean in" (Sandberg, 2013, p. 10). Due to these contextual differences, I am cautious about how participants' demographic information (e.g. religion, disability) is represented in this paper. Participants are presented with the option to review and edit these information in the analysis stage.

I am aware of the contextual nature of intersectionality (Crenshaw, 1991; Olive et al., 2015) that comes with growing up cross-culturally and trans-nationally from my personal experiences (Choi et al., 2012). I, therefore, resonate with my participants in the confusion and at times, frustrations, that come with navigating between sets of different intersectional identities depending on the context. I am cautious about projecting my world views onto the experiences of my participants. I might have a different definition of gender from my participants, shaped by the universals I've been exposed to. I try not to impose my truth regimes onto their accounts and experiences. I also embrace the subjectivity I, like any researcher, bring to the analysis process. The findings I present are what I believe to be the most noteworthy. While I acknowledge that the rich data from this research can be analyzed through many different perspectives, I hope to make the process of my interpretation and analysis visible to you, the reader, through constant reflections of subjectivity and positionality (Eisner, 1992).

2.2 Research Design

2.2.1 Procedure

This research adopts an intersectional lens, as Olive et al. (2015) outline, which has the following characteristics:

1. Centres the lived experiences of individuals.
2. Complicates identity and examines both individual and group identities.
3. Explores identity salience as influenced by systems of power and privilege.
4. Advances a larger goal of promoting social justice and social change (p. 2).

An intersectional framework lends itself naturally to the aim of the study, exploring the experiences and perceptions of learners and project leaders of GIFSTEM organizations in a range of geographical settings. Semi-structured online individual interviews are conducted

with learners and project organizers. In total, 13 participated, out of which 5 are PL (past learners), 5 are POL (project organizers/leaders), and 4 are CL (current learners). One participant is both a PL and a POL, leaving the total number of participants at 13 instead of 14. All learners are young women who are currently pursuing an undergraduate STEM degree or have recently graduated with one in the past year. They all have cross-cultural and trans-national educational experiences. All learner participants are above 18.

A document containing detailed information about the research and a written consent section was sent to participants before the interviews (see Appendix C). At the beginning of the interview, verbal consent from participants to record is given. Roughly following the interview schedule (see Appendix A), each interview lasts for approximately 30min, the longest at 42min and the shortest at 24min. They are audio-recorded and fully transcribed by the researcher. All data are stored locally on the researcher's computer. The process of interpretation follows the blueprint of thematic analysis outlined by (Terry et al., 2017). After findings have been generated, participants are presented with the option to review and edit writings about them through a document which includes the corresponding row of participant overview (see Table 1, 2 and 3 in Section 2.3), direct quotes if applicable and their contexts.

2.2.2 Reflections

Direct questions about participants' socio-economic backgrounds were not asked due to concerns of trust breaching between the researcher and the participant (Eide & Allen, 2005). It can nevertheless be inferred, based on participants' self-introductions and initial exposure to STEM, that not all of them come from middle-to-upper class families in high-income countries. While some learner participants are socio-economically disadvantaged, all of them have received higher education at American Gulf University (AGU), an elite institution that is structurally Western (See section 2.3.1 for more details). An intersectional lens is useful because it addresses how systems of privileges and underrepresentation can manifest in the lived realities of one individual (Crenshaw, 2019). It opens up the space for nuances in learners' experiences, where the different metrics that shape one's identity are dynamic and contextualized, and social privileges and disadvantages coincide (Martinez Dy et al., 2014).

It is also evident to me, from my interviews, that all learner participants have thought extensively about how the unique individual mapping of their identity influences their experiences of GIFSTEM programs. Individual qualitative interviews are valuable because

they illustrate the multiplicities of learners' perceptions, depending on their intersectional identities, of GIFSTEM programs, which fundamentally highlight 'gender' as the defining feature of an individual. As Convertino (2020) points out, personal accounts of learners of GIFSTEM programs provide much-needed nuances in the landscape of GIFSTEM literature which illustrate that learners' experiences "cannot be collapsed into a single, monolithic meta-narrative" (604). It is therefore fitting to analyze and cross-compare their accounts through qualitative interviews from an intersectional perspective. The participants, both learners and project leaders, do not need me to project their voices. By inviting participants to edit how they are presented, their quotes and how they are analysed, this research tries to maintain the "partnership" between the participant and the researcher in "telling the story of the data" (Goldberg & Allen, 2015, p. 14).

2.3 Sampling

As outlined in the previous chapter, there are four main gaps in current GIFSTEM literature: the need for more qualitative evidence, geographical breadth, voices of project organizers, and an approach that accounts for the nuanced experiences of different women of GIFSTEM organizations (Cohoon, 2002; Dee et al., 2009; Niler et al., 2019; Kemp et al., 2020). Grounded by an intersectional lens, this research utilizes qualitative methods to investigate how learners and POLs experience and organize GIFSTEM programs in a range of geographical contexts.

With the spirit of resonance, defined by Tracy (2010) as "meaningfully reverberate and affect an audience" (p. 844), this study presents personal accounts by learners and program organizers as situated knowledge which enables the readers to engage in processes of transferability (Lincoln & Guba, 1985) and naturalistic generalization (Stake & Trumbull, 1982).

2.3.1 Sampling of Learner Participants

All learner participants are recent alumni or current undergraduate students at AGU (American Gulf University). As the name suggests, AGU is a portal campus of an American university in a Gulf country. With abundant funding, AGU offers generous scholarships that cover relevant school and living fees, with many additional grants to support student's research and career needs on an individual basis. Roughly following a liberal arts education model (Pascarella et al., 2005), AGU also offers funded study abroad opportunities for

students at partner universities in a range of geographical contexts. This is how some learner participants were involved in more than 1 GIFSTEM program in locations other than their home country and the Gulf country. The generous financial support and opportunities attract a diverse student body, in which over 50% of students come from LMICs (Low-or Middle-Income Countries). More than a quarter of students at AGU are first-generation college students.

All learner participants satisfy two criteria: (1) They are currently pursuing, or recently graduated with, a STEM undergraduate degree at AGU. (2) They have participated in GIFSTEM organizations in addition to their formal STEM education.

Non-probability purposive sampling (Etikan et al., 2015) was used to recruit learner participants. The technique allows the researcher to select relevant sites such as organizations and people by "establishing criteria concerning the kinds of cases needed to address the research questions" (Bryman, 2016, p. 422).

Additionally, a snowball sampling strategy (Patton, 1990) was used in the later stages of the interview process, in which "the researcher accesses informants through the contact information that is provided by other informants" (Noy, 2008, p. 330). It can be an effective method of participant recruitment (Goodman, 1961). Individuals who meet the selection criteria and are interested in participating in the study were personally referred to the researcher by previous participants. While all participants fall under the umbrella term 'women in STEM' (Ahuja, 2002), it is necessary to note that a significant amount of inner variation exists among participants, both in terms of the specific discipline(s) of their undergraduate degree, as well as their cross-cultural backgrounds. This reaffirms the observation made by Vitores & Gil-Juárez (2016) that 'women in STEM' is a broad social category with complex inner differentiation.

All learner participants have lived and studied trans-nationally and cross-culturally. This means two things: (1) They are accustomed to education spaces rooted in but transcending the bounds of any single nation-state (Mahler & Pessar, 2001). (2) They have experienced different presentations of gender (Butler, 1990). There is room to explore whether their expectations and experiences of different GIFSTEM programs in different contexts differ due to the dependency of metrics of intersectionality on specific spatial contexts (Valentine, 2007). For example, 'race', a social category critical for an individual's identity in the UK, might not apply in the context of India, where 'caste' would be a more relevant identity metric (Haq, 2013). For an Indian female student studying in the UK, in addition to the metrics outlined by the two societies, they would also take on additional social

categories (e.g. immigration status) that also shape their experiences (Jang, 2018; Mirza, 2013). Using qualitative research methods in conjunction with an intersectional approach has the advantage to present the nuances in how different trans-national and cross-cultural learners perceive GIFSTEM programs they have participated in. As Jang (2018) describes, this methodology leaves space for the researcher to "thoroughly explore the meaning of students' multiple and less visible social constructs by actually talking with students about their identities" (1272).

Table 1 and Table 2 outline information about PL (past learner) and CL (current learner) participants of this research.

TABLE 1. Overview Of PL (Past Learner) Participants and Their Contexts

Pseudonym	*Bachelor's degree(s) Obtained*	*Cross-cultural Educational Experiences*	*Current Status*	*Current Location(s)*
Vaneet	Interactive Digital Media and Computer Science, minor in Design	U.S. Hong Kong, A Gulf Country *(specific country name removed for anonymity)*	Data visualization journalist at a media company	U.S.
Seo-Yeon	Electrical Engineering	South Korea, A Gulf Country	Engineer at a big Tech; Incoming Computer Science Master's student at a top American university	South Korea
Inaya	Computer Science	Sri Lanka, A Gulf Country	Product Manager at a Tech company	A Gulf Country
Laila	Electrical Engineering and Computer Science	Canada, Egypt, A Gulf Country, U.S.	First-year Electrical Engineering PhD student at a top American university	U.S.
Aubree	Computer Science	Ghana, A Gulf Country	Software Engineer at a big Tech	Canada

TABLE 2. Overview Of CL (Current Learner) Participants and Their Contexts

Pseudonym	*Year*	*Current Bachelor's Degree in Progress*	*Cross-cultural Educational Experiences*	*Educational/Professional Aspirations*	*Current Location(s)*
Marta	1	Economics and maybe also Computer Science	Hungary, A Gulf Country	Entrepreneurship	A Gulf Country
Shinar	3	Interactive Digital Media/Math, minor in computer engineering	Kazakhstan, A Gulf Country	Not sure, but something related to Tech	U.K.
Zabreen	3	Computer Science	A Gulf Country	Industry (Software Engineer/Data Analyst), or PhD.	A Gulf Country
Valini	2	Social Science and maybe also Computer Science	U.S., A Gulf Country	Not sure, but maybe quantitative social science research	Ghana

2.3.2 Sampling of Project Leaders

Similar to the recruitment methods of learner participants, non-probability purposive sampling was adopted in the beginning stages of this research. The researcher outlined a list of GIFSTEM organizations that meet one of the selection criteria: (a) Operates outside of North America or Western Europe. (b) Specifically includes non-binary learners in the mission statement. After sending outreach emails to eight organizations with no response, I pivoted into snowball sampling, I was able to successfully contact 5 POLs through referral emails by people in my network who have partnered with GIFSTEM organizations due to their work in Tech.

In the beginning stages of communicating with POLs, I also tried to explore possibilities of connecting with their learners. However, the recruitment process was unfruitful because of, POLs' privacy concerns for learners. This made me pivot to recruiting learners specifically from AGU who have participated in GIFSTEM organizations.

2.3.2.1 Participant Anonymization

I would also note that while in qualitative research, anonymization is treated as a default position for ethical reasons, in which "the researcher withholds the withhold the real names and locations of the settings and participants they study" (Nespor, 2000, p. 547), this assumption was challenged during my interviews.

The operating locations of GIFSTEM organizations are identified on a country level to create specific knowledge that does not treat regions as one homogenous entity (Heasley, 2021). The experiences of POL in organizing GIFSTEM programs are contextual, and I do not want to imply that one initiative's journey is representative of others in the region. However, one POL participant specifically asked to remove such specificity because of anonymity: Their organization is the only GIFSTEM program in the country. Another organization specifically asked not to be anonymized, perhaps because they are one of the few GIFSTEM programs specifically targeting non-binary coders.

These experiences reaffirm that researchers cannot take conventions established in academia for granted (Bouchard, 2016). Co-construction of knowledge with participants relies on a certain sense of flexibility (Nespor, 2000) by the researcher in the process of qualitative research. Table 3 presents an overview of POL participants.

TABLE 3. Overview Of POL (project leader and organizer) Participants and Operational Contexts of Their Affiliated GIFSTEM Organization(s)

Pseudonym	*Pronouns*	*Affiliated Organization(s) (Pseudonym)*	*Role(s)*	*Operating Locations*
Alicia	She/her	SheWhoCodes; MatchTech	Founding board member; Co-Founder	Switzerland
Seo-Yeon	She/her	SheWhoCodes	Founding board member	South Korea
Margareta	She/they	ChickTech (not anonymized per request by the organization)	National Programming Manager	U.S (with global expansion plans)
Ren	She/her	Tech Women in Dubai	Co-Founder	Dubai (U.A.E.)
Chris	He/him	Dot to Line	Advisor	East Asia (exact location removed for anonymization per request by the organization)

2.4 Data Gathering

Interviews are commonly described as an effective way in educational research to "delve deeper into the reasons behind student attitudes and to probe them with a depth and breadth not possible in quantitative surveys" (Choy, 2014, p. 103). Given the aim of this study, which is to explore the perceptions and experiences of different learners and project organizers of GIFSTEM programs in a range of geographical settings, the interview method is an appropriate choice.

Data was collected through individual online semi-structured interviews that lasted between 24 min and 42 min. Semi-structured interviews have the strength of connection building between the researcher and the participant in eliciting data centred on personal narratives (Galletta, 2013). The method has been commonly adopted by previous research on evaluations of informal educational GIFSTEM programs (Maric, 2018; Rushton & King, 2020; Convertino, 2020).

Due to logistical difficulties (e.g. travel restrictions, the wide-ranging contexts), online interviews were conducted for the flexibility of both the interview location and time (Deakin & Wakefield, 2014). O'Connor et al. (2008) comment on the benefit of online interviews which mitigates distances and costs associated with travelling for in-person interviews. Online interviews could facilitate responses that are more reflexive and socially desirable than more traditional interview methods (Denscombe, 2010; Cabaroglu et al., 2010).

Online interviews also give participants the option to withdraw from the study at any point in the process by clicking a button (Janghorban et al., 2014). This did happen during one POL interview (not included in Table 3 and data from this interview is discarded). The POL, 15min into our call, commented that he did not feel comfortable speaking on behalf of the organization and exited the Teams meeting.

Some challenges come with online interviews. For instance, the method requires stable internet access for all parties, which could be problematic when conducting research with marginalized participants (Hay-Gibson, 2009). This drawback did not impact the data gathering of this research, as all participants have a device with consistent internet. An additional drawback of online interviews is participants might feel uncomfortable being filmed (Deakin & Wakefield, 2014). To mitigate this, the document sent to participants before the interview informs them that only the audio files of recordings would be used.

Additionally, participants were asked for verbal consent for recording at the beginning of each interview and given the option to switch off their cameras.

The interview stage of this study has two phases. In the first week of May, I interviewed two PL participants. The recordings were subsequently transcribed, coded, and analyzed. This is to check if any unexpected themes emerge during actual interviews. The themes from those two interviews did map on to research questions, and therefore it was unnecessary to change the interview questions. The first stage of online interviews was also helpful in developing 'small chats' to develop a sense of familiarity and trust between the researcher and the participant (Bignold & Su, 2013) before rolling out the interview questions. The two initial interviews were beneficial in my decision to have a 3-5min conversation with participants on questions not related to this research to develop a personal connection in a relaxed virtual atmosphere (Deakin & Wakefield, 2014). This was also an opportunity to gauge a sense of participants' educational and cultural backgrounds. The second round of interviews with the remaining 11 participants was conducted between mid-May to mid-June.

For each interview, the researcher asked questions in the following areas (full interview schedule in Appendix A):

1. The structure of GIFSTEM program(s) the participant is involved in, either as a learner or organizer – this is to contextualize which strategies the program adopts, mapping onto the 3 common strategies of GIFSTEM programs outlined in Section 1.3.
2. Motivations for joining/working for the program – this is to evaluate participants' expectations for the program.
3. Impact of the program – for learners, this is to gauge to what extent they feel their expectations are met (PL) /are being met (CL). For POL, this explores the internal mechanisms of their organization in outcome measurement.
4. The contrast between participating in the program and experiences of formal education/industry (if any): This is mainly targeted at learners to understand how they feel their gender is being perceived differently, if at all, within and out of the program.
5. Considerations when designing program structures and relationships with commercial partners. This is mainly targeted at POL in exploring how GIFSTEM organizations navigate conditions of their specific operational contexts, as well as increasing interests from the public and private sectors in the field (See Section 1.2).

While there is an interview schedule, it is adapted to fit each participant. Depending on the interview, the researcher asks slightly different questions that all fit into the five question themes. The interviews were not entirely naturalistic and unstructured (Madill, 2011), but rather there is flexibility in accommodating participants' preferences. This is also aligned with the nature of semi-structured interviews, during which, as Brown & Danaher (2019) describe:

> *The interviewer has prepared a list of topics to be explored, and questions to be asked… but also ensures that the questions elicit open responses by the participants that enable lines of conversation to be developed in ways that could not have been anticipated when the interview schedule was being planned. (p.77)*

I am fortunate to have participants who are passionate about sharing their experiences. When they are sharing their reflections and thoughts, I choose not to disrupt their flow but rather raise follow-up questions to engage in the co-construction of reality by the participant and the researcher, based on their individual experiences participating and organizing GIFSTEM programs (Bignold & Su, 2013).

2.5 Analysis

All interviews were conducted, audio-recorded, transcribed, coded, and analyzed by the researcher. Each transcription is reviewed with its audio file and annotated at least three times. The process of thematic analysis loosely follows the 6-step framework outlined by (Terry et al., 2017).

While CAQDAS are helpful tools for the researcher to manage data in the coding process, the choice between manual and electronic analysis is individual. As Basit (2003) points out, the preference could be determined based on "the size of the project, the funds and time available and the inclination and expertise of the researcher" (p. 152).

CAQDAS such as NVivo and Leximancer have the limitation of potentially decontextualizing data and losing non-verbal cues (Rettie et al., 2008). I choose not to conduct qualitative content analysis through CAQDAS for two reasons. The major advantage of such tools is to assist researchers in processing and analyzing large quantities of data (Sotiriadou et al., 2014; Saldana, 2015). The relatively small sample of this research means

that the benefit would not be felt, but the researcher still needs to spend a significant amount of time learning and choosing between different qualitative data analysis software (Dollah et al., 2017). Denscombe (2010) notes that while CAQDAS can assist the researcher in organizing and storing data more automatically, "basic word processing software such as MS Word" can be equally useful in the analysis process of small-scale qualitative research (p.329). I find the colour-coding and text adjustment options of more traditional software, not specifically designed for qualitative data analysis, to be more suitable.

In the context of this research, 'manual' coding is not necessarily using physical artefacts such as note cards and cut-and-paste (Basit, 2003). Microsoft Word and OneNote, access provided by the University of Oxford, were used for qualitative data analysis. On my local computer, I create a folder for each participant with four files: the audio recording of the interview, the original transcript, the coded transcript, and emerging themes. In my OneDrive, I create a OneNote section group that entails all the themes of each interview, sorted by their categories (e.g. PL, CL, POL). After separate and individual analysis of each interview, initial themes are combined, edited, and refined to construct the findings of this research.

2.6 Ethical Considerations

This research is underlined by the BERA Ethical Guidelines for Educational Research. It also received approval from the Education Departmental Research Ethics Committee (DREC) under CUREC reference number CIA-22HT-047 (Appendix B). While I find it ethically ambiguous to directly ask participants for their demographic information, each participant is asked to introduce themselves at the beginning of the interview.

I did not contact individual learner participants only because of their gender in the spirit of non-essentialization (Berg & Lie, 1995). The 'outness' associated with participating and affirming one's pronouns (Goodrich et al., 2016; Staples et al., 2018; McCann et al., 2021) is possibly one of the reasons why all learner participants in our study identify as cisgender. It does happen to be that one of the POL participants adopts the non-binary pronouns (they/them) as well as the pronouns she/her.

All participants signed a written informed consent form (Appendix C). At the beginning of each interview, participants also gave additional verbal consent to being audio-recorded, and the recording to be transcribed and analyzed. To protect anonymity,

identifiable information of participants, including names, universities, and affiliated organizations, has been unidentified as per CUREC.

2.6.1 Data Presentation: Vignettes and Opening Quotes in Reporting Findings

In answering RQ1[3](see Section 3.1), findings are presented through the vignette technique. Vignettes, defined by Hughes (1998) as "stories about individuals, situations and structures which can make reference to important points in the study of perceptions, beliefs and attitudes" (p. 384), can be particularly useful in qualitative research (Miles, 1990; Rizvi, 2019; Skilling & Stylianides, 2020). The major limitation of the method is when being used in isolation (Faia, 1980; Hughes, 1998). This study, however, combines vignettes with semi-structured interviews.

After presenting the most fitting vignettes of three themes for RQ1, direct quotes are used to open findings on RQ2[4] and RQ3[5] (See Sections 3.2 and 3.3). Direct quotes effectively highlight the themes being presented (Hays & McKibben, 2021). Gioia (2021) also notes that participants' quotes have the benefit of "not only giving voice to informants, [but] also sending a strong message to readers: I am reporting what informants told us, in their own words" (p.26). The combination of opening each section of findings with either a vignette or a direct block quote aligns with the intersectional framework of this research. They capture the multiple facets of individual experiences of specific situations in participants' own words (Barter & Renold, 2000; Shields, 2008; Gioia 2021).

2.7 Mitigating Limitations and Room for Future Research

There are several limitations to this study. The interactions during the interview are co-constructed by my participants and me (Guba & Lincoln, 2000). Findings of this research are therefore accumulated and shaped by our positionalities and subjectivities. Through "seeking sites of commonality across difference" (Cole, 2009, p. 175), I acknowledge that the knowledge generated from our interactions is influenced by the specific contexts of my participants' lived realities (Olive et al., 2015). Although this study fills in a gap in existing GIFSTEM literature through qualitative accounts of learners' and project leaders' experiences

[3] What are the benefits of GIFSTEM (gender inclusion for STEM) programs perceived by different learners?
[4] What are the barriers learners feel like they face when considering STEM-related professions/postgraduate studies, and to what extent are they mitigated by GIFSTEM programs?
[5] What are the (a) aspirations of (b) challenges for different GIFSTEM organizations?

in a range of geographical settings, 13 participants is nevertheless a small sample size. More research is needed to investigate the extent to which the findings of this study apply to both GIFSTEM organizations in different locations, as well as the experiences of different learners.

Several scholars have already pointed out that while GIFSTEM literature often uses the term 'gender inclusion', often only specific groups of cis-women are included (Vitores & Gil-Juárez, 2016; Fisher & Jenson, 2017; Heasley, 2021). This research initially tried to fill in this gap by including accounts from non-binary and womxn learners, as well as from POLs of GIFSTEM programs that specifically operate beyond the gender binary. However, after 2 months of outreach, only 1 response (from ChickTech) was received. While I try to frame the research and interview question, as well as the overall framework, to not assume the gender binary, more study is needed to specifically assess the experiences of learners of marginalized genders in GIFSTEM programs.

In the initial design stages of the methodology, focus group interviews were also considered for discussion facilitation (Dilshad & Latif, 2013). However, as the interview progressed, data from individual interviews was so rich that it was no longer necessary. It was also logistically not feasible due to time constraints. Future research could utilize a combined approach of both individual and focus group interviews to observe whether different themes emerge (Lambert & Loiselle, 2008).

The findings of this research, while broadening the currently U.S.- focus in literature, are by no means representative of all women coders' experiences in GIFSTEM programs from these regions, countries, or even cities. More future research that employs a diverse range of qualitative methods is needed in evaluating the perceptions of participants with different intersectional identities in a range of spatial contexts (Ireland et al., 2018). The accounts I present are personal to the lived experiences of my participants. Yet there are overlapping themes in their responses, which potentially address the gaps in the literature presented in Section 1.4. I will dive deeper into these findings in the next chapter.

Chapter 3: Findings

This chapter presents findings in two parts. It first explores learners' experiences participating in GIFSTEM organizations, both in their benefits and relationships to learners' perceived barriers in entering and remaining in STEM professions and postgraduate education. The vignette method is used as a section opener for RQ1 findings in presenting multi-faceted individual experiences. Then, project organizers' and leaders' accounts of their organizations' aspirations, evaluations, and challenges are presented. Findings on RQ2 and RQ3 are opened with direct quotes that capture the essence of the theme discussed.

RQ1: What are the benefits of GIFSTEM (gender inclusion for STEM) programs perceived by different learners?

3.1.1 Community

> Marta is a first-year AGU (American Gulf University) student deciding between majoring in Economics or CS (Computer Science). Living in Hungary until university, Marta started joining GIFSTEM programs because she wanted to learn coding with a community. She began her CS journey with a two-week virtual web development course the summer before university. Having enjoyed the experience, Marta kept exploring the field through introductory classes and attending YesSTEM [GIFSTEM student organization on campus] events. She realized learning CS through formal education is not for her, and instead wanted other ways to continue developing coding skills. Marta feels supported by the YesSTEM community in learning resources and connections. She is also doing a summer internship with FunCode (pseudonym), a startup founded by AGU and YesSTEM alumni that uses interactive methods to engage young girls in coding. Marta wants to keep learning CS at her own pace with other peers at YesSTEM. Her career goal is to be at the intersection of Finance and CS with a start-up of her own.

Like Marta, five other learner participants initially joined GIFSTEM programs for a supportive community. Beyer et al. (2004) found a high sense of social isolation among 567 first-year women university students who had taken a CS course in the U.S.. As Cohoon (2002) points out, support from peers of the same gender is essential for the retainment of

women students in CS. Cohoon (2001) also found that CS departments with a roughly equal gender ratio all have enough numbers of female students in each class for same-sex support. While departmental change on gender inclusion can sometimes be a long-term administrative process (Alvarado & Dodds, 2010).

GIFSTEM programs have the advantage of providing informal learning communities outside of classrooms (McPherson, 2014) as spaces for same-gender peer socialization and support that encourage learners to pursue education and careers in STEM disciplines (Wang et al., 2012). The community benefit is critical considering the male-dominated reality of most STEM classes. Petrucci (2020) observes that gender-inclusive meetup groups provide training, mentorship and support that are pivotal for individuals of underrepresented genders to remain and succeed in the Technology sector.

Such findings are reaffirmed by participants' contrasting experiences between STEM learning in GIFSTEM programs and that in their formal education. Inaya, a CS graduate who is now a product manager at a fast-growing Tech start-up, reflects feeling intimidated and insecure when she first started university. While having taken many Math classes in high school back home in Sri Lanka, Inaya did not start learning CS until university:

> *I wrote my first line of code in college… I had no prior experience… YesSTEM gave me a good support group with others, especially women, who have similar struggles. It just created a good bond because I think Tech is skewed more towards males than females*. (Inaya, PL)

The need for a community is also echoed by Shinar, a rising fourth-year student majoring in Interactive Digital Media and minoring in Computer Engineering. Having gone to a STEM high school in Kazakhstan, Shinar knew she wanted to bond with other STEM peers at AGU: "*In college, I wanted to connect to more people who[6] shared my background and struggles in the field*". In addition to YesSTEM, Shinar is also involved in the Facebook group 'Women Rewriting the Code', two other gender inclusion mentorship programs with a 'Big Tech'[7] and a leading investment banking company, and the AGU alumni start-up

[6] Shinar has a speech disability which mainly results in stuttering. For the flow of text, the stuttering in Shinar's quotes is edited out but nevertheless indicated with an underline. This preference is made by the participant.

[7] A name given to the largest U.S. companies in the information technology industry (Financial Times, 2018).

FunCode (pseudonym). Through participating in a wide range of GIFSTEM programs, Shinar hopes to find communities that correspond to different metrics of her identity:

> *The main goal for me is to connect to people, share our experiences, empower each other, and find support in our individual ways… I didn't know where my identity was, at the intersection of these two strands* [of being a woman and a person with a disability]. *They* [GIFSTEM programs] *were really helpful for me in finding my own voice.* (Shinar, CL)

These accounts resonate with previous scholars' findings on the significance of a supportive and welcoming space, providing assurance and affirmation for different underrepresented groups in STEM (Farinde & Lewis, 2012; Cross et al., 2020; Zheng & Walsham, 2021). One benefit of GIFSTEM programs is the same-sex community for women STEM students (Cohoon, 2001; Petrucci, 2020) that help them navigate and integrate different aspects of their identity into their learning and working environments (Martinez Dy et al., 2014).

3.1.2 Networking-Mentoring

> Aubree, having moved to AGU from Ghana, accidentally became a CS major after stumbling upon an introductory CS class. After graduation, she became a software engineer at a Big Tech company in Canada. Aubree only started participating in GIFSTEM programs in her third year. She mainly wanted to access professional development resources that she felt her formal CS curriculum lacked, in addition to connecting with others also experiencing the Tech recruitment processes. For Aubree, groups such as YesSTEM and GIFSTEM conferences were crucial in gaining information, such as preparation tips for interviews at different Tech companies, through meeting new peers. She decided to join an established Tech company because of visa sponsorships and their structural professional developments for new hires. Having heard "*horror stories*" of some women software engineers' working experiences, Aubree worried about collogues not giving her the space and trust to perform. Luckily, her current manager, also a woman, has been nothing but

> supportive. Aubree thoroughly enjoys her current work and jokes that her manager looks after her even more than she does for herself.

Scholars have argued that women STEM learners' sense of belonging in the field is correlated with seeing role models of the same gender (e.g. Lockwood, 2006; Stout et al., 2011; Mattheis, 2018). Aubree, initially joining GIFSTEM programs for networking, expresses feeling another benefit of GIFSTEM programs. She recalls feeling more confident about starting a Tech career after meeting different women, particularly women leaders, in STEM-related industries at the U.S. GHC (Grace Hopper Celebration) conference[8]:

> *This person. started as a student like I did. is now the director or senior engineer* [of a multi-national company]. *That was really inspiring for me, knowing that I'm not the only one going through the process* [of gradually building a Tech career]. (Aubree, PL)

Aubree is not alone in benefiting from the networks and opportunities to hear success stories of women industry leaders through participating in GIFSTEM programs. Zabreen, a current third-year CS major, is also involved in various GIFSTEM conferences. She feels particularly encouraged when meeting successful women in the industry, particularly if they also wear the hijab: "*These incredible speakers* [at conferences] *are very, very inspirational… There was also a hijabi woman, which I really like because I could connect with her at a different level*". After actively participating in YesSTEM for two years, Zabreen is also now a board member of the organization: "*The network is incredible. As I'm organizing all these panels, I reach out to other women, alumni who have done incredible things, who share their achievements and journeys.*"

Zabreen's experiences illustrate how GIFSTEM programs provide opportunities where learners can also be organizers of events. This is a feature central to what Swoboda & Millar (1986) term 'networking-mentoring'. As the name suggests, it encompasses elements of a network (e.g. nonheretical connections) and the process of mentoring (e.g. an industry professional sharing her career trajectory and tips). At the heart of networking-mentoring is the dynamic nature of one's role: A member of the group, who sometimes is a mentor to

[8] GHC (Grace Hopper Celebration) is the one of the biggest gatherings for women in computing (GHC, 2019). It mainly operates within the U.S., but have also expanded to other regions with programming such as the EMENA (Europe, Middle East, and Africa) conference (GHC, 2022).

others, can also learn and benefit from the network (e.g. timely updates on the latest Tech start-up trends) (Haring, 1999). Networking-mentoring in GIFSTEM organizations is evident in two ways: Between student members and external collaborators (e.g. speakers who are industry experts), as seen in Zabreen and Aubree's experiences. It also occurs internally, both among participants of different school years and between current and past participants of the program.

Through building a network, learners also have opportunities to shape the programming of the GIFSTEM organizations they participate in (Haring-Hidore, 1987). Several learners are themselves GIFSTEM project organisers. Zabreen speaks about feeling motivated to organize YesSTEM events after being a consistent participant:

> *I know this is cliche, but* [I'm staying on the YesSTEM board] *to make an impact and help other women in Tech who are being affected because of the lack of representation* [of different women in STEM]*... I was hearing so many stories about freshman girls in CS dropping their major because they were really intimidated by their classes, professors, and male colleagues. It really broke my heart.* (Zabreen, CL)

This sentiment is also echoed by Seo-yeon, an AGU graduate who is now on the board of the South Korean branch of SheWhoCodes (pseudonym), a global GIFT (gender inclusion for Tech) organization:

> *Just getting along with them* [SheWhoCodes South Korea members]*, hearing news through them about the tech industry here in Korea and other global networks is very inspiring… I'm trying to be at the heart of women empowerment in Tech*[9]*… We show girls that there are successful women leaders* [in Tech]. *We're trying to empower women so they can also become industry leaders.* (Seo-yeon, PL and POL)

[9] There has been increasing discourse on the (sometimes inconsistent) application of 'women empowerment' in STEM and ICT (information and communications technologies) sectors (e.g. Santillan-Rosas & Heredia-Escorza, 2020; Mackey & Petrucka, 2021.). While it is beyond the scope of this research to discuss this debate in details, it could be an important angle for future studies that evaluate GIFSTEM initiatives.

Data from PL and CL interviews suggests that GIFSTEM programs enhance learners' sense of confidence in entering and remaining in STEM (Ahuja, 2002). GIFSTEM organizations, therefore, also have the benefit of networking-mentoring, resulting in opportunities for learners to (a) connect with established women in STEM-related fields that resemble different aspects of their identities, (b) become program organizers, and (c)act as role models for other underclassmen women STEM learners.

3.1.3 The Unexpected Benefit: Possibilities of Different STEM Paths

> Vaneet, self-described as "*culturally confused*", started participating in GIFSTEM programs in high school with an all-girls robotics team. During her studies at home, the U.S., and in Hong Kong, Vaneet also organized outreach programs for other youths interested in STEM. She continued her engagement in GIFSTEM initiatives at AGU, receiving various grants for different competitive programs. Vaneet also was one of the board members for YesSTEM, leading various community outreach programs to engage middle and high school students of all genders in STEM. Despite an impressive CV, Vaneet often felt like a "*fraud*", not entirely confident in her coding abilities. Two things helped her navigate the imposter syndrome: the community of women in STEM at AGU, and the discovery of data visualization, her current passion and career path. Vaneet reflects that she discovered this field through events of different GIFSTEM programs rather than her formal CS education.

Like Vaneet, six learner participants mention a broadened understanding of different education and career paths in STEM to be one of their biggest takeaways from GIFSTEM initiatives. This supports literature findings on the importance of informal educational GIFSTEM programs in providing learners with room to explore various avenues of STEM disciplines (Dorsen et al., 2006; Nugent et al., 2015; Dou et al., 2019). Additionally, while a range of STEM fields emerge when participants speak about pursuing postgraduate studies after AGU, possible careers tend to focus on the Tech field, regardless of their undergraduate major(s). This is likely due to the rapid expansions of different technologies in a wide array of industries, resulting in changes in the fundamental nature of work (Pereira & Romero, 2017). All learner participants of this study are currently, or express interests in, pursuing, postgraduate and professional opportunities in different HICs. This aligns with data on the

increased cross-border and employment-based migration, particularly from LMICs to HICs, in the past 50 years (Manyika, 2017).

Discussions on the changing nature of work perhaps also explain why learners find GIFSTEM programs so beneficial in helping them understand possible STEM education and career paths (Gagnon & Sandoval, 2020). This contribution, compared to the benefits of community and networking-mentoring, is much less discussed in GIFSTEM literature (Eccles, 2011; Solanki & Xu, 2018; Sinclair et al., 2019).

Vaneet, now a data visualization journalist, was considering leaving STEM after graduation until realizing the social impact potential of a Tech career through GIFSTEM programs: "*I was feeling a lot of tension about whether I can ethically be in Tech. Our CS program really only showed us the software engineer path.*" It was through attending different workshops by speakers at various Tech roles that Vaneet began exploring more 'non-conventional' jobs in the industry:

> [Through GIFSTEM programs], *I was learning that other paths are possible… That I wasn't a failure if I didn't want to be a software engineer at Amazon. For the longest time, I kept trying to fit myself into that mould… I felt like I had to prove to my peers that I could do it. But at the same time, I had absolutely no desire to work at Facebook or wherever… I* think [one of the benefits of GIFSTEM organizations] *is just learning that other paths are possible*. (Vaneet, PL)

Several other learner participants also talk about the benefit of GIFSTEM programs in helping them realize paths other than being a 'software engineer at a Big Tech'. Inaya, currently working as a product manager at a Tech company in the Gulf region, says GIFSTEM programs broadened her understanding of different career options:

> *I think sometimes you're sort of hammered in with this mindset of 'If you graduate with CS, you go into software engineering'. YesSTEM gives space for other women that have taken alternate paths and broadens your thinking* [of Tech careers]. *Maybe you'll find something that you like doing that you didn't even know existed, which was the case for me.* (Inaya, PL)

Laila, who graduated with a double major in EE (Electrical Engineering) and CS, is now a first-year PhD EE student at a prestigious U.S. university. She is also working as a researcher for a 'Big Tech' company. Laila reflects on the lack of departmental information on different Tech careers in her formal STEM education:

> *I remember attending one of the sessions that the Engineering department held. It wasn't student-led. The department had professors talking about engineering and the options after graduation. Everything that they mentioned seemed so limited.*
>
> *But because I was talking to people from YesSTEM. I had external resources. It's just realizing that sometimes schools are not up to date with what's actually happening when it comes to Tech… I would tell all the freshmen and sophomores that if you want to figure out what to do in the summers, just talk to people from YesSTEM.* (Laila, PL)

These reflections reaffirm findings in Wang & Degol (2013) calling teachings of STEM, both formally and informally, to inform women learners of "the diverse options available in various STEM careers":

> Conveying that math and science careers have a beneficial impact on society and involve work with people, may allow math competent females to better equate the utility of these careers with their personal goals and values (p. 27).

GIFSTEM programs, therefore, benefit learners in supplementing their formal education with an expanded understanding of possible STEM educational and professional opportunities.

RQ2: What are the barriers learners feel like they face when considering STEM-related professions/postgraduate studies, and to what extent are they mitigated by GIFSTEM programs?

3.2.1 Heightened Visibility and The Pressure for Excellence

> *"I feel like the main issues I would face is not being seen for my skills and what I bring to the table, but rather for what I look like and who I am".* (Zabreen, CL)

Zabreen is not alone in her concerns about getting an educational or professional opportunity in STEM only because of certain underrepresented aspects of her identity. Seo-yeon echoes the sentiment. As one of the few women in an engineering team of 60, she is often hyperaware of her gender. "*No one makes me conscious about my gender in my work. I just sometimes realize, especially when they* [male colleagues] *are talking about the military service that I can't relate to… These are moments where I just have to be conscious about my identity"*.

Seo-yeon reiterates that none of her male colleagues did or said anything, and that "*it* [being one of the few women at work] *doesn't work as a negative for me, but depending on the personality or the situation, it can hugely negatively impact someone's career as a woman*".

Such hyper-awareness is compounded when learners embody more than one underrepresented social categories. Laila shares encountering people who are surprised to see a Middle Eastern hijabi woman in her current position:

> *Sometimes they will be like: "You don't look like someone who is doing a PhD." … I guess their image of someone doing an EE PhD is not necessarily someone who looks like me. I would say it's already a surprise if a woman is doing an EE PhD. It is even more when you are a woman who also ticks other minority boxes.* (Laila, PL)

These accounts reaffirm previous findings on underrepresented groups in STEM experiencing simultaneously hypervisibility and invisibility, making learners feel their credibility is delegitimized because of their minority status (Sandler & Hall 1986; Ahuja,

2002; Wilkins-Yel et al., 2019). Convertino (2020) notes: “In the domain of CS, it is the sign of invisibility or marked visibility of the object (woman) that circumscribes the subject (man) as the regulatory norm” (p. 597).

Several learners speak about their experiences with passive-aggressive comments from their male peers, which also heightens their feelings of hypervisibility and imposter syndromes (Murphy et al., 2018; Allen & Peterman, 2019). Laila notes that many of such comments come from male peers who also have identity metrics (e.g. immigration status) that disadvantage them in STEM education and professions:

> *One of the things that hurt the most, and this is a thing that I have been hearing a lot, is not necessarily from people within the U.S. but other minorities outside of the U.S. applying for U.S. schools. People will be like, “If you are a multi-minority who is also a woman, you could be less experienced or less qualified for a position, but they would take you just because you fit some diversity boxes.” I think* [this] *is a very harmful narrative because that's definitely not the case.* (Laila, PL)

Zabreen also shares how such comments add to her concerns of only being seen for her minority status rather than technical abilities:

> *I feel like that that mentality* [male STEM peers saying that it's easier for women to get competitive jobs*] also contributes to my imposter syndrome. I feel like whenever I get a great opportunity, I think to myself “Ohh, they probably just wanted me as a diversity hire”, or “They only pay attention to me because they needed a diversity person”. So yeah, I feel like that way of thinking is really toxic.* (Zabreen, CL)

At the same time, such visibility partially results from the benefit of GIFSTEM organizations in raising awareness of the STEM gender gaps issue. The “in/visibility paradox” (Faulkner, 2009, p.169) is therefore experienced by learners simultaneously. Inaya, for instance, articulates the mixed feelings she has regarding GIFSTEM organizations:

> *It's positive in the way that I feel like I'm made visible in spaces where I sometimes feel invisible or inadequate. It's not good in the sense that the framing can sometimes be that every woman in Tech is brilliant. There is no space for an average female engineer.*
>
> *Sometimes it feels like to belong to 'women in Tech', you have to be exceptional, like co-founding multiple start-ups. There is no space for mediocrity. But there are so many average male engineers. There is space for men to just be OK, but I don't think that's the case for women in Tech* (Inaya, PL)

Laila echoes feeling this pressure for excellence as a multi-minority in STEM:

> *It does feel like if you're not excellent, you shouldn't be here because you're a double and triple minority. You're not a person who should be occupying these places, because you are not as 'normal'. So other people can just do their own thing. They can just exist. But then you gotta be excellent… When you feel like you are the picture and the ambassador for everyone else who looks like you. Almost like, if you do not meet this expectation, then you're failing your job.* (Laila, PL)

These accounts reaffirm previous research on individual underrepresented women in STEM feeling the pressure to represent their entire social category (Herzig, 2010; Charleston et al., 2014). For instance, Yamaguchi & Burge (2019), examining experiences of black women in computing education and professions in the U.S., notes that "participants expressed the pressure and stress, acknowledging the high standards and stress they put on themselves for excellence, but the stress they feel in representing a whole subgroup" (p.225).

One of the biggest barriers learners feel in remaining and advancing in STEM postgraduate studies and professions is therefore a heightened sense of visibility and its by-product- the pressure for excellence. While GIFSTEM programs can provide communities for different women in STEM, thereby reducing feelings of isolation (Wilkins-Yel et al., 2019), data from this study suggest they do little in removing these tensions individual learners experience.

3.2.2 Included but Excluded: An Intersectional Lens

> *"We see a lot of programs from top Tech companies trying to support women. But I also see that it's all on the surface level. Yes, they are trying to support us. They have all this programming and mentorship. But are they willing to dig deeper into the main reasons why different kinds of women are not present in STEM?"* (Shinar, CL)

GIFSTEM programs have a premise which highlights 'gender' as the defining social category of an individual (Faulkner, 2009; Cheryan & Plaut, 2010). This results in some learners having trouble finding one initiative that addresses their other needs due to their different intersectional identities. Shinar finds herself in limbo when applying for summer internships. As a woman with a speech disability, exploring opportunities in the U.S. and the U.K., Shinar needs accommodation and visa sponsorship from her employer. She shares frustrating situations where, despite the company having gender-targeted programs, her needs are ignored:

> *I think that the challenge that I've been facing the most is communicating to employers and hiring managers at all stages of the application: "Hey, I am a person with a disability. These are the accommodations that I need. Are you able to provide those for me?" Unfortunately, not a lot of companies and people are willing to go that extra mile.* (Shinar, CL)

Zabreen also talks about feeling isolated when attending a GIFSTEM conference in the U.S. which did not consider immigration status in their programming, leaving few opportunities that she can pursue:

> *The issue is that every recruiter I've met [at the conference] wasn't willing to hire someone without work authorization in the U.S.… I mean it's great that there are these conferences where influential women speak, but there aren't really any job opportunities for people who are not just women, but also women from the Middle East without U.S. work authorization.* (Zabreen, CL)

Three other learners also note that many 'international' GIFSTEM programs tend to focus on North America and Western Europe. Aubree, for instance, reflects:

> *Experiences in North America are different from those in other places, but people* [GIFSTEM organizers] *talked about it in a homogenous way, not thinking about other people that may not necessarily come from the places that they're thinking*. (Aubree, PL)

Zabreen also shares her experiences attending a GIFSTEM conference marketed for the EMENA region, only realizing that most of the programming was focused on the 'E' and little on the 'MENA':

> *They call it Europe, the Middle East and Africa. Europe is at less than 1/3 of the framing. But most of the speakers were Europeans and they were one or two Middle Eastern and African speakers… I also feel like usually when there's a hijabi woman in the conference, they are more like an afterthought or just included there for diversity purposes… So I was left out of both spaces* [the U.S. and the EMENA GIFSTEM conferences]. (Zabreen, CL.

These experiences illustrate the need for GIFSTEM organizations to adopt more intersectional framings. Due to the cultural and context-specific nature of identity, learners could experience feelings of isolation and further marginalization when engaging in GIFSTEM programs that are designed with little consideration for their various identities (Ahuja, 2002). Wang & Degol (2013) observe the importance of more cross-cultural and cross-national comparative studies on gender and STEM education because of the contextual nature of identity.

Learners' accounts echo previous research on the danger of prescriptively applying intersectionality as a theoretical framework in evaluating GIFSTEM initiatives, thereby essentialising certain underrepresented social categories and failing to present the nuanced lived experiences of individuals with such categories (Dill & Zambrana, 2009; Nash, 2017).

Different learners experience GIFSTEM programs differently due to their intersectional identities. There are, nevertheless, common themes in these varied individual perceptions, both in the benefits of such programs and the barriers they feel they face in STEM. How are these initiatives designed and evaluated internally? As Johnson et al. (2020) point out, the program structures and deliveries of GIFSTEM initiatives can also be shaped

by the intersectional identities of their organizers. The next section presents the relationships between five project leaders' lived experiences and their affiliated GIFSTEM organizations.

RQ3: What are the (a) aspirations of (b) challenges for different GIFSTEM organizations?

3.3.1 Goals, Program Strategies, and Impact Measurement of GIFSTEM Programs

It is challenging to implement effective GIFSTEM programs because of the structural contributors to the STEM gender gaps (Ziegler & Stoeger, 2004; Weisgram & Bigler, 2007; Peña et al., 2021). Boehmer & Schinnenburg (2018) outline how contextual gender roles, such as social expectations of mothers being the primary child caregivers, can prevent women from advancing in careers. Petrucci (2020) concludes that while GIFSTEM initiatives such as informal meet-up groups have benefits (e.g. community-building) for individual gender minorities in the field, they might have little effect in disrupting the broader social systems that result in their underrepresentation. Depending on their goals, GIFSTEM organizations adopt distinct program strategies contextualized to their operational contexts with different impact measurement methods (Diekman et al., 2015).

While the overarching goal for GIFSTEM programs is to bridge the STEM gender gaps, their visions can nevertheless vary. The five POL (project organizers and leaders) participants of this research outline the following end goals for their organizations:

- More women entering and remaining in STEM education and careers (G1).
- A 50/50 gender balance in senior leadership positions of all Tech companies (G2).
- A community that provides safe spaces for women in STEM to learn from and with each other(G3).
- Increase women's engagement in STEM subjects and professions for their empowerment or/and financial independence(G4).
- Strong and supportive local networks that connect all marginalized genders in STEM with each other(G5).

These goals, like program strategies, are not self-exclusionary. Several organizations I interviewed utilize different programs to achieve their visions. As discussed in Section 1.3, GIFSTEM programs typically adopt any number of 3 common strategies (Petrucci, 2020):

- Community building and networking-mentorship for women in STEM education and professions (S1).
- Skills training and development in an individual or group setting(S2).
- Alleviation of broader structural issues that manifest in barriers for women to enter and remain in STEM through providing resources to individual women learners and policy advocacy on a social level(S3).

Table 4 below outlines relevant information about five the POL participants and their affiliated organizations.

TABLE 4: Overview of POL Participants and Affiliated Organizations

Pseudonym	*Pronouns*	*Affiliated Organization(s) (Pseudonym)*	*Role(s)*	*Operating Locations*	*End goal(s)*	*Programming Structures*
Alicia	She/her	SheWhoCodes; MatchTech	Founding board member; Co-Founder	Switzerland	G1+G3+G4; G1+G2	S1+S2; S1+S3
Seo-yeon	She/her	SheWhoCodes	Founding board member	South Korea	G1+G3+G4	S1+S2
Margareta	She/they	ChickTech (not anonymized per request by the organization)	National Programming Manager	U.S (with global expansion plans)	G1+G3+G4+G5	S1+S2+S3
Ren	She/her	Tech Women in Dubai	Co-Founder	Dubai (U.A.E.)	G1+G3	S1+S2
Chris	He/him	Dot to Line	Advisor	East Asia (exact location removed for anonymization per request by the organization)	G1+G3+G4	S1+S2+S3

POL interviews show that all five organizations, with different visions, end goals, and programming structures, nevertheless use a combination of quantitative and qualitative data for impact measurement, just with different metrics. Quantitative data in this context is mainly numerical. For instance, changes in the number of participants hired by Tech companies (MatchTech), the percentage of underrepresented demographics in participants (ChickTech), or the retention rate between different programs within the organization (Tech Women in Dubai, SheWhoCodes, Dot to Line). The most common numerical metric used is the number of attendees in each event/program (all five organizations).

Numerical values might provide important insights into organizational growth but are not sufficient indicators for participants' satisfaction alone (Peña et al., 2021). To gauge a more in-depth understanding of changes in learners' sense of belonging in STEM (Wilkins-Yel et al., 2019), GIFSTEM organizations also utilize qualitative methods such as surveys to evaluate their impacts. For instance, ChickTech adopts surveys that measure the differences between a learner's confidence, belonging, and comprehension before and after participation. Dot to Line also runs a before-and-after survey tailored to each program that assesses changes in learners' confidence, technical and soft skills. Having both quantitative and qualitative data help organizations to develop a more comprehensive understanding of their progress (Ciupercă & Stanciu, 2020; Chowdhury et al., 2021; Convertino, 2020).

While several studies on GIFSTEM initiatives include comparisons of program facilitators' understandings of gender inequality as an additional measurement (Ziegler & Stoeger, 2004; Gill et al., 2018; Peña et al., 2021), no POL mentions the training process of staff when speaking about impact measurement of the organization. This is perhaps because no direct question on the topic was asked. It could also be that the GIFSTEM initiatives being evaluated in literature often are a part of a formal STEM curriculum with existing structures that document facilitators' attitudes (Convertino, 2020).

POL accounts also demonstrate the depth and breadth of thinking in organizing GIFSTEM organizations. The internal systems of impact measurement and organizational goals are interconnected with a series of challenges and subsequently, pragmatic considerations. I will outline three themes that emerged from interview data below.

3.3.2 Challenges and Pragmatic Considerations of GIFSTEM Organizations

3.3.2.1 Target Learners

> *"At the end of the day, we want to serve as many learners but also be as effective as possible. It's a challenge to address everyone's particular needs because we are all individuals with specific needs. We just try to offer* [learners] *as many resources as possible."* (Margareta, POL, ChickTech)

ChickTech, primarily based in the U.S., is one of the few GIFSTEM organizations in the country that actively include learners of different marginalized genders in their mission statement (Heasley, 2021). The organization also plans to expand their influence globally through exchanging resources (e.g. best practices from their experiences) with GIFSTEM programs outside of the U.S.. When asked about potential plans in offering immigration support to non-American participants who want to pursue education and professional opportunities in the U.S., Margareta acknowledged it as a potential future direction.

Recent literature has been calling for a more critical and intersectional lens in the framing of GIFSTEM programs (Hodari et al., 2014; Convertino, 2020; Ceia et al., 2021). As the opening quote by Margareta illustrates, most POL participants are highly aware of the intersectionality of gender, partially stemming from their own experiences. They have all grown up trans-nationally or cross-culturally, with experiences of being underrepresented or feeling marginalized in STEM education and profession.

This includes Chris, the only cis-man identifying POL participant. Now having a successful career as the Engineering Manager at a U.S. 'Big Tech', Chris does not have an academic background in STEM and only started learning to code at 28. As someone who at times feels isolated in the field, Chris has been involved in various GIFT programs for over 10 years after realizing the compounded barriers women in Tech face:

> *I look at the senior people at, say a FAANG[10] company, there isn't anybody that matches my description. They are all like computer science PhD or like 'I invented the Internet' type of people. No one started coding in their late 20s. I felt unsure whether I can personally succeed in this industry,* [this sense of uncertainty] *kind of matches the experiences I heard from women in Tech. I can empathize with some of their feelings, but at the same time, I still look the way I do* [as a cis-man]. *People look at me like: "You're a successful dude".*

[10] An acronym describing five prominent American technology companies: Facebook(Meta), Amazon, Apple, Netflix, and Google (Hobbs, 2022).

> *But there are things about me that they might not be able to see. I have a lot of impostor syndrome and insecurity about what it means to be here.* (Chris, POL, Dot to Line)

Chris's quote shows that adopting intersectionality as a prescriptive model potentially leaves little room to fully depict the experiences of POLs and learners of GIFSTEM programs, where underrepresentation and privilege often coexistence (Walt & Barker, 2020; Eynon, 2022)

POL accounts reflect their understanding of the intersectional nature of gender in GIFSTEM initiatives. Simultaneously, they must make practical decisions when structuring programs, which leaves out certain groups of learners. When asked about how ChickTech accounts for aspects of learner's identity, such as disability, other than gender, Margareta describes the mission of inclusion in STEM as a process rather than a fixed state:

> *As an organization with limited resources, it can be tempting to want to throw every problem at the table and have a go at it, but then there would not be enough resources for the other parts of the program. It's tough, and I think we're still trying to figure out that balance.* (Margareta, POL, ChickTech)

This reflection of necessary pragmatism (El-Hani & Mortimer, 2007) is shared by Alicia, co-founder of two sizable GIFT programs in Switzerland. I asked whether the organizations have any plans on including non-binary coders in their programming Alicia responded: "*So the short answer is no, we haven't thought about including it explicitly in our marketing. It's not the layers we think about, which is mainly gender, ethnicity, ability*". She further elaborated on this position, commenting on the necessity of a strategic and deliberate process of target learner demographics selection for a GIFT program to maximally benefit different participants:

> *I think we, as people who care about inclusion, of course, should hold ourselves to a high standard, and then higher… I empathize very much with every person who wants to do better in every layer and aspect. But I think some fundamental things would raise the bar for everyone: For instance, shared parental leave and not just maternal leave. Equal pension contribution*

> *so retirement costs are the same* [for all genders], *like these basic things. You gotta pick your battles. (*Alicia, POL, SheWhoCodes; MatchTech)

POLs such as Margareta and Alicia recognize that their program framing can always be further expanded to actively include different intersectionally underrepresented learners in STEM (Vitores & Gil-Juárez, 2016). They fully understand the potential issue of grouping 'women in STEM' as a homogenous group (Butler, 1990). But they also know the importance of deliberate scope-setting for a GIFSTEM organization to be sustainable.

The natural follow-up question is: How does a GIFSTEM organization decide on their target learner demographics? One factor could be the backgrounds of board members. For instance, Margareta shares that ChickTech's decision to target learners of marginalized genders from the very beginning was shaped by non-binary staff on the initial team. Another factor which influences GIFSTEM organizations' target learner demographics is their operational contexts.

3.3.2.2 Contextualization

> *"We cannot just go out to the public and say we're trying to empower women. That doesn't make sense. So, we're trying to make everything look neutral, like it's not trying to offend men or a specific group of people,* [this is how we are] *trying to be inclusive and drama-free."* (Seo-yeon, POL, SheWhoCodes)

Components of intersectionality are contextual (Valentine, 2007; Mirza, 2013; Jang, 2018). The goals of a GIFSTEM program, which shape their programming structures and target learner demographics, are influenced by the cultural and social contexts they are in (Brotman & Moore, 2008).

Even two branches of the same organization, with identical overarching operational principles, could have distinct program structures depending on their operational realities. Seo-yeon, a PL of YesSTEM, is currently a founding board member of SheWhoCodes South Korea. Seo-yeon and her team are highly aware of the contextual conditions they operate in. In recent years, there have been "on-and offline gender wars" (Jeong & Lee, 2018, p. 705) in South Korea, where feminism and efforts for gender equality face many pushbacks that can sometimes be violent (Kim, 2021). While all event speakers are women industry leaders in

the country, the board intentionally removed gender-targeted framing (e.g. data on the STEM gender gaps) in their marketing:

> *"We are aware that within Korea, there are very tense conflicts between genders already, even without the Tech industry… A lot of people find it very sensitive to even mention this* [gender equality]*, or talk about them* [gender issues] *in public… So everyone* [on the team] *is being conscious about it".* (Seo-yeon, POL, SheWhoCodes)

While the main challenge that Seo-yeon found as a POL is to strategically navigate the political and social tensions around gender-related topics, Alicia, a founding board member of SheWhoCodes Switzerland,findsd it challenging to push against structural contributors to the STEM gender gaps (Boehmer & Schinnenburg, 2018) within the country:

> *There is structural discrimination in Switzerland. There are some pretty basic ones, like, as an employee, I pay more health insurance costs for a woman employee than a male employee of the same age... We [*GIFSTEM organizations) *need to follow our* [learner] *community at all levels and make sure that they don't end up in middle management purgatory but move up past middle management.* (Alicia, POL, SheWhoCodes and MatchTech)

Alicia is not alone in recognizing the need for structural change. Dot to Line, the only GIFSTEM organization in their operational context, has a big focus on policy advocacy. Chris talks about the practical considerations the team need to make when speaking to lawmakers and politicians in the region, which involves strategically adopting the gender binary:

> *Our programs are explicitly open to women and other gender minorities. We have students who identify as female but are genetically male. But also, we need to be very careful about how we promote inclusivity because within* [our context]*,* [gender beyond the binary] *is not a thing that is well understood by policymakers… When I have 10 politicians to talk to, am I gonna spend 50% of the time talking about women and 50% of the time talking about gender minorities? Or am I gonna spend 100% of the time talking about women?*

> *Which one of those is more effective to change legal constraints? Right now, it's women. We try to be as inclusive an environment as possible for people of all genders. But when it comes to trying to define policy, that argument is a bit harder to make.* (Chris, POL, Dot to Line)

These reflections by Seo-yeon, Alicia and Chris demonstrate the nuances GIFSTEM program leaders consider when trying to reach their organizational goals. They illustrate that there can be two layers of program framing: One that is broader and public-facing for marketing and policy advocacy (Majoko, 2019; Furst-Holloway & Miner, 2019). Another is more internal and participant-focused (Miralles-Cardona et al., 2021). POL accounts illustrate that both layers can co-exist and alternate as the forefront message depending on the audience. Unlike what some literature suggests (e.g. Petrucci, 2020), such duo-layered framing allows the simultaneous occurrences of benefits for individual underrepresented learners, as well as organizational efforts for systematic changes through policy advocacy. As Achiam & Holmegaard (2017) point out, there is not a universal framework of gender inclusion when it comes to informal STEM education. POLs' experiences demonstrate the importance of intentional and contextualized choices at each stage of an effective GIFSTEM program's development and progression (David, 2001).

3.3.2.3 Relationships with Commercial Partners

It is no easy task for a GIFSTEM organization to both produce numerically measurable results and actively measure learners' experiences (Gill et al., 2018). Especially in the beginning stages of an organization, where POLs want to "*just get the ball rolling"* (Alicia, POL, SheWhoCodes and MatchTech) with few resources. While there are public resources, such as policies on STEM education (Ro et al., 2021), most GIFSTEM organizations' operations rely on partnerships with private entities, such as the Tech industry (Savchuk, 2019; Writer, 2021).

Depending on the organization and context, POLs often have complex feelings towards their relationships with commercial partners. It can be a win-win situation:

> *Commercial organizations help keep us afloat with their financial resources, or even volunteers that can lead workshops and become mentors … They also ask us to shape their diversity, equity and inclusion initiatives… There's a*

> *mutual sense of relying on each other. We are trying to support the employees that work at these big companies and help them build communities outside of their workplace, while they as the workplace are asking us for advice.* (Margareta, POL, ChickTech)

Margareta also reflects on the differences between genuine and cosmetic efforts from a commercial partner's interest in collaborations: "*We kind of play the role, whether superficial or not, of guiding them and being the subject matter experts for working with marginalized genders and being more inclusive for nonbinary folks*." The difficulty to distinguish partnership interests is echoed by two other POLs. Alicia is honest about the filtering processes her GIFSTEM organizations have in partnering with commercial partners to change their internal structures:

> *A company wanted to do a campaign for International Women's Day with us. They originally asked us to do an awareness campaign and show inspiring women or whatever. And we're like, awareness is not good enough… Then what we did is… a commitment campaign on implementing changes over the next three years, instead of "Oh, look at this inspiring woman. But we're paying her 20% less than her male colleagues doing the same work, plus there's no one that looks like her in the higher echelons of the company".* (Alicia, POL, SheWhoCodes; MatchTech)

Chris also expresses sometimes feeling frustrated when certain commercial partners do not provide concrete resources in the collaboration process:

> *When companies say they are dedicated to 'bringing more women to Tech' but are only giving like $5000. It's frustrating. You are a billion-dollar company. You can afford to do more than that… The level of megaphone to the level of action is very different.* (Chris, POL, Dot to Line)

These experiences show that the programming frameworks of GIFSTEM organizations are bidirectionally influenced by interests from the private sector, driven by policies. Williamson et al. (2019) demonstrate the complex relationships and potentially asymmetrical power dynamics between governmental, commercial, and civic sectors that

shape computing and coding initiatives. The activities of GIFSTEM organizations are influenced, and sometimes, restricted, by funding priorities and broader political agendas of their operational contexts (García-Peñalvo, 2019; Kitada & Harada, 2019).

Chapter 4: Discussions

This chapter first reviews the findings corresponding to the three research questions. It summarizes both the contributions as well as limitations of this study. Then, I outline recommendations for future GIFSTEM literature: The importance of an intersectional lens in questioning monolithic categories such as 'women' and 'STEM'; The need for more geographical breadth when evaluating the effectiveness of GIFSTEM organizations, as well as the legitimacy of the 'men vs. women' dichotomy. Lastly, drawing on previous research and findings of this study, I present two recommendations for GIFSTEM organizations.

4.1 Findings and Research Questions

This study investigates learners' and project leaders' experiences participating in GIFSTEM organizations. Through an intersectional lens, it explores how participants' different social identities interact with their gender, thereby shaping their perceptions of GIFSTEM informal educational programs. There are three research questions:

- RQ1: What are the benefits of GIFSTEM (gender inclusion for STEM) programs perceived by different learners?
- RQ2: What are the barriers learners feel like they face when considering STEM-related professions/postgraduate studies, and to what extent are they mitigated by GIFSTEM programs?
- RQ3: What are the (a) aspirations of (b) challenges for different GIFSTEM organizations?

From 13 individual online semi-structured interviews, several themes emerged. Three benefits of GIFSTEM programs experienced by learner participants of this research are community-building, networking-mentoring, and expanded understanding of different STEM postgraduate and professional opportunities.

There are, nevertheless, some challenges learners feel in terms of advancing into a STEM profession or postgraduate studies. From learner participants' perspectives, GIFSTEM organizations can mitigate some barriers. For instance, several learners find comfort in connecting with 'women like them' (Lockwood, 2006) through GIFSTEM programs.

However, outside of, and sometimes even within, these communities, learners can also feel hypervisible due to other aspects of their identities, such as religion, thereby also feeling a pressure of excellence because of the need to represent their entire social category (Yamaguchi & Burge, 2019). Such heightened visibility could also contribute to the imposter syndrome (Cross et al., 2020) several learners experience, questioning whether they receive competitive opportunities because of tokenistic purposes, i.e., their minority status, or their technical abilities. The nature of GIFSTEM organizations also leaves some learner participants feeling included for their gender but excluded for other metrics of their identity (e.g. immigration status, disability). Learners' perceptions of participating in GIFSTEM organizations are therefore shaped by their intersectional identities.

Similarly, POLs' lived experiences have direct influences on the goals, program structures, as well as target learner demographics of their affiliated organizations. To investigate how different GIFSTEM initiatives are designed and internally evaluated, five interviews with POLs are conducted. POL accounts illustrate the importance of pragmatic decisions contextualized to the organization's operational environment in developing, implementing, and evaluating a sustainable GIFSTEM organization. Some strategic choices can even seem contradictory (e.g. Dot to Line's active inclusion of gender minorities in workshops but adherence on the gender binary framework in policy advocacy).

POLs also have mixed experiences navigating relationships with different commercial partners, ranging from bidirectional partnerships to tokenistic gestures with little concrete resources. These accounts demonstrate that GIFSTEM organizations are contextual. There is not, unfortunately, a universal formula on how to operate programs which both create systemic changes and enhances individual underrepresented STEM learners' experiences.

4.2 Contributions, Limitations, and Future Research Directions

4.2.1 A Framework that Does Not Treat 'Women' in 'STEM' as Monolithic Categories

Several authors have pointed out the tendency in many GIFSTEM literature to treat 'women' in 'STEM' as monolithic groups without inner differentiation (Vitores & Gil-Juárez, 2016; Convertino, 2020; Behnke et al., 2021). What exactly do we mean when we use the terms 'women' and 'STEM'? What groups of women are being included, and subsequently, excluded? There is only a handful of research which considers intersections other than gender and race, while metrics such as disability (Slaton, 2013; Miller & Downey, 2020), religion

(Convertino, 2020), and immigration status (Igarashi & Saito, 2014) are rarely discussed. These are questions that could further nuance and broaden the current academic discourse on GIFSTEM policies and organizations.

This study fills in such a gap through personal accounts of different women learners of various STEM subjects who face different barriers due to their unique mappings of identities. As data from learner interviews demonstrate, different social categories work in conjunction with gender and affect learners differently, influencing what they think are the biggest barriers in entering and remaining in STEM postgraduate education and professions. For instance, even though both Vaneet and Laila would be categorized as 'women in color in STEM' due to their ethnicities in the U.S., where they both live and work now, their concerns and priorities differ because of immigration statuses.

Nine learner participants nevertheless form a very small sample, one major limitation of this research. All participants, as Chapter 3 demonstrates, have thoroughgoingly reflected on the implications of GIFSTEM programs and topics such as diversity. They do not need me to give them a voice. These accounts cannot be representative of the experiences of all women in GIFSTEM programs in the 10 different geographical locations. This study presents their experiences, studying and working cross-culturally, experiencing different definitions of identity and social categories, in contexts that are currently underrepresented in GIFSTEM literature (Kos, 2019; Convertino, 2020).

In the spirit of non-essentialization, I did not reach out to individual learner participants solely because of their gender. The certain degree of 'outness' associated with participating and confirming one's pronouns (Goodrich et al., 2016; Staples et al., 2018; McCann et al., 2021) perhaps partially explains why all learner participants identify as cisgender. More research is needed that evaluates womxn and non-binary learners' experiences of GIFSTEM organizations.

In policy and literature, there seems to be a relatively clear-cut distinction between what STEM disciplines are (and what they are not). But in reality, learners' experiences of STEM seem to be much muddier. Valini, who participated in GIFSTEM programs throughout high school and her first year of university, decided to pursue a Social Science degree with a quantitative focus. She wants to apply her coding skills gained through participation in GIFSTEM organizations to social science research. But Valini feels uncertain about this choice:

> *I feel so grateful to have had all these resources about STEM at such a young age, from 10 to 16…. Even though I'm super interested in integrating coding and quantitative methods into my major, it's hard for me to label myself as 'a woman in STEM'. It feels very binary. It's either you are, or you are not, which I know is not what it is supposed to be, but it just feels like that. Can I be part of it* [YesSTEM] *with my current major? All the club people say yes. But I feel a lot of pressure and discomfort making this push away from it* [STEM disciplines]. (Valini, CL)

Valini is not alone in her feelings of uncertainty. Shinar and Vaneet study both Interactive Digital Media, a multi-disciplinary subject grounded in creative and community-building usages of technology, and a more traditional STEM subject, such as CS (Vaneet) and Computer Engineering (Shinar). They feel unsure whether Interactive Digital Media is a STEM discipline, even though they have gained coding skills through the major, and thoroughgoingly enjoying the learning process due to its emphasis on the practical application of programming.

These accounts reaffirm observations made by more recent literature on expanding the boundaries of STEM (Plaza et al., 2020; Baizán et al., 2021). An intersectional lens provides a theoretical underpinning which does not treat 'women' in 'STEM' as monolithic groups with no inner differentiations. There are opportunities for future research to explore how learners with intersectional identities of less conventional STEM subjects perceive and experience GIFSTEM programs.

4.2.2 An Intersectional Lens: Beyond the 'Men vs. Women' Dichotomy

Globally, STEM education and professions tend to be male dominated (Beyer, 2014; Sax et al., 2017; Schwab et al., 2019) with varying degrees of gender gaps (Hammond et al., 2020; Bello et al., 2021). It might be intuitive to position the solution to the gender gaps as 'bringing more women into STEM'. This framing holds two tensions: The assumption of monolithic groupings (e.g. 'women', 'STEM'). It also envisions a vacuum in which GIFSTEM programs have no effects on men. A growing body of evidence suggests the contrary.

Beyer et al. (2004) found little gender difference in students' feelings of isolation and lack of belonging in a competitive CS program in a U.S. university. Murphy et al. (2018)

discovered that men, a social group previously assumed to be immune to social identity threats, experience them when there is an increased representation of women in STEM. This could be a result of the changing standards and expectations of success in STEM education and professions (Diekman et al., 2015). The threat to social identity might result in what McLeish & Oxoby (2011) describes as "push-backs to re-assert their individually held identities" (173). As shown in Section 3.2.1, such reassertion, manifested in forms such as micro-aggressions tend to not land on institutions that push for diversity in STEM, but rather their women peers, target learners of GIFSTEM initiatives (Coston & Kimmel, 2012; Diekman et al., 2015).

Categories currently under-discussed in literature (e.g. disability) also apply to men. This is evident in Chris's account, feeling uncertain about entering and remaining in Tech because of his non-traditional academic background (see Section 3.3.2.1). Coston & Kimmel (2012) obverses that a universal and dichotomous understanding of privilege oversimplifies the realities of men who have marginalized social categories such as class, disability, and sexuality. It is therefore important for literature on inclusion in STEM education and professions to adopt an intersectional lens (Miller & Downey, 2020) considering the (perhaps) unforeseeable effects the 'man vs. woman' framing have on already underrepresented women in STEM.

Furthermore, six learners expressed developing a broadened understanding of different possibilities in STEM education and professions as one of the biggest benefits of GIFSTEM programs. This unexpected benefit, less discussed in existing literature (Eccles, 2011; Solanki & Xu, 2018; Sinclair et al., 2019), is not necessarily gendered (Borrego & Henderson, 2014; Xu & Lastrapes, 2021). For instance, Mustafa et al. (2016) conducted a systematic review on effective STEM education. The authors discovered that the project-based learning approach, which combines learned knowledge of STEM disciplines with real-life problems, is effective in maintaining students' interests in, and comprehension of, STEM fields (Mustafa et al., 2016). Data from learner interviews reaffirms that understanding the practical applications of STEM degrees is a need not just unique to women, but all STEM learners (Herschbach, 2011; Pitt et al., 2019).

I, therefore, echo Vitores & Gil-Juárez (2016) and Convertino (2020) that there needs to be more nuance in GIFSTEM literature. I'm not suggesting the complete abandonment of the gender angle in inclusion and STEM education analysis, but methods which leave room for marginalization and privilege to co-exist (Martinez Dy et al., 2014). Aligning with the broader beyond-the gender-dichotomy movement in education literature (Saguy et al., 2021;

Jaekel & Nicolazzo, 2022; Zhang & Chen, 2022), a non-prescriptive intersectional approach is necessary in presenting the multifaceted experiences of underrepresented STEM learners.

4.2.3 Perspectives of POLs in Different GIFSTEM Organizations

Academic literature and discourse can certainly push the boundaries around the conceptualization of gender inclusion and STEM education (Marginson et al., 2013). However, there can also be disconnections between practice and academic debates (Goodrich et al., 2016; Lv et al., 2022; Okoroigwe et al., 2022). In addition to going outside of dichotomies (e.g. 'men and women', 'STEM subjects and non-STEM disciplines', 'privileged and underrepresented'), two other expansions of framing remain critical: Analysis of GIFSTEM programs outside of North America and Western Europe contexts (Mooney & Becker, 2020), as well as perspectives from different project organizers (Johnson et al., 2020).

In this study, interviews with POLs in five different operational contexts illustrate the pragmatic decisions different organizations have to make when caught between the public and the private sectors. More research is needed to assess and examine the practical challenges of GIFSTEM organizations when contextually evaluating their effectiveness.

4.3 Suggestions for GIFSTEM Organizations

While the six organizations affiliated with the five POL participants are a small sample, some insights remain relevant to different GIFSTEM organizations, ranging from a local organization filling a gap in the STEM community to a well-established organization considering developing global branches. I present two suggestions.

4.3.1 Wide-Ranging Considerations for Board Members

POL insights show the importance of having diverse board members, especially in the initial stages of a GIFSTEM organization. ChickTech, for instance, included non-binary coders in their mission statement from beginning partially because there were non-binary team members. It is also important to design programs depending on the political realities, such as level of social consensus on gender equality. For a large GIFSTEM organization considering scaling globally, it is crucial to have local team members who are themselves underrepresented STEM learners in that specific context (see Section 3.3.2.2 for comparisons of contextualized programming structures between SheWhoCodes South Korea and

Switzerland). Effective contextualization can also prevent well-intended GIFSTEM programs from perpetuating Western-centric assumptions (Mattheis, 2018).

4.3.2 Internal Surveys for Intersectional Assessment

Even when there is a diverse range of board members on the team, it is still important for a GIFSTEM organization to have a constant and consistent process of internal evaluation based on learners' different intersectional identities. Metrics of one's identity that is not directly visible (e.g. immigration status) can have significant impacts on their learning needs (see Section 3.2) It might not be logistically possible for one GIFSTEM organization to have tailored programming for every combination of intersections, as demonstrated in several POLs' emphasis on "*picking one's battles*" (Alicia, Margareta, Chris). However, by having up-to-date internal data on different learning needs, a GIFSTEM organization could signpost external resources (e.g. direct learners to another non-profit for visa sponsorship resources). This could help learners with other underrepresented identity metrics to feel more included.

4.4 Summary

While the sample size of 13 participants is small, it nevertheless adds to existing research by presenting personal experiences of learners and project organizers with GIFSTEM organizations in a range of geographical settings from an intersectional lens. This study makes four theoretical contributions: (a) Use of qualitative methods that critically examine monolithic categories such as 'women' and 'STEM'. (b) Presentation of learners' perspectives with various intersectional identities currently understudied (c) Introduction of more geographical breadths (d) Inclusion of facilitators and program organizers' accounts. More future studies on GIFSTEM initiatives are needed to fill in these gaps in literature.

Findings of this study also lead to two suggestions for practitioners. Having diverse board members and internal mechanisms for intersectional evaluations of participants can both be effective practices for a contextualized and sustainable GIFSTEM organization. With an increasingly globally dispersed workforce (Manyika, 2017) comes plurality of one's identity (El-Hani & Mortimer, 2007). Having nuanced understanding of the complex contextual realities of their learners, as well as their operational environment, allow GIFSTEM initiatives to better serve their goals.

Conclusion

This research investigates learners' and program leaders' perceptions and experiences of various GIFSTEM (gender inclusion for STEM) organizations in a range of geographical settings through an intersectional lens. It utilizes qualitative methods, specifically online semi-structured interviews. Nine learners (five past learners and four current learners) and five POLs (project organizers and leaders) participated, landing a total of 13 interviews (one participant provided detailed experiences in both roles). Building on existing literature on the topic, this study also adds geographical breadths, detailed individual accounts, and perspectives from project leaders of GIFSTEM organizations.

As discussed throughout the paper, with a relatively small sample, this research was not intended as a universal for effective GIFSTEM initiatives. It instead presents nuanced experiences by participants, learners and POLs alike, who, just like all of us, are multi-faceted. Their different intersectional identities shape their perceptions and experiences of GIFSTEM programs. There are, nevertheless, common themes from their accounts that respond to the three research questions.

Learners perceive three benefits through their participation in GIFSTEM organizations (Section 3.1). The first two, community-building (Beyer et al., 2004; McPherson, 2014; Petrucci 2020) and networking-mentoring (Haring-Hidore, 1987; Haring, 1999; Ahuja, 2002), align with common evidence in the existing literature. An unexpected third benefit emerged from interviews. Six learner participants speak about having more understanding of different STEM educational and professional paths through GIFSTEM organizations. They express feeling more reassured about remaining in the field after learning that options other than "*software engineer at Facebook*" (Vaneet, PL) are possible.

Although GIFSTEM organizations offer important contributions to learners' sense of belonging (Herzig, 2010) in the field, some barriers remain (Section 3.2). Being one of the few minorities in a STEM space make learners feel hypervisible (Convertino, 2020). Furthermore, some learners also feel the constant pressure of excellence due to feeling the need to represent everyone who belongs to their underrepresented social categories (Herzig, 2010; Charleston et al., 2014; Yamaguchi & Burge, 2019). Another barrier in retaining learners in STEM is, interestingly, partially influenced by GIFSTEM organizations that try to do so. Several learners express feeling included only for their gender but excluded for other identity metrics (e.g. disability, immigration status, religion). These other social categories, which cannot be isolated from their gender in their lived experiences, also influence their

educational and professional choices and needs (Dill & Zambrana, 2009; Nash, 2017). Currently, they are largely ignored in mainstream GIFSTEM literature and practices (Tefera, 2017; Miles et al., 2022) but could be remedied through the adoption of more intersectional approaches (Convertino, 2020).

POL accounts (See Section 3.3) also illustrate the relationship between their lived experiences and the programming of their affiliated GIFSTEM organization(s). Structures of different initiatives are influenced by many factors- their envisioned end goals and programming strategies, target learner demographic, the operational context, and relationships with commercial partners, just to name a few. These complicated conditions push POLs to make pragmatic choices in their operations that can sometimes seem contradictory to each other (e.g. SheWhoCodes South Korea, with the mission of increasing representation of women in STEM professions and education, avoids marketing their events with a gender lens to minimize pushbacks). As DeAro et al. (2019) and Benavent et al. (2020) have argued, the future of GIFSTEM must involve a combination of bottom-up initiatives intersectionally designed for different learners and policy changes that structurally bridge the STEM gender gaps.

While this study provides two suggestions for GIFSTEM organizations, I reiterate that there is no step-by-step guide that applies to all initiatives. Much more work is needed to evaluate GIFSTEM initiatives through both the learner's and POLs' perspectives in a range of contexts. This research contributes to that endeavour.

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Appendix A

Interview Schedule

Warm up

- Ask for permission to record. Pseudonym. Pronouns
- Should I wish to include data from our interviews, I will come back with a discussion of how data, especially direct quotes from you
- Introduce myself and the project
    - investigate how gender inclusion educational technology programs are perceived and experienced by learners and leaders of gender inclusion for tech programs. Building on past literature on the topic, this study specifically explores how different aspects of women's identities affect their experiences of gender inclusion for Tech education programs from a range of international contexts.
    - I'll be taking some notes, hence the typing sound, during our 30min convo, but my attention is fully on you.
- Introduce yourself?
    - Upbringing? Education experiences? Cultural backgrounds/influences?
        - LEARNERS: First exposure to STEM, what you are doing currently
        - Organizers: how you came into the field, your current role

Interview questions

Current Learners (RQ1+2)

- Why did you apply to this program/Why did you join this group?
- What are your academic/career goals when you graduate?
- What did you hope to gain from joining the program? For instance, any skills, attributes, or networks?
- Comparing with your courses in STEM, are there things about this program that you felt like was critical and was missing from the formal curriculum?
- Do you feel that you have developed these skills you were looking to develop? Examples?
- How do you feel as a woman going into STEM? Do you feel sufficiently supported?
- Do you feel that you are going to face any challenges?

- Ask for anyone they know??

Past Learners (RQ1+2)

- Tell me a bit about yourself? (e.g. education and cultural background, what you are currently doing.)
- What gender inclusion for tech programs were you involved in ? And what contexts?
- Were there a lot of people in these programs that you really identified with?
- Why did you apply to this program/Why did you join this group?
- What did you think you gained from the program? (skills, attributes, and communities, networks)
- Comparing with your courses in STEM, are there things about this program that you felt like was critical and was missing from the formal curriculum?
- How do you feel about the extent to which the experiences/skills you gained from the program are contributing to your present? (mixed/positive/negative)
- How do you feel about this framing of 'women in STEM'? This can be positve, negative, or both?

Project leaders (RQ3)

- How does the organization want to be identified?
    - Name
    - Description of the organization
- What challenges are your program trying to address?
- What is your end goal?
- How did you structure their programs to resolve the issues and achieve the desired outcomes?
- How are you measuring the impact of your project?
- Role of commercial partners
- What are the biggest barriers you face in the process?
- What is the future of the organization? (ties into the evolution of these organizations, the overall policy agenda)

Appendix B

CUREC

SECTION A: Filter for CUREC 2 application		
This section determines whether the application for ethics review should be made using this form (CUREC 1A) or the CUREC 2 form (for research with more complex ethical issues).		
Please indicate with an 'X'.	**Yes**	**No**
1. Does the research involve the deception of participants?	☐	☒
2. Are the research participants vulnerable in the context of the research, or classed as people whose ability to give free and informed consent is in question? For example, • Participants aged 16 or under (also answer question A5); • Participants aged 16 – 18 (refer to competent youths for guidance); • adults at risk; Note the University's Safeguarding Guidance and Code of Practice and its implications for researchers involving young people or adults at risk.	☐	☒
3. By taking part in the research, will participants be at risk of criminal prosecution or significant harm?	☐	☒
4. Does your research raise issues relevant to the Counter-Terrorism and Security Act (the Prevent Duty), which seeks to prevent people from being drawn into terrorism? Best Practice Guidance 07 on the Prevent Duty provides further guidance.	☐	☒
If you answered **'No'** to all the questions above, go to Section B. If you answered **'Yes'** to any question above, continue to question 5 below.		
5. Is your project covered by a CUREC Approved Procedure?	☐	☐
If yes, list the CUREC Approved Procedure(s) you will follow		
If you have answered '**No**' to all questions 1-4, go on to **Section B**. If you answered '**Yes**' to ANY of questions 1-4, and answered '**No**' to question 5, **stop** completing this form and do not submit it for ethical review. You will instead need to submit a CUREC 2 application form. If you answered '**Yes**' to **any** of questions 1-4, and your project is covered by an Approved Procedure, **go on to Section B**. If more than one Approved Procedure applies, contact the SSH IDREC or your DREC for advice on whether a CUREC 2 form should be submitted instead.		

SECTION B: Researchers	
1. Name of Principal Investigator or student's supervisor	[redacted]
2. Department or Institute	Department of Education

3. University of Oxford email address	[redacted]		
Copy and paste the following six rows as necessary to complete for each additional researcher who will be involved in this study, including student(s) and those external to the University.			
4. Name of researcher or student	[redacted]		
5. Department or Institute	Department of Education		
6. University of Oxford email address	[redacted]		
7. Role in research	Student researcher		
8. Degree programme, if student research	MSc Education: Digital and Social Change		
The whole research team			
9. Have the researchers undertaken research ethics and integrity training?		**Yes ☒**	**No ☐**
10. Please provide details of any research ethics and integrity training undertaken, including the dates of the training. Alternatively state relevant research experience.	2022/02/09 I have also undertaken the Foundations of Education Research and Perspectives and Debates in Qualitative Research modules at the Department of Education, both of which have included content relating to conducting ethical research.		
11. State any conflicts of interest and explain how these will be addressed.	None		

SECTION C: The research project	
1. Title of the research project	
Perceptions and Experiences of Gender Inclusion Ed-Tech Programs	
2. Anticipated start date of the aspect of the research project involving human participants and/ or personal data (**dd/mm/yy**).	April 2022, or once ethics approval is obtained.
3. Anticipated research end date (**dd/mm/yy**).	31/05/2022
4. Provide a brief lay summary of the aims and objectives of the research. This should cover the questions it will answer and any potential benefits. (max 300 words)	

This research aims to explore two questions: Given the number of well-funded gender inclusion for Tech programs, how are they being experienced by learners? Additionally, to what extent do project leaders feel like the goal of gender inclusion in Tech is being achieved?

Interviews with current learners will cover topics such as future directions after the program, self-perception before and after the participation of the program, etc. Interviews with graduated learners/industry professionals will involve topics such as what they obtained through the program, as well as how they feel their genders are perceived in the industry.

It contributes to the current literature on gender inclusion in STEM programs in two ways. While most studies on the topic investigate the impact of such programs by their outcomes (e.g. comparisons of the number of women students in the computer science department after deploying gender inclusion methods), this research explores how participating in these gender inclusion in STEM programs is perceived and experienced by learners. Most empirical studies on the topic often take place in North America and Western Europe. All learners being interviewed in this research come from geographic areas that are currently underrepresented in current literature. This research, therefore, provides personal accounts of how learners from backgrounds outside of these two contexts experience gender inclusion in STEM programs.

5. Please indicate the methods to be used (indicate with an '**X**'):

Analysis of existing records	☐
Snowball sampling (recruiting through contacts of existing participants)	☒
Use of casual or local workers e.g. interpreters (refer to guidance in BPG 01: Researcher safety)	☐
Participant observation	☐
Covert observation	☐
Observation of specific organisational practices	☐
Participant completes questionnaire in hard copy	☐
Participant completes online questionnaire or other online task (refer to guidance in BPG 06: Internet-mediated research)	☐
Using social media to recruit or interact with participants (refer to guidance in BPG 06: Internet-mediated research)	☐
Participant performs paper and pencil task	☐
Participant performs verbal or aural task (e.g. for linguistic study)	☐
Focus group	☒
Interview (refer to guidance in BPG 10: Conducting research interviews)	☒
Audio recording of participant (you will generally need specific consent from participants for this)	☒
Video recording of participant (you will generally need specific consent from participants for this)	☐

Photography of participant (you will generally need specific consent from participants for this)	☐
Others (please specify below)	☐

6. Provide a brief summary of the research design and methods. What will research participants be asked to do? (max 300 words)
   Please also submit a copy of the questions participants will be asked, if applicable, or some information about the sorts of topics that will be covered.

An information sheet (see Appendix I) that contains details of the project and how data would be analyzed and potentially used would be sent to participants beforehand. Once informed consent is obtained (see Appendix II), participants are invited to participate in focus groups and semi-structured interviews. They will be asked to share their experiences organizing or participating in gender inclusion for Tech programs. The topics and suggested questions that will be covered with each group of participants is set out in Appendix III. All interviews with project leaders would be individual. Interviews with past learners would take form in focus group discussions as well as individual interviews. The focus group interview would happen in pairs or groups of up to four participants, in which recordings would be transcribed and analyzed. The identified themes would then be used by the researcher to specify or further develop questions for individual interviews with other past learners, as well as current learners of gender inclusion for Tech programs. Pseudonyms for participants and their associated organizations would be assigned to all participants and identifying details will be removed.

7. List the location(s) where the research will be conducted, including any other countries.	All interviews will be conducted remotely online, via Microsoft Teams.
8. Clarify which parts of the research will be conducted in-person and which will take place remotely, e.g. online.	All interviews will be conducted remotely online, via Microsoft Teams.

9. If your research involves fieldwork or travel and your department requires a travel risk assessment, will you have completed and returned a risk assessment form beforehand? Please indicate with an '**X**'. (This must be approved by your department before you travel. If you are travelling overseas, you are advised to take out University travel insurance.) Refer to guidance available from your Department, the Safety Office, the Social Sciences Division, and the Humanities Division, and on travel for University business.	Yes	☐
	No	☐
	Not required in this instance	☒

10. In the case of international or collaborative research, explain how you will address any ethical issues specific to the local context. Please provide details of the local review, approval or permission obtained or required. Refer to the BPG 16: Social science research conducted outside the UK. If there will be no local review, explain why not. Please mention any stakeholder or community engagement that has been/ will be undertaken in relation to the research.

Please also address any physical or psychological risks for Oxford researchers and local fieldworkers in Section G.	
N/A	
11. Name of departmental/ peer reviewer (if applicable)	N/A
12. External organisation funding the research and grant reference (if applicable)	N/A
13. Please refer to the CUREC Best Practice Guidance and list any that have been used to develop your research.	BPG 09 Title: Management and Protection of Data Collected for Research Purposes; In particular Appendix A – Guidance on the Remote recording of participants for research projects; Best Practice Guidance 10_Version 1.0 Title: Conducting research interviews

SECTION D: Recruitment of research participants		
1. Number of participants	10-15	
2. How was the number of participants decided?	This number of participants is anticipated to yield sufficient data for qualitative analysis while working with the constraints of a MSc timetable. The total number will be dependent on the number of positive participant responses.	
3. Age range of participants	18 and over	
4. Inclusion criteria	Projects leaders, former participants, or current members of gender inclusion for Tech programs.	
5. Exclusion criteria	Participants below the age of 18.	
6. Indicate with an '**X**' all intended recruitment methods **Please submit copies of the recruitment material that will be used, e.g. advertisement text, introductory email text.**	Poster advert	☐
	Flyer	☐
	Email circulation	☒
	Social media (e.g. Twitter, Facebook)	☐
	Website	☐
	In-person approach	☐
	Snowball sampling	☒

	Recruitment sites (e.g. Mechanical Turk)	☐
	Existing contacts or volunteer database	☒
	Other (please specify):	☐
7. How will potential participants be identified and approached?	Potential participants are identified through existing contacts, individual email outreach and snowball sampling.	
8. Will informed consent be obtained from the research participants or their parents/ guardians? If not, please explain why not.	Yes (see Appendix II)	
9. For each activity or group of participants, explain how informed consent will be obtained from the participants themselves and/ or their parents/ guardians, if applicable. How will their consent be recorded? **Please submit copies of all participant-facing materials for review.** E.g.: • Recruitment material (e.g. emails, posters) • Information for participants to read (or hear) before they agree to take part (e.g. written information or, if applicable, an outline oral information script). • A document to record informed consent. Further guidance and templates.	A Participant Information Sheet (Appendix I) that contains details of the project and how data will be analysed and potentially used would be sent to participants beforehand. A participant consent form (Appendix II) will be included to provide a record of informed consent. Additionally, at the beginning of each online interview, the researcher would again ask for the participant's consent to audio record, and remind the participant to turn off video.	
10. Provide details of any payments and incentives and the rationale for providing these. Further guidance in Best Practice Guidance: 05 Payments and incentives in research.	None	
11. Describe how participants • may withdraw from the study • may withdraw any personal information they have provided from the study State any limits to withdrawal, for example once the data has been	Participants can withdraw from the study at any point, both in terms of participation as well as personal information they provided during the interview that they wish not to be included in the final paper.	

anonymised or at some other specified stage prior to publication. Make sure participants are aware of any withdrawal limits.	

SECTION E: Research data

All information provided by participants is considered research data for the purpose of this form. Any research data from which participants can be identified is known as personal data; any personal data which is sensitive is considered special category data. Management of personal data, either directly or via a third party, must comply with the requirements of the UK General Data Protection Regulation (UK GDPR) and the Data Protection Act 2018, as set out in the University's Guidance on Data Protection and Research.

In answering the questions below, please also consider the points raised in the Data Protection Checklist and Data Protection Screening Assessment and whether, for higher-risk data processing, a separate Data Protection Impact Assessment may also be required for the research. Advice on research data management and security is available from Research Data Oxford and your local IT department. Advice on data protection is available from the Information Compliance team.

For guidance on conducting internet-mediated research, refer to CUREC's Best Practice Guidance 06: Internet-mediated research.

1. What data will be collected? (Indicate with an '**X**')

Screening documents	☐	Task results (e.g. questionnaires, diaries)	☐
Consent records (e.g., written consent forms, audio-recorded consent, assent forms)	☐	IP addresses (refer to Best Practice Guidance 09: Data collection, protection and management for guidance)	☐
Contact details for the purpose of this research only	☒	Field notes	☐
Contact details for future use (guidance)	☐	Photographs	☐
Opt-out forms	☐	Information about the health of the participant (including mental health)	☐
Audio recordings	☒	Previously collected (secondary) data	☐
Video recordings	☐	Data already in the public domain. Specify the source of the data:	☐
Transcript of audio/ video recordings	☐	Other, please specify:	☐

2. During the course of the research, where will **each type of** research data be stored?	Interview recordings, as well as transcriptions and consent forms, would be stored as encrypted files on the University's One Drive. OneDrive for Business, provided as part of the University's Nexus365 offering, has been approved by the University's Information Security team for the storage and sharing of research data		
3. Who will have access to the research data during the project?	The student researcher and their supervisor would have access to the research data during the project. Data will be anonymised or de-identified (e.g. by removing all personal information that could directly identify an individual) and that whilst data might be made available to other researchers within the team, confidentiality of individual participants will be protected.		
4. Please complete this section if your research involves the use of secondary (i.e. previously collected) data.	**Please indicated with an 'X'.**	**Yes**	**No**
	Are data access agreements in place for access to and use of this secondary data? (If so, please attach these.)	☐	☐
	Did the individuals agree that their data could be used for this purpose?	☐	☐
	Could anyone (including members of the research team) link the data back to an individual or individuals? If this is a possibility, please explain how the associated ethical issues will be addressed:	☐	☐
5. How do you intend to share the research data at the end of the project?	Depositing in a specialist data centre or archive	☐	
	Submitting to a journal to support a publication	☐	
	Depositing in an institutional repository	☐	
	Dissemination via a project or institutional website	☐	
	No plans to share the data	☒	
	Other (please specify):	☐	
6. How do you intend to report and disseminate the results of the research? (Indicate with an 'X')	Thesis publication	☒	
	Publication in a peer reviewed journal	☐	
	Publicly available report	☐	
	Conference presentation	☐	
	Publication on a website	☐	
	Pre-registration	☐	
	Report to a research funder	☐	

	Providing participants with a lay summary of the results	☒
	Submission for academic assessment	☐
	Other (please specify):	☐

7. Explain what will happen to the data at the end of the research project. This question must be answered for each type of data, including completed consent forms.
The interview recordings will be destroyed once the MSc dissertation has been published. Whilst the researcher will have completed the course of study and is unlikely to remain in Oxford, the de-identified transcripts and consent forms will be kept in accordance with University policy.

SECTION F: Protection of research participants and their personal data		
1. How identifiable will the participants be from the **research outputs**? (Indicate with an 'X')	Directly identifiable from the information included	☐
	Pseudonymised/ indirectly identifiable	☒
	Not identifiable – data is anonymous	☐
	Other, please specify:	☐
2. To what extent will the **data** be de-identified? How identifiable will any individuals be from the research data? Describe any measures you will take towards assuring confidentiality, potential risks to confidentiality.	Individual data would be de-identified using pseudonyms for individuals and codes for individual organisations/programs. The researcher will minimise data collection, keeping the number of indirect identifiers to a minimum. Individuals, and their associated organisations, will receive pseudonyms and codes respectively as soon as the interviews are transcribed, so as to mitigate the risk of re-identification. The researcher is aware that answers to open-ended questions sometimes contain identifiers which are connected to respondents themselves or other persons, such as name or occupation of a spouse. Disclosure risk will be assessed on a case-to-case basis, with re-coding, pseudonyms or deletion of variables being used if necessary to preserve confidentiality.	
3. How will you ensure that third parties (e.g., interpreters and	It is not intended that any third parties will be involved during this research.	

transcribers) are aware of and adhere to the measures described in this form?	

SECTION G: Risks and benefits of the research
1. Will the research involve topics that could be considered sensitive? If so: a. Please provide more detail or supporting information (such as the interview questions) to show the range of questions; b. Explain what steps will be taken to reduce risk of distress; c. Consider seeking advice from within your Department or from the ethics committee including whether the application might benefit from additional ethics review (e.g., via a CUREC 2 application).
This research would not involve topics that could be considered sensitive. Please see Appendix III. Should the answers to interview questions change direction towards topics that might be considered sensitive, the researcher will make every effort to change the topic of discussion.
2. Describe any additional burden or risks to the participants and the steps you will take to address these.
The participants will be donating their time to the research project without reimbursement, so every effort will be made to stick to suggested time frame for interview. The online interviews will take place using headphones, so that audio can be appropriately and discreetly recorded. Care will be taken to ensure participants are in an appropriate setting for the interviews before recording commences.
3. Describe any physical or psychological risks to the researcher(s) (including local fieldworkers or research assistants) and the steps you will take to address these.
N/A
4. Describe any benefits of the research, both to participants and to others.
This research contributes to a gap in current literature on the underrepresentation of women in STEM by offering qualitative accounts of how women students experience gender inclusion in Tech programs. It also offers contextual experiences of learners and project leaders outside of contexts of North America and Western Europe. Through a summary of research findings, participants would also engage in knowledge exchange where findings of the research (with no identifiable information) would be exchanged and discussed.
5. Give details of any other ethical issues or relevant information.

Participants will be asked to record personal experiences, but the researcher will seek to stick within the framework of the interview schedules and avoid sensitive disclosures.

SECTION H: Professional guidelines		
Please indicate with an '**X**' at least one set of professional guidelines you will follow.		
Research specialism/ methodology	**Association and guidance**	
Anthropology	Association of Social Anthropologists of the UK	☐
Computer Science	ACM Code of Ethics and Professional Conduct	☐
Criminology	British Society of Criminology Statement of Ethics	☐
Education	British Educational Research Association Ethical Guidelines for Educational Research	☒
Geography	American Association of Geographers Statement on Professional Ethics	☐
History	Oral History Society of the UK Ethical Guidelines	☐
Internet-mediated research	Association of Internet Researchers Ethical Guidelines British Psychological Society: Ethics Guidelines for internet-mediated research Association for Computing Machinery Code of Ethics and Professional Conduct	☐
Management	Academy of Management Code of Ethics	☐
Political Science	American Political Science Association (APSA) Guide to Professional Ethics in Political Science	☐
Politics	Political Studies Association. Guidelines for Good Professional Conduct	☐
Psychology	British Psychological Society Code of Ethics and Conduct	☐
Social research	Social Research Association: Ethical Guidelines	☒
Socio-legal studies	Socio-Legal Studies Association: Statement of Principles of Ethical Research Practice	☐
Sociology	The British Sociological Association: Statement of Ethical Practice	☐
Visual research	ESRC National Centre for Research Methods Review Paper: Visual Ethics: Ethical Issues in Visual Research	☐
Other professional guidelines		☐

SECTION I: Endorsements and signatures

Please ensure this form is endorsed by the Principal Investigator (or student's supervisor), the Head of Department (or nominee) and, if student research, by the student themselves. **The SSH IDREC Secretariat accepts either option below. If you have a DREC, check which signature option it prefers.**

- **Option 1: direct email endorsements**
  Each of the signatories should submit an email from a University of Oxford email address, indicating their acceptance of the responsibilities listed below.
- **Option 2: signatures**
  Please scan the signed form and email it to us as a PDF. Pasted images of signatures cannot be accepted.

Endorsement by the Principal Investigator/ student supervisor and student, if applicable

I/ we the researchers understand my/ our responsibilities as Principal Investigator (and student, if applicable) as outlined in the guidance on the CUREC website. I/ we declare that the answers above accurately describe the research as presently designed, and that the ethics committee will be informed of any changes to the project which affect the answers to this form.
I/ we will inform the relevant IDREC if the Principal Investigator changes.

Name of Principal Investigator	[redacted]
Principal Investigator's signature	[redacted]
Date	2022/03/14
Name of student (if applicable)	[redacted]
Student's signature	[redacted]
Date	2022/03/14

Departmental endorsement – from the Head of Department or nominee
(Another senior member of the department may sign where the head of department is the Principal Investigator, or where the Head of Department has appointed a nominee. Example nominees include Deputy Head of Department, Director of Research, or Director of Graduate/ Undergraduate Studies.)

On the basis of the information available to me, I confirm that:

- I am aware of the research proposed and have read this application;
- To the best of my knowledge, the proposed design and scientific methodology do not raise ethical concerns;
- I support this research in principle, subject to ethical and other necessary reviews.

Signature	Instead of a signature, endorsement may be provided by an email confirming the points above.
Name	
Role	
Date	

CUREC Approval

Dear [redacted]

Perceptions and Experiences of Gender Inclusion Ed-Tech Programs
CIA-22HT-047

The above application has been considered on behalf of the Departmental Research Ethics Committee (DREC) in accordance with the procedures laid down by the University for ethical approval of all research involving human participants.

Our prior discussion on this was very useful – an impressive team as ever, and project, vastly experienced, and a model of genuine care in relation to research ethics.

I am pleased to inform you, then, that, on the basis of the information provided to DREC, the proposed research has been judged as meeting appropriate ethical standards, and accordingly, approval has been granted.

Please continue to follow all current guidance issued by CUREC during the pandemic, notably COVID-19: CUREC guidance on research involving human participants, https://researchsupport.admin.ox.ac.uk/governance/ethics/coronavirus

If relevant please also check the CUREC website for their best practice research guides, these can be very useful in refining the writing up of ethical considerations in your research – see https://researchsupport.admin.ox.ac.uk/governance/ethics/resources/bpg

Good luck with your research study,

Keep well and safe,

Yours sincerely,

All good wishes,

Liam

Chair, DREC

Liam Francis Gearon, PhD, FHEA, FRSA, Docent

Senior Research Fellow, Harris Manchester College, University of Oxford
Associate Professor, Department of Education, University of Oxford
Conjoint Full Professor, Newcastle University, Australia
Docent, University of Helsinki, Finland
Extraordinary Professor, North-West University, South Africa
Visiting Professor, Irish Institute for Catholic Studies, MIC, Limerick, Ireland
Honorary Senior Research Fellow, School of Education, University of Birmingham

Appendix C

Written Informed Consent Form

PARTICIPANT INFORMATION SHEET

Thank you for your interest in participating in this research study. It is important that you understand why the research is being done and what it would involve for you. Please take time to read this information, and discuss it with others if you wish.

What is the purpose of the study?

This study aims to investigate how gender inclusion educational technology programs are perceived and experienced by learners and leaders of gender inclusion for tech programs. Building on past literature on the topic, this study specifically explores how different aspects of women's identities affect their experiences of gender inclusion for Tech education programs from a range of international contexts. The research will be written up as part of an MSc dissertation in Education: Digital and Social Change.

Why have I been invited?

You have been invited to participate in this study because you have experience organizing or participating in gender inclusion for tech programs. I am hoping to speak to 10-15 individuals linked to a range of programs and in several geographical contexts.

What does participation involve?

You will be invited to take part in a semi-structured interview that should take about 30 minutes, in either the form of individual or focus group discussions. If you are a program leader, the format of the interview would be individual. If you are a past or a current participant of gender inclusion for Tech education programs, you might be invited to participate in either form of the interview. The researcher would confirm which form of the interview you would be participating in.

No preparation before the interview is required. The interview will take place online, via Microsoft Teams or similar software. With your permission, it will be audio-recorded and transcribed.

All interview data can be de-identified as far as possible, including your personal information and the organizations you are associated with, and codes/pseudonyms will be assigned to your data as soon as your interview is transcribed. Whilst data may be shared with the wider research team, your confidentiality will be protected.

Do I have to take part?

The answer is 'No'. Taking part is entirely voluntary. You may withdraw if you later change your mind, without giving a reason.

What are the possible benefits of taking part?

You will be able to review the research outputs, which I hope will be of interest to you and, where applicable, your organization.

Will my taking part in the study be kept confidential?

The data collected would be kept strictly confidential, available only to my supervisor and myself, and not used other than specified without the further consent of all involved being obtained. All recordings would be destroyed at the end of the research period and kept in secure conditions until then. Directly identifying information will be removed as far as possible from the research data collected. Your data will be allocated a pseudonym, and any programmes you are associated with will be allocated a code. The de-identified transcripts will be stored in an encrypted file in a secure University storage facility. Once the study has ended, de-identified research data will be archived according to University guidelines.

Who is organising and funding the study?

This project has been reviewed by, and received ethics clearance through, a subcommittee of the University of Oxford Central University Research Ethics Committee under reference number CIA-22HT-047.

The Principal Researcher is [redacted] who is affiliated with the Department of Education at the University of Oxford. This project is being completed under the supervision of [redacted] You may ask any questions before deciding to take part by contacting the researcher at [redacted] *If there is anything that is not clear, or if you would like more information, please ask us.*

Thank you for reading this information.

Perceptions and Experiences of Gender Inclusion Tech Programs

CONSENT FORM FOR PARTICIPANTS

Central University Research Ethics Committee (CUREC) Approval Reference: xxxxx

Please review the following information and if it is okay with you, indicate consent for each one.

☐ I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

☐ I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without any adverse consequences or penalty.

☐ I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without any adverse consequences or penalty.

☐ I understand that this project has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee.

☐ I understand who will have access to personal data provided, how the data will be stored and what will happen to the data at the end of the project.

☐ I understand how this research may be written up and published.

☐ I understand who should contact for questions or concerns.

☐ I consent to being audio recorded.

☐ I understand how audio recordings will be used in research outputs.

☐ I give permission to be quoted directly in the research write-up if a pseudonym is used, and identifying information is removed as far as possible.

☐ I agree to take part in the study.

_____	dd / mm / yyyy	_____
Name of Participant	Date	Signature
_____	dd / mm / yyyy	_____
Name of person taking consent	Date	Signature