



Article

Empowering Undergraduate Women in Science, Technology, Engineering, Mathematics, and Medicine: Exploring Experiences, Fostering Motivation, and Advancing Gender Equity

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Abstract: The representation and success of women in Science, Technology, Engineering, Mathematics, and Medicine (STEMM) have sparked discussions, given their underrepresentation in these traditionally male-dominated fields. While women comprise 40% of STEMM undergraduates, senior-level positions see this figure drop below 20%. Research suggests that gender disparities in STEMM participation result from motivational differences, rather than competence. Exploring the reasons for these disparities are important as they can have significant consequences for the acknowledgement of women in STEMM, the maintenance of their STEMM discipline, and future careers. As such, this study explored how the experiences of 13 female undergraduates in Australian STEMM programs impacted their motivation and persistence in their degree. Through face-to-face semi-structured interviews, analysed via reflexive thematic analysis, five themes were constructed, encapsulating diverse experiences shaping female undergraduates in STEMM, influencing self-efficacy, determination, and well-being. Early exposure and environment were pivotal, acting as motivators or deterrents. Additionally, peer support was suggested as being crucial, fostering belongingness in the male-dominated space. Participants also grappled with recognition challenges, influenced by gender imbalances and a lack of role models. Intimidation was evident, leading to thoughts of dropping out, but passion drove persistence amid these challenges. The research increases awareness and understanding of the challenges faced by female undergraduates in STEMM, offering valuable insights for developing strategies to enhance their university experiences and promote success in future STEMM careers.

Keywords: female; STEMM; undergraduate; motivations; persistence; gender; academia



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1. Introduction

The ongoing discourse surrounding women's participation and triumphs in Science, Technology, Engineering, Mathematics, and Medicine (STEMM) fields is primarily driven by the profound gender imbalance (da Costa 2016; Phillips 2022). Despite a gradual increase in the number of women entering STEMM, a palpable underrepresentation endures, positioning women as a minority within sectors which have been historically dominated by men (da Costa 2016; Phillips et al. 2023b). This persistent gender gap has sparked extensive research, delving into the factors that sway women's choices regarding pursuing or refraining from STEMM degrees. These investigations aim to uncover the intricacies that either impede, or bolster, the motivation and persistence of women in these fields (Leaper and Starr 2019; Robnett 2016).

Emerging findings suggest that gender disparities in STEMM are not merely rooted in competency discrepancies, but are profoundly intertwined with variations in motivational factors. The multifaceted nature of these challenges is underpinned by the intricate and divergent experiences of female undergraduates in STEMM fields, where no one-size-fits-all explanation exists (Leaper and Starr 2019). This diversity of experiences within the female STEMM student cohort unveils a complex tapestry shaped by individual circumstances,

socio-cultural factors, and institutional dynamics. The significance of exploring these gendered disparities extends beyond the academic realm. It carries profound implications for recognising and celebrating women's achievements in STEMM, playing a pivotal role in sculpting the trajectories of their future careers. Understanding the nuances of women's experiences within STEMM is not merely an academic pursuit; it is a catalyst for fostering lasting change and ensuring the enduring presence of women in these disciplines (Bloodhart et al. 2020).

The quest for a comprehensive understanding is not an isolated academic pursuit but a critical step towards cultivating a more inclusive and equitable environment within STEMM fields. The intricate interplay of various factors shaping the experiences of women in STEMM demands the use of a holistic approach to address and dismantle barriers systematically. A deeper comprehension of these multifaceted aspects is, therefore, not only an academic imperative, but a societal necessity in the pursuit of true gender equality and equity within STEMM and beyond.

1.1. Gender Disparities in Academia and STEMM: Challenges and Implications

The challenges faced by women in academia and STEMM fields are multifaceted, extending beyond mere numerical imbalances. Existing research has consistently illuminated the distinct disadvantages encountered by women compared to their male counterparts. These challenges encompass a spectrum ranging from a lower likelihood of consideration for tenure to receiving reduced pay and holding fewer senior positions (Martínez-Ruiz and Hernández-Amorós 2023; Meadhbh Murray et al. 2023).

Within the academic landscape of Australian universities, the disparity is starkly apparent. Despite constituting 44% of academic roles, women occupy only 31% of senior positions, underscoring the persistence of gender inequities (Australian Academy of Science 2019). These patterns are mirrored in STEMM disciplines within higher education, revealing a complex web of challenges that extend beyond mere representation. Science in Australia Gender Equality (SAGE 2016) reports that, while female representation in STEMM is 40% at the undergraduate level, this number plummets to below 20% at senior positions. The disparities are even more pronounced in specific STEMM fields, such as Engineering, Information Technology (IT), and Physics, where female graduates constitute fewer than 15%. In contrast, fields like Biology and Chemistry maintain a more balanced representation, with women constituting 59% and 42% of graduates, respectively (Office of the Chief Scientist 2016).

However, progress in bridging these gaps is not uniform across all STEMM disciplines. While certain fields, like Medical Sciences and Health, have shown improvements, others such as Mathematics, Technology, Engineering, and Architecture lag behind (Office of the Chief Scientist 2016; SAGE 2016). This nuanced landscape necessitates a targeted examination of the unique challenges faced by women in specific disciplines. Moreover, the struggles faced by female students pursuing undergraduate STEMM courses are significant. Research indicates that they often grapple with concerns, heightened anxiety levels, and a pervasive sense of lower confidence compared to their male counterparts. Addressing these challenges is not merely an academic endeavour; it is a crucial step towards enhancing the overall university experiences of women and fostering their success (Fisher et al. 2020; Meaders et al. 2020).

The gender disparities in academia and STEMM fields are not isolated phenomena, but interconnected challenges that demand a nuanced and comprehensive approach. These challenges transcend mere statistical representation and delve into the intricate dynamics of workplace culture, systemic biases, and the need for targeted interventions to create an environment in which women can thrive and contribute meaningfully to the STEMM landscape. Understanding these challenges is fundamental for crafting effective strategies aimed at dismantling barriers, and fostering an inclusive, equitable, and supportive academic environment for women in STEMM.

Unravelling the Leaky Pipeline: Understanding Gender Disparities in STEMM

The metaphor of the ‘leaky pipeline’ has become a poignant and illuminating framework employed by academics investigating the underrepresentation of women in STEMM fields (Archer et al. 2023; Resmini 2016). This metaphor encapsulates the intricate journey of students as they progress from lower levels of education through university and into STEMM careers. According to the pipeline concept, the trajectory of women within the STEMM pipeline is not seamless; instead, it is marked by exits at different stages. These exits, often representing a departure from pursuing STEMM careers, can be attributed to a variety of factors. One key factor is the influence of shifting interests and academic pursuits, influenced by elements such as differential treatment, gender bias, and gendered barriers (Buckles 2019; Grogan 2019). The leaky pipeline framework acknowledges the additional layer of complexity introduced by intersectionality. This perspective, introduced by Crenshaw (1991), posits that diverse identities can face an elevated risk of exiting the pipeline. The intersections of gender, race, and sexual identity, to name a few, create unique challenges, compounding the difficulties faced by women in these underrepresented groups. The leaky pipeline operates under the influence of a myriad of interconnected factors. These may include institutional practices, societal expectations, and cultural norms that contribute to the gender imbalance observed in STEMM fields today (Blackburn 2017). Recognising and understanding these factors is crucial for formulating effective interventions and policies aimed at promoting gender diversity and inclusion in STEMM. The application of the leaky pipeline metaphor to the female undergraduate experience in Australia sheds light on the factors contributing to the lack of female representation in STEMM. Researchers emphasise the necessity of unravelling these factors to gain a comprehensive understanding of the challenges faced by female students in STEMM disciplines (Buckles 2019; Grogan 2019).

1.2. Decoding Gender Inequities in STEMM: Stereotypes, Discrimination, and Effects on Women’s Journeys

Contemporary research underscores the pervasive impact of gendered discrimination on the profound gender disparities witnessed within STEMM fields (Jensen and Deemer 2019). Stereotypes, often rooted in societal biases, play a significant role in perpetuating gender disparities. For instance, studies by Carli et al. (2016) and Jensen and Deemer (2019) reveal that women are commonly stereotyped as less proficient in the sciences, perpetuating the false narrative that they lack essential qualities for success in scientific endeavours compared to their male counterparts. The notion of gendered workplaces, as supported by Mavin and Yusupova (2023), further compounds these stereotypes. Jobs are often stereotypically categorised as either ‘male’ or ‘female’, with professions like nursing being predominantly considered as a female profession due to the nurturing stereotypes associated with women. These ingrained stereotypes can lead female undergraduate students in STEMM to question their sense of belonging, grapple with feelings of non-recognition, and wrestle with their identity within their respective disciplines (Piatek-Jimenez et al. 2018).

Research indicates that gendered discrimination extends beyond stereotypes, persisting from adolescence into undergraduate university experiences (Archer et al. 2023). Female students report encountering sexist comments, harassment, and bias from peers and teachers, negatively impacting their motivation and competence in STEMM fields. Such instances of gendered bias and sexual harassment have been associated with adverse effects on women’s academic competence, motivation, overall well-being, and implications for their career aspirations and motivations in STEMM (Leaper and Starr 2019).

In a disconcerting example reported by Goldman (2012), participants discussed experiences in which they were labelled as ‘princesses’ by their university professors. Despite finding this experience degrading, these individuals chose not to address the issue, fearing they might appear too sensitive. This reluctance to confront and address disrespectful behaviours perpetuates a culture of silence around gendered discrimination in STEMM. Addressing these negative and disrespectful behaviours towards women in STEMM is not

only crucial for ensuring that female undergraduate students feel comfortable studying and working in these fields, but it is also paramount for supporting the sustainability of their future careers. Initiatives and interventions aimed at dismantling stereotypes, combating bias, and fostering an inclusive and respectful environment are imperative for achieving gender equity in STEMM disciplines (Leaper and Starr 2019; Rosenthal et al. 2016).

1.3. Fostering Resilience and Encouragement: Institutional Support for Women in STEMM Education

The literature underscores the imperative of addressing the consequences of underrepresentation, gender bias, and sexual harassment in STEMM fields by examining the encouragement and treatment of women (Robnett 2016). A pivotal aspect of this investigation is understanding the profound impact that encouragement has on the motivation and persistence of women in their academic journey within STEMM. Drawing on the Expectancy–Value Theory of Achievement (Eccles and Wigfield 1995, 2002) which emphasises that encouragement is a critical factor in individuals’ determination to succeed in areas where they anticipate thriving. Studies indicate that the level of encouragement women receive significantly influences their motivation (Leaper and Starr 2019; Talley and Ortiz 2017). Perceived praise from peers and family contributes to increased motivation among undergraduate women in STEMM, fostering a sense of capability and belonging.

The presence of a supportive network plays a pivotal role in shaping women’s experiences in STEMM. Participants with a robust support system exhibit a higher STEMM self-concept compared to those with limited support (Robnett 2016). This encouragement serves as a source of resilience, strengthening women’s motivation and shaping their outlook on their experiences within the STEMM academic landscape (Leaper and Starr 2019). Additionally, recognising the need for institutional support, efforts have been made to enhance conditions for women in STEMM. Various programs and resources have been introduced to provide academic and social support and are designed to meet the unique needs of female STEMM students (Gregor et al. 2023). Mentoring programs, in particular, have demonstrated positive impacts, leading to increased optimism and confidence among female STEMM students (Reid et al. 2016). External support also becomes particularly crucial due to the observed influence of a lack of self-confidence on the motivation of undergraduate females (Maltese and Cooper 2017). Women, more than men, tend to identify mentors, teachers, and peers as being critical to maintaining their interest in STEMM fields. Efforts to boost confidence through external encouragement contribute significantly to women’s persistence in their STEMM degrees. Students’ perceptions of institutional support for learning, well-being, staff commitment, and responses from peers emerge as critical influencers in determining female students’ decisions to persist or withdraw from their STEMM degree (Cuthbert et al. 2023). A comprehensive understanding of these factors is imperative for designing interventions that support the diverse needs of female students in STEMM, emphasising the necessity for further research in this domain (Maltese and Cooper 2017).

1.4. Research Rationale

The journey of female students pursuing STEMM degrees is intricate and influenced by numerous factors. Existing literature underscores the complex interplay of these factors, impacting the motivation and persistence of women in STEMM disciplines. A critical theme emerging from the literature is the insufficient support and institutional challenges faced by women in STEMM, particularly in the Australian context and across various STEMM fields. These challenges range from gender disparities in academia to the underrepresentation of women in senior positions within STEMM disciplines. The literature suggests that these issues contribute to a challenging environment for female students, potentially hindering their academic progression and professional growth.

Despite the extensive research on women in STEMM, a notable gap exists in terms of qualitative studies that delve into the personal experiences of female undergraduate

students. The nuances of these experiences, how they navigate challenges, and the impact on their future academic and professional endeavours remain relatively unexplored. This gap highlights the need for a more in-depth understanding of the lived experiences of female students in STEMM beyond quantitative metrics. To gain a holistic understanding of how female students persist and find motivation in STEMM fields, a closer examination of their experiences and decision-making processes is deemed essential. The proposed research aims to address this gap by delving into the multifaceted aspects of the female undergraduate STEMM experience. By closely exploring day-to-day encounters, obstacles, and triumphs, the research aims to uncover the underlying dynamics that shape the journey of female students in STEMM disciplines.

The significance of this research lies in its potential to bridge the existing knowledge gap in qualitative studies. By unravelling the intricacies of female undergraduate students' experiences, the research aims to contribute nuanced insights that quantitative analyses might overlook. Understanding the motivations and persistence factors which are unique to this demographic is vital for informing targeted interventions, policy changes, and institutional strategies to foster a more inclusive and equitable environment within STEMM fields. The proposed research responds to the imperative call for a comprehensive exploration of the female undergraduate STEMM experience. By addressing the gaps in the current knowledge, this research endeavours to shed light on the rich tapestry of experiences, ultimately fostering an environment in which the potential of every aspiring female scientist, technologist, engineer, mathematician, and medical professional is recognised and supported.

2. Methods

2.1. Design

I employed an exploratory qualitative design with the primary goal of delving into the profound insights embedded within participants' experiences (House 2018; Phillips 2023). This design choice allowed for an in-depth exploration of the nuanced aspects of participants' experiences, going beyond surface-level insights. Anchored in a social constructionist epistemology, the investigation recognised that individual experiences are crafted through their dynamic interactions within social and cultural milieus (Phillips 2023; Ültanir 2012). The acknowledgement of the influence of social and cultural contexts on individual experiences emphasised the dynamic and contextual nature of the study, providing a rich foundation for a better understanding. This epistemological stance provided a robust foundation for a thorough exploration of female undergraduates' encounters in STEMM disciplines, unveiling a spectrum of diverse and distinctive factors that shaped their persistence and motivation.

The integration of a feminist theoretical lens served to deepen the comprehension of these experiences, especially in untangling the influence of gender on women's choices to pursue and persist in STEMM fields (Phillips 2023; West and Zimmerman 1987). Characterised by its critical perspective, the feminist lens aimed to not only understand, but illuminate, aspects of women's lives often marginalised in contemporary research, contributing to a more comprehensive narrative (Phillips 2023; Lorraine Radtke 2017). In the context of this study, it served as a framework to scrutinise how various environments, spanning both social and educational realms, impacted women's perceptions of gender. The lens aimed to uncover the intricate ways these environments moulded their progression in self-efficacy and influenced subsequent decisions to pursue a career in STEMM post-university (Bartlett 1990; Bensimon 1989). The examination of how different environments shaped women's perceptions and self-efficacy progression emphasised the multidimensional influences at play, both during university studies and in subsequent career decisions.

2.2. Positionality

I acknowledge that my background and personal experiences within the Australian public higher education system have played a significant role in shaping the approach and design of this research project. Maintaining a reflexive stance involves an ongoing awareness of how one's background and experiences influence the research approach, ensuring transparency and accountability. This reflexive positioning is not a one-time consideration, but has been an ongoing, integral aspect of my work. In terms of my identity, I personally identify as an Anglo-Australian, cisgender male, and a member of the LGBTIQ+ community. I hold an early career tenured academic role, encompassing both teaching and research responsibilities. Recognising that my position embodies certain elements of diversity, while also reflecting some of the most common identities in academia, especially those associated with being white, cisgender, and male, is essential. Therefore, it was imperative for me to acknowledge the specific privileges linked to my identities and actively address their impact throughout the research process. Navigating inherent tensions requires a pragmatic approach, including a practical and realistic strategy in dealing with the complexities of identity and its impact on the research. Engaging in reflexive practices has been a fundamental strategy to ensure the rigour and authenticity of the findings. I place significant value on the importance of reflexive practice in thoroughly exploring and being aware of how my personal positioning might influence both the research process and the interpretation of the findings.

2.3. Participants

This study enlisted a sample of 13 female undergraduate students currently pursuing STEMM degrees across Australian universities. These students were distributed across the first through fourth years of their respective programs. To extract insights related to the study's main points, semi-structured interviews were conducted. The recruitment of participants employed purposive and convenience sampling methods, deemed particularly suitable for qualitative research due to their deliberate and strategic participant selection aligning with the study's goal of exploring specific phenomena, contexts, and experiences within the chosen group (Coyne 1997). This approach ensured that the collected data were meaningful, comprehensive, and closely aligned with the study's objectives. Furthermore, the research, situated within university settings, provided access to an easily accessible population which met the inclusion criteria (Jager et al. 2017). Recruitment strategies involved various channels such as social media platforms (e.g., university group pages on Facebook), distributing flyers within STEMM cohort buildings on university campuses, and utilising a student participation pool.

The selection of the sampling method and the sample size adhered to the principle of information power, in which the relevance of the information held by the sample in relation to the research question determined the required sample size (Malterud et al. 2015). Following Malterud et al. (2015), this study achieved sufficient information power by considering the study's specific aim, utilisation of established theory, the sample's specificity, the quality of dialogue during interviews (evident in the researchers' conversational fluency, evidence of prompting and elaboration provided by participants, and participants' expertise on their experiences), and the analysis strategy. Detailed demographic information for all participants is available in Table 1.

2.4. Materials

A semi-structured interview guide was crafted to provide a conversational framework, with flexibility for additional probing if necessary for clarification or further elaboration (Kallio et al. 2016). This method aimed to establish a rapport, fostering a comfortable and thorough exploration of participants' experiences within STEMM domains. The interview guide's development was an iterative process, involving reflexive engagement to ensure that questions were in line with the research focus (Korstjens and Moser 2017). Fourteen questions were constructed, covering a spectrum from broad to detailed inquiries, with

the goal of investigating the participants' perceptions of their motivations and drivers in their STEMM experiences. Example questions included, "What are your previous experiences with STEMM subjects in your primary/secondary schooling?" and "What prompted you to pursue a STEMM degree at university?". The guide was structured for an approximate 60 min interview duration. Additionally, a demographic questionnaire was constructed to gather information on participants' age, academic year, and specific STEMM field. This questionnaire did not request personally identifiable information or directly link to the interview data. Participants were asked to complete the demographic questionnaire before the interview, with the option to leave it blank if they preferred not to disclose such information. All collected information was de-identified.

Table 1. Participant Demographics.

Demographics	<i>n</i>
Age (in Years)	
Mean	24.2
SD	6.47
Minimum	19
Maximum	43
Range	24
STEMM Field	
Science	6
Technology	0
Engineering	2
Mathematics	2
Medicine	3
Year of Study	
1st year	4
2nd year	2
3rd year	5
4th year	2
Identity Description	
With a disability	2
Culturally and linguistically diverse	2
Diverse in sexual identity	2

2.5. Procedure

After receiving approval from the Human Research Ethics Committee at Curtin University (HREC2018-0243), the recruitment process commenced. Participants were urged to reach out to the author using the provided email address in the recruitment flyer. Eligible participants were provided with information sheets and consent forms, which they reviewed and signed before the scheduled interview. The interviews were conducted either on the university campus (in locations like a café, meeting room, or library) or through electronic platforms such as Zoom or Skype. Before the interview began, participants were briefed on the study's purpose and the session's agenda. They were requested to submit their signed consent forms and were given the opportunity to ask any questions. The interviews typically spanned 20 to 45 min, with an average duration of 35 min. Towards the conclusion of the interview, participants were invited to contribute any additional points relevant to the research topic. All audio recordings underwent transcription, ensuring the removal of any identifiable information, and subsequently, these records were securely discarded. The transcriptions were printed and subjected to analysis using a pen-and-paper approach, employing reflexive thematic analysis (Braun and Clarke 2006, 2019, 2021). The interviews, transcription, and analysis phases were conducted iteratively, allowing for repeated movement through the stages as required, progressively advancing towards the conclusion through ongoing engagement. Participants were given the option to participate in member checking, enabling them to provide feedback on the preliminary data analysis. The feedback received from the participants was incorporated into the research findings.

2.6. Data Analysis and Quality Procedures

An inductive, reflexive approach to thematic analysis was employed, aligned with the guidelines produced by [Braun and Clarke \(2006, 2019, 2021\)](#). Distinct from, and not relying on, pre-existing frameworks, this analysis sought to capture the direct experiences of female undergraduate STEM students regarding how they persist and find motivation in such fields. It also delved into the contextual factors influencing and underpinning their academic journeys. Immersion into the data involved attentive listening to audio recordings and subsequent transcription. Initial coding, encompassing both explicit and underlying content, was developed through an inductive process. Further coding involved the organisation of these codes into broader categories based on their relationships, culminating in the identification of distinct themes. These themes underwent continuous review, refinement, naming, and definition. The final findings, detailed in the following section, incorporate detailed descriptions and relevant sentiments to capture their essence.

To ensure the robustness and credibility of the study, various measures were implemented for quality assurance. The semi-structured interview guide underwent thorough scrutiny and pilot testing before the actual data collection phase. This process aimed to refine the guide, ensuring its alignment with the overarching research question, and identifying any areas requiring adjustments in the interview framework ([Majid et al. 2017](#)). Additionally, a reflexive journal was diligently maintained to facilitate continuous reflection and processing of the interviews. Serving as a record and audit trail, the reflexive journal captured pertinent information influencing the analysis ([Morrow 2005](#); [Yardley 2017](#)). Following the completion of data collection and analysis, participants were given the opportunity to voluntarily engage in member checking. This involved presenting a summary of the key research findings to the participants, allowing them to provide feedback on the accuracy and impartiality of the interpretations. This process also welcomed additional insights from participants, enriching the research findings ([Locke and Velamuri 2009](#)).

3. Findings

Five overarching themes were constructed to investigate the experiences of female undergraduate STEM students in terms of persistence and motivation in their academic domain. Whilst each of the experiences were unique to the students, there were also commonalities across experiences. These constructed experiences are presented in the following themes: (1) Navigating STEM: Breaking Barriers, Defying Assumptions; (2) Sisterhood and Resilience: Navigating STEM Together; (3) STEM Trailblazers: Unveiling Visibility Challenges and Role Model Empowerment; (4) STEM's Gender Dilemma: Navigating Intimidation, Isolation, and the Fight for Belonging; and (5) STEM Warriors: Fuelled by Passion, Driven by Purpose. Any identifying information has been removed and replaced with [descriptor].

3.1. Navigating STEM: Breaking Barriers, Defying Assumptions

Participants highlighted the pivotal role of their early schooling experiences and the support they received in shaping their engagement in STEM fields. The experiences and support, or lack thereof, during the formative stages of their education significantly influenced their trajectories in STEM and, consequently, their future experiences in these domains. Instances were shared in which participants encountered discouragement from pursuing STEM during their school years, as illustrated by one participant's narrative: "I actually had to phone my teachers to talk to them and one of them told me I was too stupid to ever learn maths" (*Mathematics student, 2nd year*). This revelation underscores the detrimental impact of unsupportive environments on young women's aspirations in STEM. It considers the need for more encouraging and unbiased educational settings, emphasising the role of educators in shaping the aspirations of female students in STEM fields. Such a narrative calls for a critical examination of existing educational practices, teacher training, and societal biases that contribute to gender disparities in STEM. Moreover, another participant expressed a desire to pursue a STEM degree but decided against it, stating,

“...there’d be a lot more ‘having to justify myself’ in those kinds of roles, and I just...I didn’t want work to be my whole identity” (Science student, 1st year). It becomes evident from these accounts that the participants lacked a supportive environment during their early education, potentially dampening their motivation to persist in a subject they genuinely enjoyed. The participants’ concern about having to constantly prove herself in STEMM roles, either due to their gender or perceived competency levels, reveals the anticipated challenges and barriers that might deter women from fully embracing STEMM careers. This reluctance stems from a hesitancy to let the need for constant justification become a defining feature of their identity.

Several participants conveyed how class sizes played a significant role in shaping their exposure to STEMM, shedding light on the challenges and biases present in educational settings. One participant noted a situation where the gender imbalance and stark reality was palpable:

...in the higher-level science classes there would only be like 10–12 girls max doing it, it was actually hard for the school to keep them running...except for the psychology and human bio classes, because I guess it’s one of the softer sciences (Science student, 1st year).

This observation suggests that maintaining ‘hard’ STEMM classes for females was challenging due to the limited number of participants. The struggle to sustain these classes, particularly in the more rigorous STEMM fields, became evident, painting a picture of the hurdles faced in creating an inclusive learning environment. Notably, the participant pointed out an exception for psychology and human biology classes, hinting at the prevailing notion that these are perceived as ‘softer’ sciences. The participant extended on this further, alluding to the distinction between the ‘hard’ and ‘soft’ sciences perceived by societal norms complicating the landscape of women’s STEMM participation, stating

I feel like women are always pushed into human bio fields because it’s...I guess more of a palatable thing, you know? Like physics and maths are what men do, which is not true but that was the assumption... (Science student, 1st year).

The participant’s remark on women being directed towards human biology fields as they are considered more palatable highlights the deeply ingrained stereotypes that dictate the perceived suitability of certain disciplines for women. The assumption that physics and mathematics are domains which should be exclusive to men reflects a prevailing discourse that influences women’s perceptions of their capabilities in various STEMM fields, limiting their choices and reinforcing gendered expectations. Participants also emphasised the lack of support, resulting in a lower awareness of available STEMM subjects, which added another layer of complexity for the participants. One participant shared:

...my school never offered those subjects to us girls, they had an engineering specific subject, but I never did it, I didn’t even know what it was. It was just one of those things where the only ones who did it were already in the upper echelon of students who had immaculate grades already... (Mathematics student, 3rd year).

This sentiment highlights the importance of early education in defining what STEMM entails. The participant also pointed out that typically male-dominated subjects are viewed as more suitable for students with higher grades, creating a perceived barrier to entry for female students. This perception can create a barrier to entry for female students, linking STEMM fields with an exclusive, high-achieving academic circle. The implication is that the limited availability of certain subjects, coupled with gendered perceptions of academic success, may deter women from exploring or pursuing a STEMM education. Another participant discussed dropping out of Physics due to feeling unprepared, revealing

Primary school was cruiseey, like we would build volcanos and do stuff like that, so I only really noticed it when I started doing ATAR and I was like ‘oh this really is a problem, I don’t like this because I feel really dumb and small in here’ (Science student, 4th year).

This instance underscores the importance of early STEM exposure and education, as inadequate preparation during early school experiences can lead to feelings of inadequacy and hinder future pursuits in STEM. The participant advocates for schools to provide proper preparation, tools, and knowledge to empower female students for successful STEM careers. Overall, these narratives reveal the lasting impact of early educational experiences on women in STEM, highlighting discouragement and the need for constant justification as significant barriers. Challenges in sustaining 'hard' STEM classes and gender stereotypes shaping career choices underscored systemic biases. Limited awareness of available subjects further complicated women's paths. The narratives stress the critical role of early education in shaping access and success in STEM, emphasising the need for proper preparation and support to empower female students.

3.2. Sisterhood and Resilience: Navigating STEM Together

Participants emphasised the pivotal role of peer support as a driving force in persisting through the challenges of STEM degrees. Faced with a lack of external support, these women formed a close-knit community with others, relying on one another to create a nurturing and supportive space within the often-demanding STEM environment. For instance, one participant drew motivation from friends who had successfully completed STEM degrees, viewing their achievements as a source of inspiration and assurance in her own capabilities:

...my friends as well, they have gotten through their degree, in a similar thing, and that is a motivator for me, knowing that people with the same intelligence and the same sort of personality as me can get through it, then I can as well (Engineering student, 3rd year).

Here, the participant draws inspiration from observing the academic success of their friends who have navigated a similar academic path in engineering. Such a sentiment suggests that the participant identifies with, and relates to, their peers, viewing them as comparable in terms of cognitive abilities and personality traits. Such motivations stem from a shared capability and resilience, where if similar participants have successfully completed the degree, the participant, too, possesses the same potential. The achievements of peers serve as a positive influence, fostering a belief in one's own capabilities. The camaraderie among peers was further emphasised by another participant, who highlighted the positive impact of studying together and providing mutual support, *"I have a lot of friends that are in my cohort, having that good support system and being able to study together and support each other has really helped"* (Science student, 2nd year). This underlies the significance of a robust support system in navigating the complexities of STEM studies. The mention of a 'good' support system suggests the social network provides companionship, assistance, and encouragement to the participants, creating a collaborative learning environment to share insights, discuss challenging concepts, and collectively navigate the complexities of their studies. This sense of camaraderie and mutual empowerment can provide a buffer against the isolating nature of demanding STEM coursework. Moreover, participants shed light on the unique sisterhood that emerges in response to the gender imbalance within male-dominated STEM spaces. A participant recounted instances where female students strategically gathered together during lectures, forming an unspoken bond to navigate the challenging environment, *"I could sort of see the girls that were there strategically sitting with the other girls...almost as if there was an unspoken bond between them"* (Engineering student, 3rd year). This sense of unity among women in STEM degrees was echoed by another participant, emphasising the norm of women sticking together within these male-dominated fields, *"...they just tend to, in a way, stick together...like, I pretty much know all the girls doing my degree, so it's just kind of how it works"* (Medical student, 1st year). The sentiment reflects the established norm of women supporting and connecting with each other in the challenging STEM domain. The organic formation of a supportive community suggests a collective response to the unique challenges and underrepresentation that women often face in male-dominated STEM fields. The sentiment not only reflects the numerical minority of women within the participant's degree, but the strong connection among said

women to share experiences, offer encouragement, and collectively address and navigate the barriers associated with STEMM and academia.

Interestingly, the participants shared insights into how the gender balance within STEMM disciplines influences their experiences. In male-dominated settings, the strategic bonding among female students creates a supportive network to counter the intimidating atmosphere. Conversely, in female-dominated STEMM classes, a participant noted a stark contrast in her sense of belonging, feeling more alone in a male-dominated physics unit, *“I’d go in there and be all alone”* (Engineering student, 3rd year). The importance of peer support was further emphasised, with one participant expressing that the absence of female peers made the challenges more pronounced:

... as soon as I didn’t have that peer support, then things were felt so much harder, and like the distinction of being women in STEMM felt a bit more obvious. . . I think that’s when like the struggle became a bit more obvious (Science student, 3rd year) (Science student, 3rd year).

Here, the participant’s reflection considers the significant impact of an absent peer support system, where the academic journey becomes notably more challenging. There appears to be a tangible difference in the perceived difficulty of the academic tasks and challenges faced in STEMM when lacking peer support. The mention of the ‘distinction of being women in STEMM’ highlights the magnification of the sense of minority status and experience of gender-based obstacles, making the challenges more pronounced. Moreover, the dialogue also delved into the future prospects of undergraduate women in STEMM, emphasising the crucial role of women’s representation in creating safe and inclusive spaces:

Obviously having more women there is going to help because then you know, they’ve got each other, they can feel more inclined to speak up and gain more confidence from being around each other, they can create a safe environment for each other. . . (Science student, 4th year).

The participants articulated the positive impact of having more women in these environments, fostering an environment where women can speak up, gain confidence, and provide support to one another. This sense of belonging, in turn, contributes to resilience in the face of challenges. Notably, the participants stressed the need for a safe and accepting culture within the STEMM field. They highlighted that an unsupportive environment could significantly impact motivation and, in extreme cases, lead women to consider dropping out of their STEMM programs:

. . . if the culture isn’t right, and it doesn’t feel like they can speak up, if it doesn’t feel like a safe space for them. . . then you’re inevitably going to get women that drop out and don’t continue. I feel that, and I’ve been tempted so many times to stop the degree because of the subtle way the culture is in physics and in STEMM (Science student, 3rd year).

To address this, participants advocated for promoting a safe, inclusive culture to ensure women feel heard and supported, ultimately encouraging their persistence in STEMM pursuits. In this theme, peer support emerged as a crucial motivator for women in STEMM, offering a resilient community to navigate challenges. The narratives highlight strategic bonding in male-dominated settings and the necessity of peer support in female-dominated classes. Increased women’s representation is seen as essential for fostering a supportive environment, contributing to resilience. Participants stress the importance of cultivating a safe and inclusive culture within STEMM to ensure women’s persistence in their pursuits.

3.3. STEMM Trailblazers: Unveiling Visibility Challenges and Role Model Empowerment

Participants acknowledged the significance of having role models and mentors in their STEMM journey, citing the profound impact on their motivation and persistence. One participant expressed this influence, stating, *“I’ve met a lot of strong women role models who do work in the field, and they persevere because for the couple of awful parts of the field, there’s so*

much more that brings joy to them" (Medical student, 4th year). This participant highlighted the crucial role of witnessing resilient women in their STEMM field, emphasising it as a transformative influence in that the visible perseverance of these role models serves as an inspiration and assurance that challenges can be overcome. By actively witnessing the success and tenacity of these women, the participant acknowledges the motivational impact, turning challenges into surmountable hurdles, and instilling confidence in the feasibility of navigating the complexities of STEMM fields. Such a perspective highlights the crucial role of representation and resilient role models in fostering a supportive and empowering environment for women in STEMM.

In male-dominated STEMM environments, female tutors were particularly emphasised by participants as being pivotal role models. As one participant shared:

I had a few tutors that were females in STEMM, and they really helped us girls through it, so having them there definitely helps. Seeing people in the industry doing well is really good, like yeah there is a place for you here (Engineering student, 3rd year).

This experience reinforced the idea that seeing successful women in the field not only provides encouragement, but also signals that women can thrive and belong in traditionally male-dominated spaces. This dual impact not only motivates individuals but also challenges stereotypes, reshaping perceptions and fostering a sense of ownership and acceptance within these fields. The visibility of successful women becomes a transformative force, affirming the legitimate and thriving presence of women in STEMM. Another participant highlighted the reassurance derived from having role models, stating, *"... it's good reassurance that I'm doing a good thing"* (Science student, 4th year). This reassurance serves as a source of inspiration, affirming the participants' belief that they are on the right path within the STEMM field. Beyond encouragement, this affirmation instils a sense of purpose and direction, grounding the participants in the conviction that their pursuits in STEMM are not only worthwhile, but also aligned with a trajectory of success. The transformative power of role models was further explained by a participant who noted:

... it makes women think, well if she can do it, then I can do it. I mean if I am a woman in the same field then maybe I can start going into that direction to get to that point, there is nothing stopping me... (Science student, 1st year).

This perspective describes the motivational aspect of having role models and how it fuels determination among women to persist and succeed, breaking down barriers and stereotypes. It highlights the transformative impact of visible figures who have triumphed in STEMM, contributing to a cultural shift in societal perceptions and fostering a sense of community determination for women pursuing success in traditionally male-dominated fields. However, the desire for visibility and acknowledgement also brought to light the challenges faced by participants in male-dominated environments. Some participants revealed that they felt the need to change their behaviour to fit into these spaces, as articulated by one participant,

... I'm going to have to make myself look really good, and I have to show that women can really do it kind of thing you know? And I think in a way, I always try to live up to the idea that I'm always on top of things... (Medical student, 3rd year).

This pressure to constantly prove themselves not only places an additional burden on women in STEMM but also highlights the pervasive gender biases that they must navigate. Such a pressure reflects deeply ingrained stereotypes, perpetuating the perception of women as exceptions in STEMM disciplines. Addressing this issue not only requires individual mindset shifts, but a systemic transformation to create an environment where competence is assumed, relieving women from the burden of disproving persistent stereotypes. Furthermore, participants shared instances where assumptions about their abilities based on gender led to self-doubt and the need to dispel stereotypes. One participant recounted:

I don't know if it's because I'm a woman, or if it's because of my personality, but everyone thought I was dumb, and so I had to fight to be like "no I'm just as smart as everyone else and I'm getting the marks" (Mathematics student, 3rd year).

This participant's experience reflects the challenges of combating gendered stereotypes and the persistent need to prove competence, impacting not only individual confidence, but also contributing to a broader cultural issue within STEMM fields. Beyond individual confidence, this narrative highlights the systemic nature of these challenges, calling for a cultural shift within STEMM to presume competence and actively challenge deeply ingrained biases. The participant's sentiments serve as a compelling call to address these issues systemically for a more inclusive and equitable environment in STEMM. Moreover, the participants discussed the perception of women as less intelligent in certain STEMM fields, with one participant expressing, *"I definitely think in other STEMM fields there is that assumption, whether it's active or passive, that men are smarter than women and are therefore more capable"* (Engineering student, 3rd year). This stereotype creates an added layer of pressure for women in STEMM, compelling them to work harder to challenge and overcome biased expectations. Such a challenge not only requires exceptional professional competence, but also constant efforts to reshape deeply ingrained biases. The impact extends beyond individual pressures, contributing to a broader cultural challenge that impedes the collective advancement of women in STEMM. Addressing the issue calls for systemic changes to eradicate biased expectations and create a thriving environment for women without the burden of disproving entrenched stereotypes. Furthermore, the feeling of invisibility, and the constant need to prove oneself, were further highlighted in classroom settings, particularly in heavily male-dominated environments. A participant shared the impact of feeling invisible, stating:

I almost dropped physics in school even though I needed it because I was sick of going to a class where I felt like I constantly had to prove myself and I feel like that happens a lot in STEMM as well (Science student, 1st year).

This sentiment reflects the adverse effects of the persistent struggle for acknowledgement and visibility, often leading to the contemplation of dropping out. This contemplation reflects systemic challenges within STEMM, highlighting the need for structural changes to ensure acknowledgement and visibility are intrinsic components of the field. The consideration of leaving becomes a collective plea for an inclusive and equitable environment that fosters the success of all individuals in STEMM. These narratives illustrate the multifaceted challenges faced by undergraduate women in STEMM, ranging from the influence of role models to the pressure to dispel stereotypes, and the struggle for visibility and acknowledgement within historically male-dominated spaces.

3.4. STEMM's Gender Dilemma: Navigating Intimidation, Isolation, and the Fight for Belonging

This theme encapsulates the participants' sentiments of intimidation stemming from the significant gender disparity within STEMM fields, particularly the overwhelming presence of men compared to women. The perceived and experienced intimidation has notable repercussions on their STEMM journeys. One participant articulates this apprehension, suggesting *"I feel like a female would be intimidated by how many guys are there, like in general it would be really intimidating, and I feel like they might persuade you to not go any further or you'd feel outnumbered"* (Engineering student, 3rd year). This reflection highlights the potential impact of intimidation on one's resolve and perseverance in STEMM, potentially leading to withdrawal from this formidable environment. The recognition of intimidation emphasises the need for a supportive and inclusive culture in STEMM to mitigate adverse effects and nurture resilience. Addressing this challenge is crucial for retaining diverse talent and fostering an environment conducive to long-term engagement and success in STEMM.

Several participants shared the experience of being the lone woman in their STEMM classes, fostering feelings of insecurity due to the absence of female peers for support and encouragement. One participant expressed concern, stating

...there are definitely many women who would be intimidated by that and be like 'I can't do this. I'm being taught by men, I'm surrounded by men... no'. and I think I'd have a really hard time in that cohort as well because... (sighs) that's so many men (Science student, 4th year).

In this context, the participant suggests that being immersed in an environment predominantly comprised of men can instigate self-doubt regarding one's abilities and hinder a sense of belonging within the STEMM community. This observation underscores the psychological impact of gender imbalances, emphasising the need for proactive measures to create an inclusive culture that fosters confidence and belonging for all, regardless of gender. Further instances within this theme explored nuances where the perceived intimidation in male-dominated STEMM classes affected participants' behaviour. One participant shared her experience, revealing "*...when I go into physics, I never would raise my hand to answer questions 'cause I felt really intimidated by everyone you know?'*" (Science student, 3rd year). This acknowledgement sheds light on the gender imbalance in STEMM, leading undergraduate women to fear active participation, questioning, and engagement in class discussions due to the dominance of male voices. This dynamic not only reinforces existing inequalities but also poses a potential barrier impacting the motivation and persistence of women in STEMM. Such sentiments underscore the need for interventions to foster inclusive learning environments, ensuring that all voices are empowered and heard.

Participants stressed that the intimidation and gender stereotypes prevalent in STEMM can detrimentally influence their self-belief and motivation. One participant highlights potential discouragement, noting, "*I think some of them would discourage women who might otherwise be perfectly capable of doing a degree, and doing it well, because they've been made to feel like they can't*" (Mathematics student, 2nd year). This observation illuminates the impact of gender-based assumptions on women's confidence, potentially deterring them from pursuing STEMM fields. It emphasises the need for systemic changes to challenge stereotypes and create an inclusive culture that supports the diverse contributions of individuals in these fields, acknowledging the broader implications on the representation and success of women in STEMM. Another participant delves into the consequences of feeling the need to prove oneself, stating

I have to prove that I'm as smart and as worthy for a certain job. And I think that when you don't have that and women feel like they aren't worthy, which happens because if you're going into a class every day and you feel isolated and segregated...you're going to drop out (Science student, 2nd year).

Here, the participant emphasises how the sense of isolation and intimidation can erode women's self-worth and belief in their competence within STEMM, ultimately jeopardising their sense of belonging in this academic and professional sphere. This insight emphasises the urgency of creating supportive and inclusive environments to counteract these detrimental effects, highlighting the need for interventions that foster resilience and empowerment. The broader implications include the potential influence on career aspirations and leadership roles within STEMM, highlighting the imperative for holistic approaches to address the challenges faced by women in these fields. In the face of the intimidating gender disparities within STEMM, these narratives illuminate the challenges that women encounter, feeling outnumbered, insecure, and at times, questioning their very place in the field. The narratives also underscore the potential consequences of such intimidation, from dampened motivation, to self-doubt, and the struggle for self-worth.

3.5. STEMM Warriors: Fuelled by Passion, Driven by Purpose

The participants' narratives reveal a powerful theme centred around the driving force of passion within their STEMM disciplines, acting as a resilient motivator in the face of challenges. Despite acknowledging the stressful and overwhelming nature of the STEMM environment, especially for women in male-dominated spaces, these individuals emphasise how their love for their discipline, and a determination to succeed, outweigh the negative

experiences. In instances where male-dominated STEMM units were perceived as being isolating, participants found solace in their passion for the subject matter, demonstrating an inner strength that propelled them forward. One participant noted how she ‘pushed through’ the isolation: “...that specific unit I found quite isolating, but I just loved the content, so I pushed through it” (Mathematics student, 3rd year), emphasising the profound impact of passion on persistence. Moreover, these women shared stories of overcoming setbacks, using instances of being put down as fuel to adapt and work even harder:

...just pushed me even more to do what I want to do, so now I just don't let it bother me. Just worked 10 times harder, thick skin. I've gone through a lot to get to where I am today. ...whatever you can do I can do; you can pick on me all you want but that is not going to affect me in anyway (Science student, 4th year).

The sentiment of not letting external negativity affect their pursuit of goals is encapsulated in the participant's resolute statement above, reflecting a resilience cultivated in the face of adversity. Competitiveness within the STEMM field, while potentially contributing to feelings of isolation, is reframed as a driving force for persistence. This underpins the determination of turning adversity into an opportunity for personal and academic growth, aligning with broader discussions on mindset and resilience, and emphasising the importance of fostering a supportive environment within competitive academic and professional contexts. Moreover, the desire for challenge, and the acknowledgement of a competitive environment, only served to fuel determination. As one participant expressed: “I just find the STEMM side more interesting than the other side and like I know it can be quite competitive. ...that's the type of career like I want to be challenged, I don't want it to be easy to get something, I want to compete for it I guess” (Engineering student, 3rd year). The participant's perspective, articulated as a preference for challenges and competition within the STEMM field, challenges conventional notions by highlighting these aspects as sources of inspiration and fulfilment. This viewpoint highlights the diverse motivations individuals bring to their pursuits in STEMM, suggesting the positive impact of embracing challenges in personal and professional fulfilment. Such sentiments prompt considerations for tailoring educational and professional environments to accommodate diverse motivational factors within the STEMM landscape.

Participants also described how their vision for the future played a crucial role in sustaining motivation. The clarity of purpose, evident in the sentiment “I really just wanna be like driven, like I just got this idea of like having my name on the door in a private practice. ...” (Science student, 4th year), which reflects the aspiration to have their name on the door of a private practice, providing a tangible goal that propels them forward. This vision acts as a powerful driving force, intensifying their commitment to the journey. This clear sense of purpose goes beyond academic achievements, providing a roadmap for decision-making and influencing their efforts. The articulated vision represents a multifaceted motivation within the STEMM landscape, emphasising the importance of personalised and meaningful goals in driving academic and professional pursuits. Additionally, the participants' narratives delved into the mindset that participants carried forward, one that resists becoming a statistic of women deterred by challenges;

It's one of those things well, I always have this mentality sometimes when things get hard of like, I don't want to fall into that statistic of women who get deterred because of all these different things. There's just things like that I guess, you know when things get tough, which can help reignite my passion and encourage me again to keep going (Medical student, 3rd year).

The above sentiment acknowledges how such a mindset becomes a powerful tool during tough times, serving to reignite passion and encourage perseverance. The fear of succumbing to struggles and becoming a mere statistic is, in itself, a force that compels these women to persist in their STEMM pursuits. It reflects a strategic mental framework that transforms adversity into an opportunity for growth and resilience, highlighting the complex interplay of psychological dynamics in women's determination within STEMM

fields. Overall, this theme portrays a vivid picture of passion as a driving force, enabling the women to navigate through the challenges of their STEMM journeys. It highlights the transformative power of love for discipline, resilience in the face of setbacks, and the significance of a clear vision for the future in propelling these individuals towards their goals.

4. Discussion

The objective of this study was to investigate how the experiences of female undergraduate students in STEMM impact their motivation and persistence in pursuing their degrees. The identification of five themes collectively encompasses a spectrum of experiences, delving into their influence on participants' STEMM journeys, particularly regarding their self-efficacy, determination, and overall well-being. Early experiences and exposure to STEMM emerged as critical factors shaping participants' future in STEMM, serving as either motivators or deterrents. The findings suggest that the environment for undergraduate women, coupled with peer support, plays a pivotal role in fostering a sense of support and belonging in a historically male-dominated space. Participants grappled with the challenge of being recognised within the STEMM domain, contending with feelings of invisibility due to gender imbalances, exacerbated by a lack of female role models, further impacting their sense of belonging and acceptance. The pervasive presence of males in STEMM led participants to experience intimidation, potentially prompting thoughts of dropping out due to a sense of being outnumbered and isolated. Despite these challenges, participants' passion and dedication to their STEMM degrees significantly contribute to their persistence in the field and their aspirations for the future.

Participants reflected on their initial experiences in the field of STEMM, underscoring the pivotal roles of support, early education, and exposure. They recounted instances where discouragement within STEMM subjects during school or obstacles to STEMM involvement due to insufficient class enrolment had tangible repercussions on their STEMM self-efficacy and confidence in university settings. These findings align with existing research on the leaky pipeline concept, shedding light on factors contributing to women's early departure from STEMM careers and emphasising the critical role of early experiences in preventing further attrition from STEMM (Buckles 2019; Grogan 2019). Furthermore, my investigation illuminated the discourse surrounding 'soft' and 'hard' STEMM disciplines, unveiling prevalent gender stereotypes associated with STEMM topics. Female participants shared experiences of being nudged towards 'softer' STEMM fields like biology, while being dissuaded from pursuing 'harder' STEMM fields such as engineering, which are often characterised by a male-dominated environment. This narrative aligns with the broader literature, indicating that gender stereotypes influence young women's choices to pursue STEMM degrees that align with stereotypical feminine qualities (Carli et al. 2016; Jensen and Deemer 2019; Mavin and Yusupova 2023; Phillips and Dzidic 2023).

While existing research, exemplified by Robnett (2016), emphasises the significance of encouragement and support during university years, my study uniquely highlights the critical role of early experiences in shaping women's STEMM self-concept. The narratives of participants suggest that adverse early experiences can act as deterrents, influencing women to abandon their pursuit of STEMM fields. These findings align with the Expectancy–Value Theory of Achievement proposed by Eccles and Wigfield (1995, 2002), emphasising that, if women face discouragement from a young age due to a lack of support, exposure, and STEMM education, it adversely affects their self-confidence and, consequently, their future prospects in STEMM. The participants stressed the importance of fostering self-confidence through positive early experiences for sustained success and engagement in STEMM fields.

Participants acknowledged the significance of peer support as a crucial motivator within their STEMM degree, especially given the lack of external support from peers, instructors, or institutions. Establishing connections with fellow women navigating similar journeys fostered a sense of belonging and confidence in their STEMM abilities. This aligns with the existing literature, emphasising the centrality of relationships for a sense

of belonging in STEMM (Leaper and Starr 2019; Talley and Ortiz 2017). The findings underscored how peer support acted as a source of resilience, bolstering motivation and persistence in their degree. Notably, the concept of sisterhood emerged, illustrating an automatic camaraderie among undergraduate women in STEMM to navigate the challenges of workload and the male-dominated environment. da Costa (2016) supports the notion of peer support, reinforcing the participants' need to seek connection when feeling unwelcome, affirming their presence.

Participants demonstrated an awareness of their marginalised position or a tendency to experience self-doubt, influenced by internalised messages suggesting women do not belong in the STEMM environment (Maltese and Cooper 2017). Additionally, my study highlighted the crucial role of a safe and encouraging STEMM environment, not only within the university space, but also in future STEMM workplaces. Discussions explored the negative impact of an unsupportive culture and environment, leading women to consider dropping out to escape feelings of seclusion (Meadhbh Murray et al. 2023). The feminist perspective provides insight into participants' understanding of their gender and its implications for being a woman in STEMM, emphasising the effects of this distinction (Phillips et al. 2022, 2023a; West and Zimmerman 1987).

The undergraduate women emphasised the importance of visibility, acknowledgement, and recognition in establishing their place within the STEMM space. Role models played a pivotal role, helping participants to visualise success and persist in their degree. My study contributes to existing research by delving into the function of role models, highlighting their impact on participants' persistence and motivation. Participants expressed the need to adapt their behaviour in classroom settings to gain acknowledgement, citing assumptions about their abilities based on gender and STEMM degree, leading to feelings of invisibility. Low expectations for success were linked to reduced persistence in STEMM, with stereotypes and the lack of role models contributing to a lack of motivation to continue in STEMM, sometimes outweighing the positives (Eccles and Wigfield 1995, 2002).

The gender imbalance in STEMM, with men significantly outnumbering women, invites a feminist perspective to illuminate women's experiences shaped by their environment (Martínez-Ruiz and Hernández-Amorós 2023; West and Zimmerman 1987). Participants described feelings of intimidation in male-dominated settings, acting as a deterrent to pursuing or persisting in their degree. This intimidation connects to a lack of belongingness and emphasises the importance of supportive peers. The gender ratio in classrooms and future workplaces, coupled with the absence of female peers and instructors, subtly conveys a message that participants may not belong (da Costa 2016). Unlike previous literature emphasising explicit sexual harassment and discrimination, this study highlighted more subtle forms through gender stereotypes and assumptions, resulting in feelings of isolation and intimidation (Leaper and Starr 2019). The findings contribute to the existing literature by presenting women's narratives, adding crucial insights to the broader understanding of gender equity.

4.1. Implications

The application of qualitative methods in this study has enabled the identification of rich and meaningful themes that effectively encapsulate the experiences of undergraduate females in STEMM. While quantitative methods have provided numerical data on these experiences, the qualitative approach allows for an expansion of the quantitative literature by offering context and a textual exploration of the findings. Theoretical implications of the findings are linked to the expectancy-value theory of achievement, emphasising that undergraduate female students' likelihood of persistence in STEMM depends on their expectations of success, confidence, competency, and intrinsic values (Eccles and Wigfield 1995, 2002). Understanding these factors could underscore the importance of supporting women, contributing to the enhancement of their confidence and, consequently, their achievements in STEMM.

The practical implications stemming from the findings extend from the individual to the organisational level. Schools and universities could benefit from insights into the types of experiences women undergo at a younger age, emphasising the significance of exposing and educating female students in a supportive manner. Establishing a supportive foundation for women's STEMM journeys is crucial, as it can influence their future endeavours. These implications stress the importance of support networks and role models to help undergraduate females feel seen and supported in their academic pursuits. Encouraging student support and providing mentoring for female undergraduate students could prove beneficial in navigating the challenging STEMM environment. A safe and accepting environment is pivotal for the persistence of female undergraduate students in their STEMM degree. Additionally, the implications extend to the university-wide and professional levels, encouraging educational institutions and workplaces in future STEMM fields to address and acknowledge women's experiences by fostering inclusive and safe study, and work, spaces. Disseminating knowledge about these women's experiences can motivate universities and companies to create environments that prioritise the well-being and success of women in STEMM.

4.2. Limitations and Future Research Directions

The current research employed numerous quality controls to ensure the rigour and trustworthiness of the process. However, certain factors need consideration. Using Facebook as one of the sampling methods involved reaching out to various STEMM pages to diversify the recruitment audience. Unfortunately, some Facebook STEMM pages, particularly those administered by male undergraduate students, displayed reluctance to support or cooperate with a study focusing on a contentious gender equity issue. This reluctance affected the ability to reach a broader spectrum of undergraduate women in STEMM, impacting the representation of experiences and affecting the transferability of the study's findings.

The study predominantly featured heterosexual Caucasian women, with only a few culturally diverse, and diverse identity, participants. The absence of Indigenous Australian women, women of colour, and those with diverse identities, highlights a lack of culturally diverse perspectives and experiences and their impact on motivation and persistence. While there were some participants with disabilities, cultural diversity, and diverse identities, I could not link their responses to the demographic information collected due to ethical and confidentiality restraints. Consequently, the data interpretation lacked consideration for the diversity of backgrounds and identities among participants. Future research should conscientiously incorporate diverse perspectives. Furthermore, the insufficient representation of women pursuing Technology degrees limited perspectives on motivation and persistence within this field.

Building upon the insights gained from the current study, a promising avenue for future research involves conducting a more extensive investigation with a larger and more diverse sample of undergraduate women in STEMM. While the present study provided valuable in-depth perspectives from a specific cohort, expanding the participant pool could significantly enhance the transferability of findings and contribute to a more comprehensive understanding of the experiences faced by women across various stages of their STEMM education. Example of this could be interviewing women at the degree selection stage ('pre-engagement') as well as those women who opted for non-STEMM pathways to explore reasons for their decision-making. To address the call for greater diversity, future research could intentionally recruit participants from different academic years, disciplines within STEMM, as well as institutions. In addition, future directions could involve examining the impacts of intersectionality, encompassing females and the interconnecting experiences of their identities to comprehend the diverse perspectives in STEMM and their impact on motivation and persistence. This broader representation would allow for a more nuanced exploration of how experiences may vary based on factors such as academic progression, field of study, and institutional context. Moreover, a larger sample size would

facilitate a more robust analysis of potential intersections between gender and other identity markers, such as ethnicity, socioeconomic background, or first-generation college status. Understanding the intersecting factors influencing women's experiences in STEMM can uncover unique challenges and opportunities for support. Such a direction could also extend and focus on further male-dominated STEMM fields like technology, engineering, and mathematics to gain richer data of diverse experiences. In addition to qualitative methods, incorporating quantitative measures could provide a more comprehensive view of the broader STEMM landscape. Surveys or structured interviews could capture broader trends, enabling the identification of commonalities and variations in experiences across a more extensive participant base. Ultimately, a larger and more diverse sample would not only strengthen the external validity of the findings but also contribute valuable insights to inform targeted interventions, policies, and support mechanisms aimed at fostering gender equity and empowerment for undergraduate women in STEMM disciplines.

5. Conclusions

The presented research and findings make significant strides in advancing our understanding of the diverse experiences of undergraduate women in STEMM and consequential impacts on motivation and persistence. This study goes beyond surface-level exploration, delving into the intricacies of the women's experiences and the decision-making processes that shape their future academic and professional accomplishments. The research emphasises the crucial need to address the gender disparities prevalent in STEMM spaces and examines how these environments contribute to issues such as invisibility, anonymity, intimidation, and a lack of belongingness for women. Moving forward, there is an urgent call to action for society to actively participate in making STEMM spaces more gender equitable. This entails a comprehensive exploration of the factors that perpetuate gender imbalances and the implementation of strategies to mitigate issues that hinder women's progression in these fields. By increasing education, knowledge dissemination, and providing robust support systems, society can embark on a journey to genuinely value and appreciate the experiences of women in STEMM. This collective effort is crucial for fostering motivation and persistence among women, ultimately leading to enhanced gender equality and the empowerment and success of women in what have traditionally been male-dominated spaces.

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