Forging Engineers: Capital Mobilisation and Professional Identity Development in the University

Patricia Jimenez

May 2025

This thesis is submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

Department of Educational Research
Lancaster University
UK

Abstract

Forging Engineers: Capital Mobilisation and Professional Identity Development in the University

Patricia Jimenez

This thesis explores how engineering students from disadvantaged backgrounds in Chile perceive and experience their education as a means of promoting social mobility. Using Bourdieu's theoretical framework of field, habitus, and capital, the study examines the complex strategies these students employ to navigate engineering education, the barriers and facilitators they encounter, and how they develop their professional identities.

Through semi-structured interviews with 17 engineering students at a regional Chilean university, the research identifies eleven strategies students used to accumulate and mobilise economic, cultural, and social capital. These strategies coalesce into five integrated patterns: Academic Achievement Approach, Financial Management Strategy, Professional Skill Development, Enrichment Opportunity Utilisation, and Adaptive Coping Mechanism. The findings reveal that students actively transform constraints into opportunities through strategic adaptation and reflexivity rather than merely reproducing their social positioning.

The study contributes to theoretical understandings of capital mobilisation, habitus transformation, and identity formation in engineering education. It identifies the development of a "reflexive habitus" as crucial for students' successful navigation of the engineering field while maintaining connections to their primary habitus. The research also highlights the "bifocal professional vision" that disadvantaged students develop, a simultaneous awareness of engineering's technical aspects and its potential for social transformation.

While existing Chilean research has primarily focused on elite Santiago-based institutions and structural barriers in higher education, this study provides novel insights into how students at regional universities demonstrate agency and develop professional identities despite limited access to elite networks. The

research challenges Santiago-centric narratives by examining how regional universities with strong accreditation levels can serve as effective spaces for social mobility, particularly within engineering disciplines. Additionally, it expands understanding of gender dynamics in Chilean engineering education, documenting how female students strategically manage discriminatory practices in male-dominated environments.

Key barriers identified include limited academic and cultural capital, socioeconomic constraints, rigid educational practices, and gendered field dynamics. Despite these challenges, students demonstrate remarkable agency through facilitators such as family support, institutional mechanisms, and the development of problem-solving mindsets and adaptive identities.

This research has potential implications for engineering education policies and practices in Chile and beyond, suggesting the need for more flexible educational approaches, comprehensive support systems, and greater recognition of diverse pathways to engineering competence. The findings challenge deficit perspectives on disadvantaged students, highlighting their resourcefulness and capacity for strategic adaptation within structural constraints.

Table of Contents

Abstract i

List of Figures and Tables xi

Acknowledgements xii

Chapter 1: Introduction and Background 15

1.1 Overview 15

1.2 Background 16

1.2.1 Inequalities in Engineering 16

1.2.2 Engineering Education as a Path to Social Mobility 17

1.2.3 The Chilean Context 18

1.2.4 Bourdieu's Theory as a Theoretical Framework 27

1.3 Research Aims, Objectives, and Questions 29

1.4 The Significance of the Study 30

1.5 The limitations of the study 31

1.6 Structural outline of the thesis 32

Chapter 2: Literature Review 34

2.1 Overview 34

2.2 Theoretical Framework: Bourdieu's Concepts and Extensions.....36

2.2.1 Theory of Action.....37

2.2.2 Field.....38

2.2.3 Habitus.....39

2.2.4 Capital.....40

2.2.5 Capital Conversion.....46

2.2.6 Capital Accumulation and Mobilisation in Higher Education Students.....48

2.3 Low-Income Students' Experiences in Higher Education.....52

2.3.1 Higher Education Choices and Access.....52

2.3.2 Barriers and Challenges in Higher Education.....58

2.3.3 Social Integration and Identity Negotiation.....62

2.3.4 Institutional Factors and Potential for Change.....65

2.4 Professional Identity Formation in Engineering.....71

2.4.1 The context: Engineering Field and Engineering Education.....72

2.4.2 Defining Engineering Identity.....73

2.4.3 Technical-Social Dualism in Engineering.....75

2.4.4 Engineering Identity in Low-Income Students.....76

2.4.5 Navigating Identity in a Gendered Field 79

2.5 Conclusions 83

Chapter 3: Methodology 85

3.1 Overview 85

3.2 Research Approach 85

3.2.1 Design 85

3.2.2 Trustworthiness 86

3.3 Research Positioning 88

3.4 Research Setting 91

3.4.1 Site Selection 91

3.4.2 Recruitment Procedure 92

3.4.3 Participants 93

3.5 Data Collection 96

3.5.1 Semi-structured Interviews 96

3.5.2 Rapport in qualitative interviews 98

3.5.3 Interview Guide 100

3.5.4 Online Interviews 103

3.6 Data Management **105**

3.6.1 Ethical Considerations 105

3.6.2 Translation 108

3.6.3 Transcription 110

3.6.4 Coding Process 112

3.7 Data Analysis **114**

3.8 Limitations **115**

3.9 Conclusion **116**

Chapter 4: Forms of Capital Mobilised in Engineering Students' Trajectories **117**

4.1 Overview **117**

4.2 Economic Capital: Financial Resources Enabling Educational Pursuits . **117**

4.2.1 Leveraging Financial Aid and Support 118

4.2.2 Balancing Work and Study 121

4.2.3 Reframing Economic Constraints as Opportunities 123

4.3 Cultural Capital: Navigating the Field of Engineering Education **125**

4.3.1 Capitalising on Academic Excellence 126

4.3.2 Accessing Enrichment Opportunities 128

4.3.3 Developing Language and Communication Skills: 130

4.3.4 Leveraging Strong Study Habits 133

4.3.5 Applying Practical Knowledge 135

4.4 Social Capital: Support Networks Facilitating Educational Success 137

4.4.1 Building Supportive Networks 138

4.4.2 Developing Leadership Skills 140

4.4.3 Adapting Social Interactions 142

4.4.4 Summary of strategies used by participants to accumulate/mobilise capital . 145

4.5 Conclusion 146

Chapter 5: Navigating Barriers and Harnessing Facilitators in Engineering Education (Habitus and Reflexivity) 148

5.1 Overview 148

5.2 Barriers Experienced by Engineering Students 148

5.2.1 Individual Habitus 149

5.2.2 Institutional Habitus and Structural Obstacles 150

5.2.3 Field (Engineering Education) 154

5.2.4 Navigational Challenges in the Engineering Field 161

5.2.5 Summary of Barriers in Engineering Education 164

5.3 Facilitators and Enablers for Engineering Students 164

5.3.1 Mobilisation of Primary Habitus (Familial and friends support) 165

5.3.2 Institutional Mechanisms for Habitus Adaptation 167

5.3.3 Reflexive Habitus 169

5.3.4 Summary of Facilitators in Engineering Education 172

5.4 Strategy Integration Patterns: How Disadvantaged Engineering Students Combine Resources for Success 172

5.4.1 Patterns Characterisation 173

5.4.2 Prevalence and Foundational Relationships 175

5.4.3 Sequential and Reciprocal Relationships 176

5.4.4 Engineering-Specific Dimensions of Strategy Deployment 177

5.4.5 Patterns of Strategy Combination 178

5.5 Conclusion 180

Chapter 6: Developing Professional Identity as an Engineering Student 182

6.1 Overview 182

6.2 Technical-Professional Identity 183

6.2.1 Technical Foundation: Mathematical and Scientific Skills 184

6.2.2 Technical Pathways: Negotiating Career Choices 186

6.3 Social-Ethical Identity 189

6.3.1 Awareness of Ethical Responsibilities and Engineering Impact 190

6.3.2 Gender Dynamics in Engineering Education 202

6.4 Summary of Themes in Engineer Identity 204

6.5 Conclusion 205

Chapter 7: Conclusions 207

7.1 Overview 207

7.2 Addressing the Main Question 207

7.3 Key Findings 208

7.4 Theoretical Contributions 212

7.4.1 Expanding Understanding of Capital Mobilisation in Engineering Education . 212

7.4.2 Reconceptualising Habitus Through the Lens of Engineering Education 213

7.4.3 Illuminating the Complex Dynamics of Professional Identity Formation 213

7.4.4 Advancing Understanding of Gendered Experiences in Engineering Education 218

7.4.5 Contextualising Engineering Education Within Chilean Higher Education 219

7.5 Practical Implications 221

7.5.1 Institutional Implications 221

7.5.2 Policy Implications 222

7.5.3 Implications for Educators 223

7.6 Limitations 223

7.7 Future Research Directions 224

7.8 Final Reflections 224

Appendix One 227

Appendix Two 230

Appendix Three 232

Appendix Four 236

List of abbreviations 238

References 239

List of Figures and Tables

Table 3.1 Sample Demographic information 95

Table 3.2 Research question and interview guide 101

Table 3.3 Example from Codebook (for Code: Economic Capital) 113

Table 4.1 Strategies to leverage financial aid and support 120

Table 4.2 Work-study Strategies 122

Table 4.3 Reframing Strategies 124

Table 4.4 Academic Excellence Strategies 128

Table 4.5 Enrichment Strategies 130

Table 4.6 Language and Communication Strategies 132

Table 4.7 Study Habits Strategies 134

Table 4.8 Practical Knowledge Strategies 137

Table 4.9 Supportive Networks Strategies 139

Table 4.10 Leadership Strategies 142

Table 4.11 Social Interaction Strategies 144

Table 4.12 Summary of strategies used by participants to accumulate/mobilise capital 145

Table 5.1 Barriers in Engineering Education 164

Table 5.2 Facilitators in Engineering Education 172

Table 5.3 Strategy Integration Patterns 179

Table 6.1 Aspects of Engineer Identity 205

Acknowledgements

I dedicate this thesis to the memory of two beloved people lost during this PhD journey: my father, who instilled in me the importance of education for social mobility, and my younger brother, an engineer with a profoundly humanitarian spirit.

This research journey has been made possible through the support and encouragement of many individuals to whom I am deeply grateful.

First and foremost, I would like to express my sincere gratitude to my supervisor, Dr. Richard Budd, for his invaluable guidance, meticulous feedback, and unwavering support throughout this research process. His expertise and thoughtful insights have significantly shaped this work and my development as a researcher.

I am profoundly thankful to my family for their patience, understanding, and encouragement during this long process, during which I have had to be somewhat absent from their lives. Their unconditional support has been my foundation and has given me the strength to persevere through challenging times.

I would also like to extend my appreciation to my employer, Pontificia Universidad Catolica de Valparaiso, and particularly to Dr. Ricardo Gatica and Dr. Jimena Pascual, whose flexibility, understanding, and consistent encouragement to complete this research have made it possible for me to balance professional responsibilities with academic pursuits.

Additionally, I wish to thank the participants who generously contributed their time and insights to this study. While they remain anonymous following ethical guidelines, their contributions form the backbone of this research.

Finally, I am grateful to the academic and administrative staff at Lancaster University for their assistance and support throughout my doctoral studies.

This thesis stands as a testament to the collective support of all these individuals, without whom this work would not have been possible.

Author's declaration: This thesis is my own work and has not been submitted for the award of a higher degree elsewhere.

The word length of this thesis does not exceed the permitted maximum of 45,000 words.

Signature .....

Chapter 1: Introduction and Background

1.1 Overview

Engineering education has long been recognised as a pathway to professional success and social mobility, particularly for underrepresented and marginalised groups (Godfrey & Parker, 2010; Seron et al., 2015). This field of study offers significant potential for upward social advancement, providing opportunities that can be especially impactful for those from disadvantaged backgrounds (Lichtenstein et al., 2015). However, persistent inequalities in access and outcomes, particularly related to socioeconomic class and gender, continue to challenge the field's potential for promoting social equity (Pawley, 2019; Secules et al., 2018). These disparities are evident in many countries, including Chile (Canales et al., 2022), where this study is situated.

This thesis explores the perceptions and experiences of university students from disadvantaged backgrounds in an Engineering School at a regional university in Chile. By examining how these students navigate their educational journey, I aim to uncover the factors that enable or constrain social mobility in this context and identify potential barriers to equity in engineering education (Dryburgh, 1999; Pawley, 2017; Riley, 2008). The research addresses a gap in understanding the lived experiences of engineering students from non-traditional backgrounds in Latin American contexts (Camacho & Lord, 2011).

This chapter will introduce the study by first discussing the background and context, followed by the research problem, aims, objectives, and questions. The significance of this study lies in its potential to inform more inclusive teaching approaches and institutional policies that better support diverse engineering students (Cech, 2014). By centring the voices of disadvantaged students, this research contributes to ongoing efforts to transform engineering education into a more equitable space where talent from all backgrounds can thrive (Baillie et al., 2012; Riley et al., 2017).

1.2 Background

1.2.1 Inequalities in Engineering

Engineering education faces persistent global challenges related to diversity and inclusion (Powell et al., 2012; Schmitt, 2021). Despite efforts to broaden participation, the underrepresentation of certain groups, particularly women and individuals from low-income backgrounds, remains a significant issue (Bonaldi & Silva, 2014; Major et al., 2018; Smith, 2011). This underrepresentation perpetuates existing social inequalities and limits the diversity of perspectives crucial for innovation and problem-solving in the field (Hunt et al., 2018; Østergaard et al., 2011). The global relevance of these challenges unites us as a larger academic community, underscoring the need for collective efforts to address them.

Research on engineering education reveals significant socioeconomic barriers affecting underrepresented minority students. Geisinger and Raman (2013) document how schools with high minority populations often lack resources essential for engineering preparation, including qualified teachers and technology access. May and Chubin (2003) complement this finding by emphasising financial challenges in higher education, noting that scholarship aid rather than loans significantly impacts retention, with data showing that converting just $1,000 from scholarships to loans reduces graduation probability by 17% among low-income students. The demanding nature of engineering programs makes employment during studies impractical, further highlighting how socioeconomic factors directly influence diversity in engineering education.

Engineering is predominantly occupied by middle-class white men (Baird, 2018; Douglas, 2015; Kramer, 2024), a trend that is deeply rooted in the profession's cultural and structural dynamics. The underrepresentation of women and minorities in engineering is a well-documented issue (Durbin & Lopes, 2018; Hardtke et al., 2023; Martin et al., 2013; Reggiani et al., 2024; Smith et al., 2021), with women comprising only 17% of the engineering workforce and a significant portion of these

women being white (Baird, 2018). This gender imbalance is perpetuated by a "masculinised" culture that excludes women through assumptions about their competence and commitment, as well as through everyday interactions and institutional policies (Baird, 2018; Douglas, 2015; Kramer, 2024). Furthermore, engineering is not only gendered but also racialised, with white privilege playing a significant role in the profession (Pawley, 2019). The field has historically been dominated by white males, and efforts to diversify often take a colonial perspective, focusing on assimilating minorities rather than addressing systemic biases (Douglas, 2015). The challenges faced by women in engineering, such as hostile work environments and pay inequalities, further reflect a culture that favours male dominance (Pitka & Tézli, 2024). Additionally, the profession's diversity problem is evident from education to the workplace, necessitating efforts to narrow the gap between practitioners and their clientele by fostering cultural competence (Chubin et al., 2005). Gender segregation in engineering is reinforced by societal stereotypes about gender roles, which begin in education and persist into professional settings (Durbin & Lopes, 2018).

1.2.2 Engineering Education as a Path to Social Mobility

Engineering education is often viewed as a potential catalyst for social mobility, offering opportunities for professional advancement and economic stability (Seron et al., 2018). Engineering majors are considered to have a positive impact on earnings, with alumni majoring in mathematics, computer science, or engineering showing significant positive earnings differences compared to those in other majors (Wolniak et al., 2008). However, the relationship between engineering education and social mobility is complex and nuanced.

Traditional approaches to studying social mobility often focus on quantitative measures, such as changes in income levels over time (Galiani, 2013; OECD, 2018; Wolniak et al., 2008). While these studies provide valuable insights into broad trends, they can mask the diversity and complexity of individual experiences (Goldthorpe,

2013). Moreover, reducing social mobility to purely economic indicators overlooks other crucial aspects of social advancement and well-being (Reay, 2013).

I need to consider both aggregate data and individual experiences to better understand how engineering education might promote social mobility. This approach enables me to uncover the subtle details of how students from disadvantaged backgrounds navigate the engineering field and identify the factors that contribute to their success or create barriers (Bathmaker et al., 2013).

1.2.3 The Chilean Context

Chile exhibits significant socio-economic disparities, with a Gini coefficient[1] of 0.43 in 2022, ranking it among the most unequal OECD countries. As in other less industrialised nations, access to higher education in Chile (Canales & De los Ríos, 2009), particularly in fields such as engineering, is often viewed as a pathway to socioeconomic mobility and professional success (Orellana et al., 2017). However, despite efforts to promote inclusivity, disparities persist, especially among low-income students (Espinoza & González, 2016).

1.2.3.1 Historical Evolution and Structural Transformation

The Global South, where Chile belongs, encompasses a diverse array of nations that share common historical trajectories shaped by colonial legacies, economic marginalisation, and ongoing struggles with structural inequality (Hogan & Patrick, 2024). These countries, primarily located in Latin America, Africa and Asia, have experienced similar patterns of resource extraction under colonial or semi-colonial arrangements, late industrialisation processes, and persistent challenges in achieving equitable development (Connell, 2007). Many nations in the Global South

[1] https://data.worldbank.org/

underwent transitions from authoritarian rule to democratic governance during the latter half of the twentieth century, often accompanied by neoliberal economic reforms that profoundly impacted their educational systems (Heller, 2022; Stokke & Törnquist, 2013). Common challenges include managing the tension between expanding educational access and maintaining quality, addressing historical exclusions based on class, ethnicity, or geography, and navigating brain drain as educated elites migrate to developed economies (Afolabi & Idowu, 2019; Mudaly & Chirikure, 2023). These countries also frequently grapple with the legacy of educational systems designed to serve colonial interests or authoritarian regimes, requiring fundamental restructuring to meet democratic and developmental aspirations (Sanborn & Thyne, 2013).

The Chilean higher education system has undergone substantial structural transformation over the past five decades, evolving from a small elite system of eight universities serving a highly selective student body before 1973 to a complex mass-access structure now serving over 1.3 million students across 54 universities, 34 professional institutes, and 50 technical training centers (Alarcón & Brunner, 2024; Brunner & Alarcón, 2023). This transformation occurred through distinct periods characterised by different governance approaches, beginning with academic oligarchy governance, where universities negotiated funding politically rather than competing in markets.

The military coup of 1973 initiated intense state control that eliminated academic autonomy through military-appointed rectors, followed by the most significant transformation during the 1980-1990 neoliberal period, when deliberate atomization policies and massive privatisation expanded the system from eight to approximately sixty universities (Bautista et al., 2024; Brunner & Alarcón, 2023). Research demonstrates that the Pinochet dictatorship's contraction of higher education access disproportionately affected lower-income students, creating long-lasting effects on social mobility and income inequality that continue to influence contemporary policy priorities (Bautista et al., 2024).

Within the broader Global South context, Chile shares similarities with several countries in terms of higher education evolution and systemic challenges. Argentina presents perhaps the closest parallel, given its shared Spanish colonial heritage, experience with military dictatorship (1976-1983), subsequent democratisation, and similar middle-income status that creates comparable tensions between access expansion and resource constraints (Brunner, 2009). Other countries from the global south, such as South Africa, despite its distinct apartheid legacy, share with Chile the challenge of addressing historical inequalities through higher education while managing quality concerns and resource limitations in a middle-income economy context (Badat, 2010).

South Africa's higher education system underwent a similarly dramatic structural transformation following the end of apartheid in 1994 (Reddy, 2006), evolving from a racially segregated system of separate institutions designed to exclude Black students to a unified national framework serving over one million students across public universities, universities of technology, and a growing private sector (Mabokela & Mlambo, 2017). Like Chile's transition from military dictatorship, South Africa's democratic transition required dismantling discriminatory policies embedded in legislation such as the Extension of University Education Act of 1959, which had created racially segregated institutions that perpetuated educational inequality for decades (van der berg, 2007).

Following democratisation in 1990, Chile consolidated a mixed public-private system, achieving a 99% gross tertiary enrolment ratio by 2022, substantially exceeding the Latin American average of 59.7% and positioning Chile among global leaders in tertiary education access (UNESCO, 2024). However, this high level of access occurs within an underfunded system that spends only USD 10,718 per tertiary student annually (OECD, 2024), which is approximately half the OECD average of USD 20,499.

Chile's tertiary education system presents a complex picture of significant individual benefits alongside structural challenges and heavy privatisation. While tertiary

education offers clear advantages to graduates, with unemployment rates of just 5.5% compared to 8.1% for those with upper secondary education, and earnings that are 112% higher (more than double the OECD average premium of 54%), the country has struggled to expand access to these benefits (OECD, 2024). Although Chile's bachelor's degree attainment among 25-64 year-olds (20%) aligns with OECD patterns, the country lags significantly in advanced degrees, with only 2% holding master's qualifications versus the OECD average of 15%, a gap that persists among young adults (2% versus 17%). The system operates through extensive privatisation, with over 60% of total tertiary education funding derived from private sources (OECD, 2024), which may help explain both the system's accessibility challenges and its orientation toward market-driven outcomes.

Despite their similarities, the scale and nature of massification differ markedly between Chile and other countries in the Global South. While Chile achieved an exceptional 99% gross tertiary enrollment ratio by 2022, substantially exceeding the Latin American average, South Africa's gross tertiary enrollment[2] reached only 25% by 2021, reflecting more constrained expansion despite serving a significantly larger population base. This disparity suggests that while both countries pursued access expansion, Chile's neoliberal model achieved broader quantitative reach (Quaresma et al., 2022). In contrast, South Africa's approach prioritised institutional restructuring and quality assurance over rapid enrollment growth (Dhunpath & Subbaye, 2018; Woodrooffe, 2011).

South Africa’s post-1994 transformation mirrors Chile's experience with institutional restructuring approaches, but diverges in regulatory philosophy (Torres, 2022). South Africa implemented major policy restructuring through White Paper 3 of 1997 (South Africa. Department of Education (DoE), 1997), which outlined intentions to

[2] https://data.worldbank.org

transform higher education through the development of a programme-based higher education system, planned, funded and governed as a single coordinated system (du Preez et al., 2016), reflecting similar comprehensive reform approaches to those implemented in post-Pinochet Chile. The restructuring involved consolidating 36 universities and technikons into 22 new institutions by 2005 through mergers and incorporations (Hall, 2015), demonstrating a systematic approach to institutional reorganisation comparable to Chile's system rationalisation during its neoliberal period (Cabalin, 2012). However, unlike Chile's market-driven atomization (Rosenzvaig-Hernandez, 2024), South Africa's consolidation aimed to create stronger, more viable institutions capable of serving transformation goals (Hall, 2015).

Chilean contemporary higher education institutions' governance represents a complex hybrid regime combining strengthened state regulation through mandatory accreditation requirements, continued market competition for students and resources, professional managerial practices, and limited academic self-governance, creating highly centralised yet multi-actor systems that complicate institutional responses to equity and quality challenges (Alarcón & Brunner, 2024). This governance complexity affects equity and access, as universities must navigate competing demands for market competitiveness, regulatory compliance, and social responsibility within resource-constrained environments.

In Chile, students from private high schools represent only 9.5% of the total secondary education enrollment, meaning that students from publicly funded schools account for 90.5% of the enrollment (according to Open Data from the Ministry of Education). However, upon entering university, students from these publicly funded institutions make up 80.9% of the total university enrollment (average from 2007 to 2024). When considering only the most prestigious engineering programs, this proportion decreases further to 73.8%. This data highlights a significant disparity in the representation of students from public and private schools as they progress through the Chilean education system. While public school students form the majority of secondary education, their representation diminishes

at the university level (Canales & De los Ríos, 2009), particularly in highly competitive fields such as top-tier engineering programs.

In recent years, Chilean public policies have aimed to facilitate access to higher education for students from lower socioeconomic strata (Bellei & Munoz, 2023; M. Santelices et al., 2018). Since 2016, free education ("Ley de Gratuidad" or free-tuition law) has been available to individuals from the 60% lowest income bracket (Ministerio de Hacienda, 2015). Additionally, universities have implemented propaedeutic[3] programs for public schools and priority access routes for this segment of students (Bernasconi, 2017). Those programs serve as a bridge between individual dispositions (associated with lower cultural capital) and the institutional space of universities, which typically operate with "high culture" codes recognised by elites (Leyton et al., 2012). It aims to strengthen academic competencies and provide specific training aligned with students' vocational expectations, ultimately facilitating their successful integration into university life.

Student movements, particularly the 2011 "Chilean winter," emerge as important forces catalysing educational reforms focused on reducing marketisation and increasing equity. Their activism influences policy agendas, including free tuition and quality assurance reforms, while challenging neoliberal educational models (Quaresma, 2023; Villalobos Saldivia, 2023). However, resulting policies have often been characterised as limited or cosmetic by activists, maintaining market-driven

[3] A propedeutic program is an educational initiative designed to promote the integration of talented students from vulnerable backgrounds into university life. These programs specifically target high school students who have demonstrated strong academic achievement despite their disadvantaged socioeconomic contexts. The academic content can vary year by year depending on the specific propedeutic program chosen, and it's tailored to align with different areas of knowledge taught at participating universities.

structures while providing symbolic concessions that fail to address fundamental systemic inequalities (Guzmán-Concha, 2017; Ríos-Jara, 2025). Véliz et al. (2022) document how policy translation processes created compromises that preserve core market principles, generating persistent tensions between regulation and desmercantilization.

As a result, challenges persist. Low-income individuals' access to quality education remains limited due to financial constraints, inadequate infrastructure, and systemic barriers (Espinoza et al., 2024).

1.2.3.2 Engineering Education

1.2.3.2.1 Structure, Challenges, and Geographic Concentration

Engineering education in Global South countries navigates tensions between adopting foreign models and developing contextually appropriate approaches that address local realities while meeting global competitiveness demands in postcolonial contexts (Case, 2017).

Historically shaped by Western models imported from the Global North, curricula often fail to address regional technological demands and development contexts (Mavhunga, 2022; Wolff et al., 2022). Despite decades of reform emphasising outcome-based and problem-based approaches, a critical gap persists between academic training and industry requirements, contributing to graduate unemployment and underutilisation of engineering talent (Okoroigwe et al., 2022; Toroka & Kafanabo, 2024). This disconnect is compounded by outdated content, insufficient practical exposure, and limited collaboration between universities and industry (Kumba et al., 2024).

The formation of engineers in Chile is based on a scientific and technological foundation that combines rigorous theoretical education with practical application. Chilean universities offer programs that typically span five to six years, culminating

in a Bachelor of Engineering Sciences degree and the professional title of (Civil) Engineer. These programs integrate fundamental sciences, engineering design, and transversal skills, including teamwork, communication, and ethics. Over the past decade, national initiatives such as “Ingeniería 2030” and “MECESUP” have driven modernisation and international alignment through credit transfer systems. These efforts have also fostered greater collaboration among academia, industry, and government institutions to strengthen innovation, research, and continuous improvement (Instituto de Ingenieros de Chile, 2018).

Recent analyses reveal that Chilean engineering education faces challenges in balancing academic excellence with practical relevance. Universities tend to prioritise research productivity and accreditation indicators over real-world experience, creating a widening gap between academic training and industry needs (Instituto de Ingenieros de Chile, 2025).

Chile's engineering education demonstrates expansion alongside persistent challenges. Forty-six universities enrolled 112,847 students (24,686 first-year students) in 2024, representing 49.8% growth since 2007 but only 7.5% since 2020, suggesting stabilisation. The system features traditional six-year "Civil Engineering" degrees, shorter "Ingeniería de Ejecución" programs (introduced in the late 1960s), and five-year programs (introduced in the 1990s), without clear international equivalents, reflecting unique regulatory approaches where degrees provide lifelong professional status without renewal requirements (Instituto de Ingenieros de Chile, 2002, 2025).

Geographic concentration proves particularly problematic: the Metropolitan Region hosts 24 of the 46 universities (49,798 students, accounting for 44% of enrollment. This situation reinforces "inequalities of origin" where historical centralisation and neoliberal marketisation disadvantage regional universities through competitive dynamics favouring metropolitan institutions (Alarcón & Brunner, 2024; Fleet et al., 2024).

1.2.3.2.2 Relative Position of Engineering Programs

Medicine represents a contrasting professional pathway with markedly different cultural perceptions and gender dynamics compared to engineering. Medicine enjoys higher social prestige across most Global South contexts and is more culturally accepted for women, aligning with traditional caregiving roles (Koul et al., 2017; Upadhya, 2016). While engineering struggles with severe female underrepresentation (Baird, 2018; Durbin & Lopes, 2018; Maccaro et al., 2024), medicine demonstrates somewhat better female participation rates globally, with women comprising over fifty percent of medical school enrollments in many contexts (Pelley & Carnes, 2020; Sims et al., 2025; Spooner, 2002), though this participation remains concentrated in specific specialties such as pediatrics, obstetrics-gynecology, and dermatology (Tahir et al., 2025). Familial expectations, societal status, and economic perceptions strongly guide program selection across the Global South, favouring medicine for prestige and engineering for financial stability (Koul et al., 2017; Upadhya, 2016). Gender norms and community values further affect preferences, with medicine more culturally accepted for women as it aligns with traditional caregiving roles, while engineering faces persistent stereotypes about gender-appropriate careers and physical demands (Maccaro et al., 2024; Odebiyi et al., 2024). In Chile, there is a significant association between gender and the choice of medical specialities, with clearly differentiated patterns: women predominate in paediatrics and geriatrics, while they are underrepresented in traumatology, neurosurgery, and urology. Women are concentrated mainly in non-surgical specialities. This choice is influenced by factors such as lifestyle, work-life balance, social status, and sociocultural barriers (Pantoja de Prada et al., 2024).

Chilean engineering programs require higher standardised test scores than sciences or humanities, but lower than Medicine's highly competitive seven-year program. This positions engineering as more accessible professionally while maintaining prestige. With average annual costs of $5,900 USD (compared to $5,500 for general programs and $6,300 for Medicine), engineering occupies a middle fee position,

representing 35-40% of median household income for middle-class families. The 2016 free tuition policy covers full tuition for students from the poorest 60% of families at accredited institutions, significantly altering access patterns.

According to calculations based on official data from SIES (Higher Education Information System of the Chilean Ministry of Education), in 2024, 58.6% of students studying Medicine were women, compared to 24.4% studying Engineering at the university level. Similarly, while 46.2% of Medicine students come from private secondary education, in Engineering this proportion is approximately 23.5%. These figures illustrate the marked gender segregation between these two professional fields in Chilean higher education. Medicine shows near gender parity with a female majority, while Engineering remains substantially male-dominated. Furthermore, the differential representation of students from private secondary education suggests that socioeconomic background intersects with field choice, as private school attendance in Chile is strongly associated with higher socioeconomic status.

1.2.4 Bourdieu's Theory as a Theoretical Framework

Pierre Bourdieu's social theory provides a valuable framework for examining social mobility through engineering education (Archer et al., 2015; Martin et al., 2014; Naidoo, 2004). His concepts of habitus, capital, field, and symbolic violence offer tools for understanding how social inequalities are reproduced or challenged within educational settings (Bourdieu, 1986; Bourdieu & Passeron, 1990). Habitus is a system of internalised dispositions that shapes perception, thought, and action, unconsciously guiding behaviours in ways that both reflect and reproduce social patterns (Bourdieu, 1990). Capital is accumulated labour that manifests in three interconvertible forms - economic (money and property), cultural (knowledge and qualifications), and social (connections and relationships) - which together structure the social world by determining individuals' possibilities and constraints for action (Bourdieu, 1986). A field is a structured social space where agents compete for specific forms of capital, with their positions determined by their possession of relevant capital and relationships with others (Bourdieu & Wacquant, 1992).

Symbolic violence is a subtle form of domination that operates through communication, knowledge, and recognition. It involves dominated groups unconsciously accepting and participating in their subordination, perceiving it as natural rather than a form of violence (Bourdieu, 2001).

By applying this theoretical lens to engineering education in Chile, we can explore how students from disadvantaged backgrounds mobilise different forms of capital, navigate the engineering field, and potentially challenge existing social structures (Naidoo, 2004; Reay et al., 2009b). Bourdieu's theory enables us to transcend economic factors, considering the roles of cultural, social, and symbolic capital in shaping students' experiences and outcomes (Bourdieu, 1984).

Bourdieu's work has significantly impacted educational research, inspiring studies on how curriculum, pedagogies, and cultural capital reproduce inequality (Dimaggio, 1982; Lareau & Weininger, 2003; Mills, 2008; Nash, 2002a; Reay, 2004d). His habitus and cultural capital concepts have been applied to educational identities (Archer et al., 2007; Dumais, 2002; Reay, 2004d), inequality in schooling (Ball et al., 2002), leadership (Thomson, 2016), and teacher education (Nolan, 2012), offering innovative ways to address issues of access and social inequalities (Murphy & Costa, 2015). His theory provides insights into challenges faced by low-income university students, highlighting:

- Cultural capital deficits: These students often lack access to culturally valued resources needed to navigate university environments (Bathmaker et al., 2013; Lehmann, 2012).
- Social reproduction: Educational systems reproduce existing inequalities by favouring privileged backgrounds (Ball, 2003; Bourdieu & Passeron, 1990)
- Symbolic power: Dominant groups establish cultural norms as legitimate standards, potentially marginalizing low-income students (Scandone, 2017; Winkle-Wagner, 2010).

- Limited social networks: Low-income students typically have reduced access to social capital that facilitates academic advancement (Bathmaker et al., 2013; Stanton-Salazar, 2011).

In various studies, Bourdieu's theory and concepts have been applied to engineering education (Devine, 2012b; Gilbert, 2009; Mendoza et al., 2012), establishing a foundation for understanding social dynamics within this field. These studies have used the concept of "capital" to describe valued resources in the engineering field and the concept of "field" to characterise specific engineering cultures and analyse the practice and context of engineering education. The study of gendered (Bonaldi & Silva, 2014; Du, 2006) and institutional habitus (Atkinson, 2011) in engineering education and professional practice illuminates the persistent lack of diversity within this field.

1.3 Research Aims, Objectives, and Questions

This research aims to examine the experiences, challenges, and coping strategies of low-income engineering students in Chile, focusing on how they perceive and navigate their education as a means of social mobility.

Main Research Question:

How do engineering students from disadvantaged backgrounds in Chile see and experience their education as a means of promoting self-mobility?

This question is addressed from the student's point of view. The purpose is to investigate how the experiences lived at the university have transformed students' lives. As far as possible, I am interested in identifying the effect of engineering education against the impact of access to the university in general terms.

The main research question has been divided into three interconnected sub-questions to explore the main research question thoroughly.

1. What forms of capital do students mobilise in their trajectory towards gaining an engineering degree?
2. What barriers and support do they experience as related to their success?
3. How and why do these students understand the role of the engineer, and come to inhabit it?

The first sub-question examines the various forms of capital that students utilise throughout their educational journey. The second sub-question investigates the obstacles and support systems that impact students' success. The final sub-question examines how students conceptualise the engineering profession, develop their professional identity as engineers, and internalise and embody this identity. These sub-questions contribute to a richer understanding of students' experiences in pursuing engineering degrees.

1.4 The Significance of the Study

Engineering has a crucial impact on people's lives (Schneider et al., 2009). Among all professions, the engineering discipline has been traditionally recognised for its critical contribution to the development and prosperity of communities and countries (Salazar Monroy et al., 2019; Serna & Serna, 2013). Historically, engineering has been integral to human progress, from creating essential tools in ancient societies to developing complex technologies in modern times, defining the possibilities for human advancement (M. P. Kelly & Glover, 1990). Moreover, in today's global economy, engineers have become influential players. However, this discipline's power has not gone hand in hand with the democratisation and integration of diversity in its ranks (Lezotte, 2023; Panaia, 2014; Emma Smith, 2011). Attempts to improve diversity among engineering students have been reported worldwide (Engström, 2018; Schmitt, 2021). New research that contributes to understanding the origin of inequalities in engineering education can provide elements for designing effective policies and programs, as well as helping to comprehend why existing programs and policies have not had the expected result (for example, in increasing the number of women who study engineering in Chile).

This study seeks to contribute to the current literature by understanding the effects of social exclusion in engineering education. Identifying areas in engineering education where exclusion exists could lead to better public policies and institutional programs aimed at a more diverse student population. By illuminating the experiences of low-income engineering students, it contributes to our understanding of the intersecting factors that shape students' experiences and outcomes in university settings. Moreover, the findings can inform the development of targeted interventions and support programs aimed at addressing the unique needs of low-income engineering students, ultimately promoting equity, diversity, and inclusion within the engineering profession and higher education more broadly.

Findings from this study can inform policy recommendations and institutional practices aimed at improving access to engineering education through targeted recruitment and financial assistance programs, enhancing academic support services to address the specific needs of low-income students (such as mentorship, tutoring, and career guidance), fostering a more inclusive and supportive campus culture that values diversity and recognises students' contributions from diverse socio-economic backgrounds.

1.5 The limitations of the study

The small sample size of this research raises the problem of generalising to a broader context of engineering students. Furthermore, it is impossible to generalise the results to Chilean reality since the study was conducted in a regional university with a particular context.

This sampling was selective and purposive, focused on students who study for free. The invitation was extended to students from all departments of the engineering school. However, the response rates were uneven. Therefore, the results do not aspire to represent the students of the School of Engineering, where very diverse subcultures coexist.

1.6 Structural outline of the thesis

This chapter introduces the research's purpose, preliminarily analyses key concepts, and gives an overview of the theoretical framework.

Chapter 2 reviews relevant literature on approaches to social mobility through higher education, explores theoretical approaches to social reproduction and social change and contextualises those approaches to engineering education.

Chapter 3 outlines the research methodology and method justification. This qualitative study employed in-depth, semi-structured interviews with purposively sampled low-income engineering students from diverse backgrounds, capturing rich accounts of their experiences, challenges, and coping strategies throughout the university.

Chapters 4, 5, and 6 are analysis chapters, each addressing one of the sub-questions of the research.

Chapter 4 focuses on the first sub-question: "What forms of capital do students mobilize in their trajectory towards gaining an engineering degree?" This chapter analyses the various forms of capital (cultural, social, economic) that students from disadvantaged backgrounds utilise and develop during their engineering education.

Chapter 5 addresses the second sub-question: "What barriers and support do they experience as related to their success?" This chapter examines the challenges faced by low-income engineering students and the support systems, both formal and informal, that contribute to their academic progress and overall well-being.

Chapter 6 explores the third sub-question: "How and why do these students understand the role of the engineer and come to inhabit it?" This chapter examines the students' perceptions of the engineering profession, their professional identity development process, and how their background influences their understanding and embodiment of the engineer's role.

Each of these analysis chapters will present findings from the thematic analysis of interview data, supported by verbatim quotes from participants to illustrate key themes and insights. The chapters will also interpret these findings in light of the theoretical framework and existing literature.

Chapter 7 synthesises the findings from the three analysis chapters, addressing the main research question: "How do engineering students from disadvantaged backgrounds in Chile see and experience their education as a means of promoting self-mobility?" This chapter also includes a detailed discussion of the findings' implications, policy and practice recommendations, and suggestions for future research. I will conclude the thesis with a summary of the key findings, a reflection on the research process, and final thoughts on the role of engineering education in promoting social mobility for students from disadvantaged backgrounds in Chile.

Chapter 2: Literature Review

2.1 Overview

In this section, I examine the complex interplay of factors shaping engineering students' experiences and identity formation, focusing on those from disadvantaged backgrounds. The review aims to contextualise the research questions outlined in the previous chapter.

This review draws on literature from the sociology of education, higher education studies, and engineering education research. I identified sources through systematic searches of databases, including ERIC, Web of Science, and Scielo, focusing on peer-reviewed articles published since 1990.

To find relevant literature, I use the following list of main search themes and specific terms:

Higher Education Access & Social Class:

- "first generation university students"
- "social class AND university access"
- "educational trajectories AND social mobility"
- "Bourdieu AND higher education"

Engineering Education & Identity:

- "engineering identity formation"
- "engineering education AND social class"
- "engineering student experiences"
- "engineering education AND habitus"

Gender in Engineering:

- "women in engineering education"
- "gendered habitus engineering"

- "female engineering students experiences"
- "gender barriers STEM education"

Capital & Higher Education:

- "cultural capital AND engineering education"
- "social capital AND university students"
- "forms of capital AND higher education"
- "Bourdieu AND engineering education"
- "capital mobilization AND students"

Student Experience & Adaptation:

- "student adaptation university"
- "academic integration engineering"
- "engineering student persistence"
- "student transitions engineering"

Latin American/Chilean Context:

- "Chilean higher education access"
- "engineering education Chile"
- "Latin American university students"
- "Chilean university student experiences"
- "social mobility Chile education"

Additional seminal works outside this timeframe were included where relevant. While international literature informs the review, particular attention was paid to research from Latin American contexts where available.

The chapter is structured in three main sections:

Theoretical Framework: Examining Bourdieu's concepts of habitus, field, and capital as the foundational lens for analysis.

Low-Income Students' Experiences: Exploring how disadvantaged students accumulate capital, navigate academic environments, and overcome barriers during access, transition, and integration processes.

Professional Identity Formation: Analyzing how engineering students develop their understanding of being an engineer through academic experiences and practical engagement, with attention to how disadvantaged students may transform traditional notions of engineering identity.

These integrated themes establish a foundation for investigating engineering education in Chile, focusing on disadvantaged students' perspectives.

2.2 Theoretical Framework: Bourdieu's Concepts and Extensions

Theoretical frameworks help understand complex phenomena and guide research design and analysis (Creswell, 2009). This research employs Bourdieu's theory to examine how social, cultural, and economic factors influence the educational experiences of low-income Chilean engineering students. Bourdieu's sociological theories provide a foundational framework for understanding education's social dynamics through key concepts (Bourdieu, 1977, 1984, 1986, 1990, 1993, 1998a).

Key Bourdieusian concepts include:

- Habitus: System of durable, transposable dispositions shaping perceptions and actions, structured by past experiences while structuring future practices (Bourdieu, 1990).
- Field: Structured social space with its own rules and domination schemes where different forms of capital hold varying value (Bourdieu & Wacquant, 1992)
- Capital: Resources beyond economic wealth, including cultural knowledge, social connections, and symbolic recognition (Bourdieu, 1986).

These brief definitions provide an initial overview, with more detailed exploration to follow.

2.2.1 Theory of Action

Bourdieu's theory of human action emphasises the interaction between individual agency and structural constraints (Bourdieu, 1977, 1990; Öztürk, 2005; Walther, 2014). This framework is particularly relevant in education research, shedding light on how disadvantaged students navigate their environment and leverage various forms of capital to shape their academic trajectories (Grenfell & James, 2003).

Bourdieu founded his theory on social action as praxis, prioritising action over thought and recognising material production as fundamental to meeting societal needs (Bourdieu, 1990). Praxis is the activity through which individuals produce and reproduce society in its cultural, economic, and social aspects (Öztürk, 2005).

Central to understanding social phenomena is the dynamic relationship between human agency (an individual's ability to act and make choices) and social structures (the overarching frameworks influencing behaviour) (Cauce & Gordon, 2012; Jessop, 1996). Bourdieu posits that social action emerges from the interplay between an agent's mental structures and the social structures of the field. This interaction generates social practices that are actively constructed by individuals in response to their environment's constraints and opportunities (Sallaz & Zavisca, 2007; Wacquant, 2006).

To explain this theory, Bourdieu defines three interrelated concepts: field, habitus, and capital, which together generate social practices (Martinez-García, 2017). The dynamics of a field depend on its structure and the specific forces within it, which define the particular capital essential for the field's functioning. The distribution of these instruments constitutes the field's structure, governed by rules and regularities that define its operation (Bourdieu & Wacquant, 2005). The habitus is closely related to the field, with each structuring the other (Bennett, 2007).

Each field follows a specific logic, with positions defined by the ownership of valued capital types. Differences in positions generate power relations and struggles for status and influence. In essence, fields are specialised domains of practice with unique "logic" composed of specific combinations of capital types (Postill, 2010).

Bourdieu (1984, p. 101) expresses social conditioning through the formula: [(Capital) x (Habitus)] + Field = Praxis. This formula metaphorically suggests how these concepts interact, influencing one's actions and lifestyle (Winkle-Wagner, 2010). It's important to note that these concepts are highly complex and multi-dimensional, resisting straightforward quantification or literal mathematical operations.

2.2.2 Field

A field is a network of objective positions defined by their place in power structures and their relationships to other positions (Bourdieu & Wacquant, 1992). These positions influence their occupants and determine access to specific resources based on capital distribution. The field represents a structured social space with its own rules and forms of capital. In his book “Distinction: A Social Critique of the Judgement of Taste” Bourdieu points out that “(…) one can construct a space whose three fundamental dimensions are defined by the volume of capital, the composition of capital, and change in these two properties over time” (Bourdieu, 1984, p. 114).

In this framework, fields are social spaces where agents and institutions compete for positions through power dynamics that establish dominance hierarchies. Society comprises multiple relatively autonomous fields, each with distinct boundaries, rules, and contested products. For example, the art field involves various agents (artists, curators, critics) struggling to define "good art" through internal power negotiations. The field concept has been widely applied in education research, from English higher education (Bathmaker, 2015) to higher education (Reay et al., 2009b; Turnbull et al., 2019), school setting (Allard, 2005), and engineering education (Matemba & Lloyd, 2019; Valbuena, 2018). Approaching fields requires adopting a relational

perspective (Bourdieu & Wacquant, 2005), where the configuration of relationships between positions constitutes the objective dimension in social action theory.

2.2.3 Habitus

Habitus functions as both a structuring and structured structure, generating practices and perceptual schemas through the embodiment of social structures developed across generations (Bourdieu & Wacquant, 1992). These internalised dispositions and practices shape students' aspirations, choices, and experiences in educational contexts. Reay (2004d) advocates for the nuanced application of habitus in educational research to explain class-based differences in educational engagement.

Bourdieu conceptualises habitus as a socialised subjectivity, a system of dispositions acquired by internalising particular social and economic positions (Bourdieu & Wacquant, 1992). Importantly, habitus is physically incorporated, not limited to mental attitudes and perceptions (Reay, 2004d).

Within specific contexts, habitus manifests as a "feeling of the game" (Reay et al., 2009b; Sayer, 2009), knowledge of implicit rules and norms governing success within fields. Individuals must immerse themselves in field-specific habitus, transforming from their original dispositions. Those with family exposure to higher education gain advantages in navigating academic environments (Nuñez, 2009; O'Shea, 2016).

Bourdieu developed habitus as a conceptual tool to transcend structure-agency and micro-macro dualisms (Decoteau, 2016). Unlike Giddens' duality of structure (Giddens, 1984), Bourdieu's approach maintains relative autonomy between interconnected elements, with the intersection of subjective and objective structures creating doxa.

Reay (2004d) identifies habitus as Bourdieu's most criticised yet least understood concept. Researchers often misuse it as an explanation for data rather than an analytical tool (Reay, 2004b). Ideally, habitus should be conceptualised according

to specific social phenomena and research objectives (Costa et al., 2019), reflecting this alignment in methodological approaches.

2.2.4 Capital

Bourdieu (1986) outlines economic, cultural, and social capital as key resources individuals use to navigate social fields. In engineering education, students accumulate and leverage these forms of capital throughout their academic trajectories.

Capital represents assets with productive consequences, yielding profits and more efficient production (Rubio, 2012). Unlike Marx, Bourdieu extends capital beyond economics, recognising its various forms and transformative potential (Cerón-Martínez, 2019).

Bourdieu views the social world as accumulated history, defining capital as "accumulated labour (in its materialised form or its 'incorporated,' embodied form) which, when appropriated on a private, i.e., exclusive, basis by agents or groups of agents, enables them to appropriate social energy in the form of reified or living labour" (1986, p. 241). Capital accumulation allows individuals to harness society's productive power through objectified labour (like factory ownership) or living labour (like mobilising social connections).

Capital determines the class structure, positioning individuals based on ownership. The dominant class exploits the subordinate class through capital accumulation (Barba del Horno, 2020), creating a cycle of inequality. Bourdieu emphasises how resources transform into capital that dominant classes use to legitimise their social position.

The production of capital occurs under specific field conditions where their value fluctuates over time (Cerón-Martínez, 2019). Every social field possesses unique characteristics based on the relative importance given to different forms of capital, significantly influencing individuals' likelihood of success (Siisiäinen, 2000).

Over time, the process of capital accumulation yields benefits for those who appropriate it in either material or embodied forms. The distribution of capital throughout the social world creates inherently unequal opportunities. Within specific fields, various forms of capital circulate and compete with one another, some legally transferable while others are not (Cerón-Martínez, 2019).

In Bourdieu's framework, capital manifests in three distinct aspects (Bourdieu, 1986): economic capital (money and financial resources), social capital (networks and relationships), and cultural capital (qualifications, dispositions, and cultural goods). These three dimensions differ regarding their convertibility into monetary units and institutionalisation possibilities, with the institutionalised state referring to official credentials that formally recognise accumulated capital.

2.2.4.1 Economic capital

Bourdieu takes the concept of economic capital from Economic Theory in the same sense used by Marx (Siisiäinen, 2000). Economic capital comprises assets that can be readily converted into cash and institutionalised through property rights. Personal/family income and assets are often used to measure economic capital (Hassani & Ghasemi, 2016; P. Xu & Jiang, 2020).

Indicators of economic capital in university students include the objective financial situation of students and their families, financial support from parents, students' self-assessment of their financial situation, and their ability to independently obtain financial funds legally (such as through employment or scholarships) (Hvozdetska et al., 2022). The ability to manage available financial resources, including loans, is also considered an important aspect of economic capital. These indicators collectively reflect the financial self-sufficiency of students during their university years. Such resources can be measured by the family income level (Bahna, 2018; Colorado-Carvajal, 2008). Additional indicators of the level of economic capital among higher education students encompass the material resources provided by their families to attain objectives, such as learning spaces and learning materials

(Hee & Shuhan, 2022) and students' weekly allowance (Pagulayan et al., 2021). Hours per week working (Colorado-Carvajal, 2008; Nuñez, 2009) is also a way to assess students' economic capital.

According to Brouwer (2016), those students whose parents or relatives provide financial support during higher education may focus more on their studies, which affects the consistency of their academic performance.

2.2.4.2 Social Capital

Bourdieu (1986) defined social capital as the network that individuals or groups establish and maintain over time, often through intentional investments of time and effort. These connections become institutionalised to some degree and are used to establish or maintain social relationships.

The relationships established in a network of connections provide the bearer with the backing of collectively owned capital and allow them to use these relationships in the short or long term. These relationships generate subjectively felt obligations or institutionally guaranteed rights.

Social capital can be classified into internal and external family social capital (Coleman, 1988; Hee & Shuhan, 2022). The primary aspect of internal social capital pertains predominantly to the dynamics between parents and children, educational investments, and similar factors. On the other hand, external family social capital encompasses interactions with neighbours, teachers, and fellow parents. Internal and external social capital can enhance students' academic accomplishments (Hee & Shuhan, 2022).

Material or symbolic exchanges help maintain the network of relationships (Bourdieu, 1986). Likewise, these links can be socially instituted (Bourdieu & Wacquant, 1992) by applying a common name or belonging to a social group and by a set of acts to form and inform its members. By way of illustration, once they

become adults, individuals who, as children, attended an elite private school receive a designation that identifies them as members of an exclusive and tight-knit network of relationships (e.g. "Old Macks" for those who studied at The McKay School, a Chilean private school for boys).

The volume of an agent's social capital depends on the size of his network of connections and the associated cultural, symbolic and economic capital (Bourdieu, 1986).

In higher education, students acquire resources through connections with various groups: parents (family capital), friends and peers (peer capital), and academic faculty (staff capital) (Brouwer et al., 2016). These resources include shared information and extend to financial, practical, and emotional support.

Family capital encompasses family support (Hee & Shuhan, 2022) for students dealing with loneliness and parental knowledge about academia (Brouwer et al., 2016). Faculty capital involves support from instructors and staff through advice, information, feedback, guidance, and motivation (Brouwer et al., 2016). Research has not definitively established the impact of student-staff interactions on academic success (Cotten & Wilson, 2006; Cox & Orehovec, 2007).

Peer capital (Boat et al., 2022) includes interactions and social backing from peers or friends, which is crucial for university adaptation, fostering belonging, facilitating social engagement, promoting academic achievement, and influencing retention decisions (Wilcox et al., 2005). As students become more familiar with each other, they increasingly seek peer assistance rather than faculty support.

Additional social capital indicators include anticipated ease of navigating college environments (Nuñez, 2009), potentially gained through parents with relevant occupations, and friendships with university students, teachers, staff, and students in campus organisations (Colorado-Carvajal, 2008).

There is evidence (Brouwer et al., 2016) that first-generation students in higher education are less prepared than their peers for the transition to college. However, the evidence regarding the relationship between parents' higher education and student dropout rates is inconclusive. Moreover, there are suspicions that most research has problematised this group as lacking compared to other students (O'Shea, 2016).

2.2.4.3 Cultural capital

According to Bourdieu, cultural capital refers to knowledge and skills recognised and institutionalised through education and qualifications (Bourdieu, 1986), manifesting in three distinct states (Bourdieu & Wacquant, 1992): embodied, objectified, and institutionalised.

Embodied cultural capital encompasses long-lasting mental and bodily dispositions accumulated through lifelong socialization (Bourdieu, 1986). It includes cultural tastes, skills, and attitudes requiring personal effort and tied to an individual's physicality (Kraaykamp & Van Eijck, 2010). This form manifests through language use (vocabulary, accent, and speaking manner), bodily comportment (posture, gestures, and movements in social contexts), cultural tastes (preferences in art, music, literature, and food), social etiquette (understanding of unwritten social norms), and aesthetic judgments (the ability to appreciate and discuss cultural works in socially valued ways) (Reay, 2004b). The circumstances of its initial acquisition leave discernible imprints like dialect or class-specific mannerisms, determining its concrete value (Bourdieu, 1986).

The objectified state refers to transferable material cultural objects like books, paintings, monuments, and instruments (Bourdieu, 1986; Reay, 2004b). Unlike other forms, objectified cultural capital can be immediately transmitted (Kraaykamp & Van Eijck, 2010). However, while legal ownership transfers, genuine appropriation requires embodied cultural capital (Sieben & Lechner, 2019). Different types of objectified cultural capital come with their own set of 'rules' or social expectations

(Tan, 2020). For example, owning musical instruments like pianos requires understanding musical theory and playing techniques to fully utilize them (Bourdieu, 1984; Harahap et al., 2023; M. E. Walker, 2000). Similarly, appreciating art requires knowledge of art history and techniques (Bullot & Reber, 2013), while owning books requires literacy and analytical skills (Wright, 2006). While these "rules" are not explicitly codified, they are part of the social and cultural context in which these objects exist and determine how objectified cultural capital is valued within society (Bourdieu, 1986; Lamont & Lareau, 1988).

Institutionalised cultural capital refers to academic qualifications (Bourdieu, 1986), such as the degrees and diplomas that certify internalised cultural capital. This widely diffused, quantifiable form indicates class position and functions as a power resource (Lamont & Lareau, 1988). Institutional recognition enables standardised evaluation and potential interchangeability among credential holders (Bourdieu, 1986). The value of academic qualifications depends on their scarcity (Ashley, 2022).

As higher education becomes universal, the focus shifts from credential possession to quality and prestige (Marginson, 2016; Prieur & Savage, 2013). Credential inflation creates a complex hierarchy where institutional prestige (Rivera, 2011), the field of study (Van de Werfhorst, 2009), postgraduate qualifications (Brown, 2003), and performance indicators (Torche, 2011) become increasingly important differentiators (Brown, 1995; Van de Werfhorst, 2009).

Cultural capital has been quantified through various indicators reflecting cultural engagement (Dumais, 2002). A dominant interpretation combines two premises (Lareau & Weininger, 2003): cultural capital represents "highbrow" aesthetic culture (Yüksek, 2016) made exclusive through economic barriers and association with upper-class refinement (Meuleman & Jæger, 2023), and it remains analytically distinct from other knowledge forms.

Cultural capital accumulates primarily through family background and formal education (Bourdieu, 1986). Tramonte et al. (2010) distinguish between static cultural capital (ownership of high culture items) and relational cultural capital (cultural resources expressed within parent-child relationships) (Tramonte & Willms, 2010).

Key indicators include attitudes toward arts and self-image; activities like creating art and attending events; knowledge about literature, music, and art; educational credentials; linguistic style; parental cultural involvement; and cultural consumption (Kamphuis et al., 2015; Kraaykamp & Van Eijck, 2010). Additional indicators include ownership of cultural artefacts, computer usage (Tondeur et al., 2011), parental education levels, academic performance, class-specific pronunciation (Knight, 2024), and even health behaviours like food choices (Colorado-Carvajal, 2008; Kamphuis et al., 2015).

2.2.5 Capital Conversion

Capital conversion (Martin & Spenner, 2009) refers to transforming economic, social, and cultural capital into tangible advantages that can be utilised for personal benefit. This process involves leveraging existing capital to access opportunities and enhance social status within specific contexts.

The convertibility between different types of capital is essential for strategies aimed at reproducing capital and maintaining one's social position (Bourdieu, 1986). These conversions occur according to prevailing social power dynamics and aim to minimize inherent costs and losses.

Economic capital forms the foundation for all other capital types, though these transformed forms are not entirely reducible to economic capital (Bourdieu, 1986). While economic capital provides immediate access to certain goods and services, others require social capital in the form of relationships that demand long-term investment in sociability. The transformation between economic and social capital

creates a contrast between straightforward economic exchanges and the ambiguous nature of social exchanges that rely on misrecognition and faith (Manly et al., 2017). In fact:

- Economic capital can be converted into other forms of capital, such as paying for education (cultural capital) or joining exclusive clubs (social capital).
- Social capital can be converted into economic capital, for example, through job referrals or business opportunities that arise from social connections.
- Cultural capital can be converted into economic capital by enhancing job prospects or earning potential through education and skills.

Bourdieu (1986) explains that, similar to energy conservation in physics, profits in one area are offset by costs in another. Converting economic capital into social capital involves personalizing exchanges, which may seem wasteful economically but represents a solid investment in social exchange logic (Pret et al., 2016). Similarly, acquiring cultural capital depends on the available time made possible by economic capital through extended education and family transmission. These delayed gratification strategies often remain inaccessible to families with immediate economic needs (Reay, Davies, et al., 2001).

A qualification's value is determined by its cultural capital relative to other qualifications and its exchangeable monetary worth in the job market (Bourdieu, 1986). When excessive students attend university, as in higher education massification, degrees may devalue (Jin, 2022). This devaluation affects disciplines unequally, with professional and STEM fields maintaining higher conversion rates into economic capital than humanities and social sciences (Van De Werfhorst & Kraaykamp, 2001).

Capital conversion underscores the dynamic nature of capital accumulation and utilisation (Martin & Spenner, 2009), highlighting how individuals strategically deploy resources to navigate social structures and educational systems. It emphasizes the

interplay between different forms of capital for personal advancement or social mobility.

Anything obscuring the economic aspect increases the risk of loss, particularly in intergenerational transfers. The incommensurability between different capital types introduces uncertainty in transactions. Exchanges creating social capital through long-term obligations, such as gift exchanges, carry ingratitude risks due to their refusal of calculation and guarantees.

Cultural capital, transmitted within families, often goes unnoticed until validated by educational systems (Bourdieu, 1986). Its transmission is more discreet but riskier than economic capital. As educational qualifications become crucial for accessing positions, the educational system diminishes family control over transmitting power and privileges, impacting legitimate heirs (Bourdieu & Passeron, 1990).

In inheritance and succession contexts, every strategy for reproducing capital is also a legitimisation strategy (Lareau & Weininger, 2003). Bourdieu demonstrates that while cultural, social, and economic capital can be interchangeable, they are not equal in all directions. Economic capital converts more easily into cultural and social capital than vice versa. This interchangeability forms part of capital transmission, where symbolic aspects disguise these exchanges' true nature (Swartz, 1997).

2.2.6 Capital Accumulation and Mobilisation in Higher Education Students

The capital accumulation and mobilisation concepts are central to understanding how students, particularly those from disadvantaged backgrounds, navigate higher education. While often used in Bourdieusian analyses, these terms are not always explicitly defined in the literature (Martin & Spenner, 2009).

For disadvantaged students, accumulating and mobilizing capital begins even before university entry. Reay et al. (2001) demonstrate how working-class students often lack the "right" kind of cultural capital valued by elite institutions, which can impact their choice of university and sense of belonging once enrolled.

However, these students are not passive; they actively work to accumulate and mobilise various forms of capital throughout their educational journeys.

2.2.6.1 Capital Accumulation

Capital accumulation refers to the process of acquiring or increasing one's stock of various capital forms over time. Bourdieu (1986) portrays capital accumulation as harnessing social energy through labour appropriation, leading to capital accumulation over time. Cultural capital accumulation involves acquiring competence in society's high-status culture (Winkle-Wagner, 2010) through family socialisation, formal schooling, and cultural experiences. Social capital accumulation (Jin & Ball, 2021) represents an investment in social relations with expected marketplace returns, involving network-building with peers, faculty, and industry professionals.

Higher education students accumulate economic, social, and cultural capital through strategies influenced by social class, geographic mobility, and institutional contexts (Cuellar, 2024; Watson, 2013; Xu, 2023). Middle-class students often access valued capital more readily than working-class peers. Bathmaker et al. (2013) illustrate the disparity in capital generation between these groups: middle-class students engage more in structured extracurricular activities that directly contribute to their prospects, while working-class students invest in socializing and leisure activities that translate less readily into valuable capital. Economic capital access allows middle-class students to pursue unpaid internships and diverse work experiences, enhancing their labour market success. Non-traditional UK students must navigate established middle-class practices, requiring the acquisition of academic, linguistic, social, and professional capital to succeed in research-intensive universities (Watson, 2013).

Beyond the UK, students employ varied accumulation strategies. African students in China acquire 'Chinese' capital (language proficiency, cultural exposure), which is convertible into advantages in their home countries, enhancing social mobility while reflecting China's geopolitical influence (Xu, 2023). Latino-American students rely

on familial relationships, particularly maternal influences, drawing on mothers' knowledge for academic success and community support, enhancing their social and cultural capital (Reyes & Duran, 2024). Their success is also linked to navigating dominant cultural capital, essential for college readiness (Kolluri, 2023).

Despite socioeconomic challenges, students utilize "patchwork capital," combining various capital forms to combat disadvantage (Johnstonbaugh, 2018). Higher education students accumulate capital through social networks that provide information about educational institutions and careers (Eduardo Bonaldi, 2017). These networks enhance opportunities to convert cultural capital into economic capital, while sociability networks help underprivileged students access resources, reducing social and cultural distances.

Contemporary students accumulate cultural capital by developing what Prieur and Savage (2013) call a 'knowing' mode of cultural appropriation, engaging with culture reflexively and ironically, demonstrating mastery through navigating across cultural forms rather than through exclusive highbrow tastes, representing an emerging distinguishing form of cultural capital.

Disadvantaged engineering students accumulate capital through aspirational goals despite barriers (Samuelson & Litzler, 2016). They mobilise navigational capital (O'Shea, 2016) and skills to navigate educational institutions with dominant cultural norms by manoeuvring through institutions and seeking peer, advisor, and faculty support. Familial capital (O'Shea, 2016), emotional, moral, and educational consciousness developed within families, contributes through parental care, encouragement, and mentoring experiences supporting persistence in engineering programs.

2.2.6.2 Capital Mobilisation

Capital mobilisation refers to the strategic use or deployment of accumulated capital to gain advantages or overcome barriers. Lareau and Horvat (1999) describe this

process as the "activation" of capital. Activation of capital refers to utilising social and cultural capital in specific settings or fields of interaction. It involves the ability of individuals to effectively use their capital, the skills they possess to activate it, and how the institutions respond to this activation. The value of capital depends heavily on the social context, and individuals vary in their skill level when it comes to activating their capital.

In higher education, Bathmaker et al. (2013) discuss mobilisation as the process of deploying and investing capital, noting how students differentially activate their resources to navigate the university and prepare for the job market. O'Shea (2016) further elaborates on mobilisation in the context of first-in-family students, describing how individuals draw upon and enact capital within the higher education environment.

According to the dominant literature reviewed, the subjects of this research, engineering students from disadvantaged backgrounds, are confronted with fields operating on a different logic than what they are familiar with. However, the categories of analysis of this research also consider research (Smith & Lucena, 2016) where students' "funds of knowledge" are valued within engineering. Funds of knowledge refer to the historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being (Moll et al., 1992; Verdin et al., 2024). These are often acquired through lived experiences and interactions within communities. In the context of low-income engineering students, funds of knowledge highlight the valuable practical knowledge and skills these students bring from their backgrounds (Denton & Borrego, 2021), such as working with mechanics, electricians, or construction workers. These funds of knowledge challenge traditional views that assume minority students lack social and economic capital, emphasising the importance of recognising and leveraging the diverse knowledge these students possess.

Social capital plays a significant role in engineering education. Martin et al. (2013) found that engineering students from low-income backgrounds often lack the

professional networks and industry connections their more privileged peers may inherit from family members. These social connections are particularly valuable during the transition to university life, helping students adapt to new academic environments and understand institutional expectations. Furthermore, social capital facilitates professional development by connecting students with established engineers who serve as role models and provide insights into career opportunities (Smith et al., 2021; Volpe et al., 2023). To compensate, these students often rely on school personnel for social capital due to limited family resources. Delayed recognition of available resources can hinder access and activation, leading to challenges in university transitions. Peer groups and institutional support systems serve as valuable social capital sources for underrepresented engineering students when accessed and activated (LaDue et al., 2024).

2.3 Low-Income Students' Experiences in Higher Education

In examining the access and transition to higher education for disadvantaged students, the literature reveals a system of challenges and barriers. This section synthesises research from various authors highlighting the multifaceted nature of obstacles faced by working-class and disadvantaged students as they enter and navigate higher education institutions. The review considers both structural and individual factors. Particular attention is paid to how these challenges manifest in the context of engineering education, setting the stage for a deeper exploration of specific barriers and their impacts. This section is organised into four key areas: higher education choices and access, barriers and challenges faced by low-income students, social integration and identity negotiation experiences, institutional factors, and potential pathways for change. I tried to add some contextualised research from the Chilean context when available.

2.3.1 Higher Education Choices and Access

The decision to pursue higher education is complex for low-income students and is influenced by various factors, including social background, financial considerations,

and cultural resources. Research shows that working-class students often approach university with a more utilitarian perspective, viewing it as a means to an end rather than a transformative experience (Lehmann, 2009b). This outlook can clash with the institutional habitus of universities, particularly elite institutions.

2.3.1.1 International Literature

Low-income students use a nuanced cost-benefit analysis when considering tertiary education (Becker & Hecken, 2009). They weigh direct and indirect costs against prospective achievements and long-term benefits. However, rising tuition fees and a tendency to overestimate costs and underestimate benefits can make university seem financially unattainable for many (Cook et al., 2019; Perna, 2005; Reay, Davies, et al., 2001).

When considering the choice of a higher education institution or an undergraduate program, habitus generates subconscious behaviours (Devine, 2012a; Espinoza et al., 2023; Reay, David, et al., 2001) that, despite being perceived as independent choices by the individual, are inherently constrained by their social position and the prevailing circumstances (Bahna, 2018; Forbes et al., 2015; Martinez-García, 2017; Reay, Davies, et al., 2001; Siann & Callaghan, 2001).

The choice of institution and field of study is heavily influenced by social class. Working-class students often attend "second-rate" universities (Reay et al., 2009a), choosing local institutions to reduce moving costs and applied fields offering clear career paths (Dunne et al., 2014; Lehmann, 2009b). Reay (2003) found that mature working-class women frequently choose 'caring' professions that align with their skills and community values. This stratification is reinforced by middle-class students' habitus, orienting them toward elite institutions while excluding lower-status options (Ball et al., 2002). However, such hierarchies are not universal, as evidenced by Germany's more egalitarian system, where university prestige plays a less significant role (Koenings et al., 2020; Marginson, 2016).

Parental educational attainment plays a crucial role in shaping higher education choices. Having at least one parent with a university degree increases the likelihood of a student pursuing academic-track courses in high school, having high educational and career aspirations, and ultimately attending university (Lehmann, 2009b). Ball et al. (2002) demonstrate how social class influences the 'cognitive structures' through which students perceive their educational options.

Literature on higher education choices and access in Global South contexts offers important comparative insights into how students navigate educational systems characterised by historical inequality and institutional stratification. These contexts share common challenges, including managing tensions between expanding access and maintaining quality, addressing exclusions based on class and geography, and navigating resource constraints that shape institutional differentiation.

South Africa experienced a significant transformation in higher education access post-apartheid, with total enrollment growing substantially over fifteen years (Badat, 2010). Despite increases in absolute enrollment numbers for Black students and women, South African higher education continues to demonstrate severe inequities in proportional access (Badat, 2010; Dhunpath & Subbaye, 2018; Mabokela & Mlambo, 2017). These access limitations stem from multiple systemic barriers, including inadequate preparation at the secondary level, unaffordable tuition costs, and insufficient financial aid (Mabokela & Mlambo, 2017). The institutional merger process further exacerbated access inequities by leaving some regions, particularly former homelands like Transkei, without universities. This forced students to rely on distance education or migrate to access higher education opportunities.

The motivations for attending university are significantly related to racial identity, generational status, parental education, and family characteristics (Jackson et al., 2023). The findings suggest that South African students, especially those from disadvantaged backgrounds, view university education not only as personal development but as a collective responsibility towards their families and communities.

In engineering education, low-income students are influenced by various factors, including their self-identified attributes and interests, advanced skills, the image of an engineer, job security, and the desire to make a difference. STEM-knowledgeable individuals who offer encouragement and support also significantly influence their decision to study engineering (Strutz & Ohland, 2012).

Access to and choice of engineering studies in the Global South are conditioned by socioeconomic, geographic, and cultural factors that create constrained choice architectures. Research demonstrates that family socioeconomic status, parental education, and household income significantly influence enrollment and persistence in engineering programs (Prakasam et al., 2019; Upadhya, 2016) while intersectional factors such as caste, ethnicity, and urban-rural divides add layers of complexity (Gupta, 2019; Mkhize & Idahosa, 2025). The most capable students from affluent families in countries from the Global South dominate engineering enrollment, while women and low-income families are excluded from these high-return careers (Mkhize & Idahosa, 2025; Prakasam et al., 2019).

In South African contexts, disadvantaged students employ "safety-first" strategies, choosing institutions based on perceived accessibility rather than optimal career alignment (Dhunpath & Subbaye, 2018; Norodien-Fataar, 2016), a pattern corroborated in other countries from the Global South. Research reveals that even when financial barriers are addressed, challenges of academic preparedness and social integration persist, while inadequate infrastructure in rural areas creates systematic disadvantages (Bagde et al., 2016; Ilie & Rose, 2016; Ntsanwisi, 2024).

2.3.1.2 Chilean Context

The higher education system in Chile, as in many countries (Calderon, 2018; Giannakis & Bullivant, 2016; Mok & Jiang, 2016; Reay et al., 2002; Tepe et al., 2024), has undergone significant transformation through massification, resulting in increased tertiary education access. However, as Kuzmanic et al. (2021) point out, this expansion has not necessarily led to a more equitable system. Despite the surge

in overall enrollment, the system continues to exhibit high and persistent levels of segregation, particularly among students from high socioeconomic status (SES) backgrounds.

In the Chilean context, researchers (Donoso-Bravo, 2021; Espinoza et al., 2023) found that while students from all social backgrounds aspired to university education, their actual experiences and opportunities were strongly shaped by their class origins and the institutional habitus of their schools. Students from lower social classes now aspire not only to pursue university education but specifically to enrol in prestigious traditional institutions, a goal previously associated primarily with higher social classes.

Research on how Chilean students navigate choices between universities, Professional Institutes (IPs), and Technical Training Centres (CFTs) reveals complex decision-making processes shaped by multiple constraints. Canales and De los Ríos (2009) documented that students' institutional choices are heavily influenced by socioeconomic background. Lower-income students are more likely to select IPs and CFTs not only due to financial constraints but also because of perceived accessibility and shorter program durations. Santelices et al. (2018; 2019) documented that the standardised test creates systematic barriers for students from lower-quality secondary schools.

Villalobos et al. (2023) studied the cultural tastes and practices of elite university students in Chile, challenging traditional assumptions about the influence of family background and elite educational environments. The study found that a small number of highly selective universities concentrate on students from privileged backgrounds and act as key sites for elite reproduction. Interestingly, career choice, rather than social class, was found to play a more pivotal role in shaping an individual's cultural tastes and practices.

Research on the Chilean higher education system reveals that cultural capital influences low-income students' decisions regarding institutions and careers more

than financial barriers do. Although the implementation of gratuity (free higher education) sought to reduce access inequities, its impact has been marginal, functioning mainly as an alternative source of finance rather than attracting new low-income students (Espinoza et al., 2022). The findings demonstrate that, even with similar academic performance, students follow differentiated trajectories according to their socioeconomic origin: those from low-income families tend to attend public secondary schools that prepare them less adequately for admission tests, obtain lower scores, and self-select toward less selective public universities, with students from private schools preferring to enroll in private universities even when admitted to selective public institutions (Espinoza et al., 2024). This segmentation reflects how the Chilean educational system reproduces inequalities of origin through school segregation and differences in cultural capital. In this system, parents' education, type of secondary school, and access to social networks and information play a more determining role than direct economic costs in opportunities for access to quality higher education.

Regional inequalities represent a significant barrier to equitable higher education access. Qualitative analyses link regional inequality to historical political centralisation and neoliberal marketisation, which disadvantage state-regional universities through competitive disadvantages in resources, faculty quality, and industry partnerships (Alarcón & Brunner, 2024; Fleet et al., 2024). The highly centralised governance system compounds these challenges by limiting institutional autonomy and responsiveness to regional development needs, creating systematic "inequalities of origin" that institutional strategies attempt to mitigate but cannot overcome without structural reform.

In Chile, engineering career selection is significantly influenced by gender and social class. Engineering fields are predominantly male-dominated, with women typically gravitating toward care-oriented and education professions (Orellana et al., 2017). Social class further determines the specific engineering pathway pursued: students from higher socioeconomic backgrounds aspire to prestigious programs such as Civil Computer Engineering at selective universities, while working-class students

often opt for technical programs like Computer Programming at professional institutes. This stratification reflects broader patterns in Chilean higher education, where career choices are deeply embedded in students' social positioning and personal identity rather than purely economic considerations.

2.3.2 Barriers and Challenges in Higher Education

2.3.2.1 International Literature

Once enrolled, students from underrepresented groups in HE face numerous challenges in higher education. These include financial pressure, curriculum overload, lack of family support, and difficulties in academic and social integration (Pascarella et al., 2004; J. Smith & Lucena, 2016).

The "habitus" concept introduced by Bourdieu helps explain many of these challenges. Working-class students often experience a sense of dislocation or "habitus cleavage" in elite educational institutions (Lehmann, 2013). This can lead to feelings of being a "stranger in paradise," as Reay et al. (2009) described, highlighting the complex negotiations of identity and belonging these students undergo. Like "fish out of water" (Reay et al., 2009a), they find themselves surrounded by middle-class peers whose embodied cultural capital manifests in different ways of speaking, carrying themselves, and engaging with academic culture - from casual references to highbrow culture, to confidence in classroom participation, to tacit knowledge of institutional norms (Aries & Seider, 2005). These differences in linguistic and behavioural codes can lead to feelings of otherness and inadequacy despite academic capability.

Economic capital, referring to financial resources such as income, wealth, and assets (Bourdieu, 1986), emerged as a crucial factor in students' ability to access and persist in engineering education (Strutz & Ohland, 2012). Low-income students often face significant financial challenges that impact their higher education experiences (Pascarella et al., 2004), struggling to afford tuition, fees, textbooks,

and other educational expenses. This financial burden can detract from their ability to focus on their studies fully, participate in extracurricular activities, and engage in the college experience (Ostrove & Long, 2007; Pascarella et al., 2004; Snellman et al., 2015; Thomsen et al., 2013).

Financial constraints often necessitate part-time work, creating additional stress and time management challenges for low-income students. This can hinder their ability to fully engage in learning, particularly when courses require unpaid practical work placements (Cunninghame, 2017).

Low-income students also face barriers to accessing valuable opportunities such as internships, study abroad programs, and extracurricular activities. However, it is worth noting that formal extracurricular programs are not universally embedded in all countries' education systems. In engineering programs specifically, students from structurally disadvantaged backgrounds face significant differences in their college experiences compared to more advantaged students. These differences include lower participation rates in internships and study abroad programs, higher rates of work-study or jobs to pay for college, and distinct demographic characteristics (Atwood et al., 2020).

These limitations can exacerbate inequalities and impact the development of professional skills and social capital (Atwood et al., 2020; Snellman et al., 2015). Major et al. (2018) found significant differences between low-socioeconomic and upper-socioeconomic students regarding their sense of community, support from other students, and participation in charity/outreach programs.

Students from low-income backgrounds and socially excluded groups in Global South countries face multiple personal and socio-economic barriers once they enter higher education institutions. Despite an increase in total enrolment numbers in higher education, stark inequities persisted. In South Africa, participation rates remained highly unequal, with Africans and Coloured students participating at rates dramatically lower than Whites and Indians, dropout rates remained unacceptably

high at nearly half of students, and graduation rates fell significantly short of national targets, revealing that increased access did not guarantee equity of opportunity or success, particularly for Black working-class and rural poor students facing structural, cultural, and financial barriers (Badat, 2010).

Financial insecurity remains a persistent challenge, as first-generation students are often expected to fulfill the role of an additional financial resource for their families while balancing academic demands, a phenomenon colloquially referred to as "Black Tax" in South Africa, which refers to the financial duty placed on students and graduates to provide for the needs of their families (Jackson et al., 2023; Mkhize & Idahosa, 2025).

Language barriers compound these difficulties, particularly for students who speak English as a second or third language. These students often have a medium of instruction at the university level that differs from the language spoken at home, creating substantial obstacles to academic success (Dhunpath & Subbaye, 2018; Mkhize & Idahosa, 2025).

Furthermore, pre-entry attributes from previous under-resourced schooling leave many students academically underprepared for the demands of university-level work, while first-generation students must navigate complex admission routes and often adjust their aspirations to settle for less prestigious programmes as a means of securing university entry (Mkhize & Idahosa, 2025; Norodien-Fataar, 2016).

Walker and Mathebula (2020) examine 30 low-income rural students enrolled in urban South African universities, identifying challenges related to material (housing insecurity, food inadequacy, lack of technology), academic (sudden immersion in an unfamiliar language of instruction, deficiencies from substandard prior education, pedagogies presuming middle-class preparedness), and social (exclusion, invisibility, feelings of alienation) dimensions. Living in a rural area and being poor exacerbates these problems, so students have to use navigational capital (Yosso, 2005) to navigate institutions that are not suitable for them. This conflict between

student autonomy and institutional responsibility is pertinent to understanding the challenges faced by disadvantaged Chilean engineering students.

2.3.2.2 Chilean Context

Chilean students from vulnerable backgrounds experience social and academic integration tensions in different university settings (Leyton et al., 2012). The first tension is observed during university admission, marked by feelings of inequality and a sense of social downgrading, which is more intense in elite universities. The second central tension lies in the relationship between social and academic integration, where academic disadvantages upon entry often lead to social closure in pluralistic universities or social isolation in elite universities- manifesting in different ways depending on the institutional context (Leyton et al., 2012). In pluralistic universities, students often withdraw into homogeneous social groups of similar backgrounds as a coping mechanism for academic challenges. In contrast, in elite universities, the combination of academic struggles and stark social class differences can lead to isolation from both academic and social spheres of university life (Canales & De los Ríos, 2009; Gallardo et al., 2014).

Research on engineering education in Chile has found that low-income students and those with lower entry-level mathematical skills demonstrate greater persistence in their academic trajectories; however, they simultaneously face more substantial barriers to degree completion (Salazar-Fernandez et al., 2019). This paradox suggests that while these students exhibit remarkable resilience and commitment to their engineering programs, persistence alone does not guarantee graduation without adequate institutional support and targeted interventions.

Women in Chilean STEM university programs face distinct barriers depending on their academic stage. At the undergraduate level, female students remain significantly underrepresented in mathematics-intensive fields like engineering and physics, though once admitted, their retention and graduation rates are comparable to those of male students, indicating that significant attrition does not occur during

undergraduate studies (Canales et al., 2022). However, barriers intensify at the doctoral level, where 16% of female students report poor or regular relationships with their supervisors compared to only 7% of male students, and 23% of Chilean women experience doctoral program interruptions, with one-third citing harassment or discrimination as the cause.

2.3.3 Social Integration and Identity Negotiation

2.3.3.1 International Literature

Low-income students in higher education often experience living in two worlds (Ingram & Abrahams, 2015), feeling like "outsiders within" academically and "insiders without" in their working-class communities, creating unique insights but also tensions and isolation.

Working-class students show less integration in higher education than middle-class peers, an effect that persists across gender and year of study (Rubin, 2012). Explanations include differences in living arrangements, campus time, financial resources, study allocation, minority status, and perceived similarity with peers. . Ostrove and Long (2007) demonstrate how social class affects students' sense of belonging, impacting academic and social adjustment, with significant implications for college success, particularly for low-income students.

Institution type powerfully influences student identities. In elite universities, working-class students often feel like outsiders due to background, financial, and academic differences compared to peers (Tett, 2004). Reay et al.(2009b) describe these students as "strangers in paradise," highlighting their complex identity and belonging negotiations.

The "destabilised habitus" concept helps explain social mobility's psychological and emotional tolls (Friedman, 2016; Mallman, 2017). Lower-class engineering students may experience emotional detachment, strained relationships, internal conflict, and

mixed feelings toward themselves and their families (Fitzpatrick et al., 2024; Major et al., 2018), affecting how they mobilize available capital and understand the engineer's role.

Bourdieu's hysteresis concept explains the discomfort when one's habitus is ill-suited to the current social context, creating a sense of not "fitting in" or being unsuited to certain spheres (Lehmann, 2013). "Habitus clivé" describes internal divisions experienced during profound life changes like social mobility (Friedman, 2016).

In engineering education, male working-class students negotiate identities and participation in project work, often associating with "technicist" masculinity but struggling to incorporate project work into their trajectories (Danielsson et al., 2019). "Laddish" masculinities in higher education can create troubled identity paths, particularly significant in male-dominated engineering programs.

Ingram & Abrahams (2015) propose a typology of habitus interruptions that accounts for both internalising contradictory structures and creative aspects of this process, categorising responses as "disjunctive habitus" (adopting one cultural pattern while rejecting another) or "conjunctive habitus" (merging both patterns).

Extracurricular activities provide opportunities to build social capital and develop professional skills, but Snellman et al. (2015) note that low-income students face participation barriers, potentially exacerbating inequalities. Côté (2016) proposes "identity capital" to understand how individuals develop resources for navigating various social contexts, with extracurricular involvement being a key source for engineering students.

Developing professional belonging closely relates to persistence in engineering (Tonso, 2006). Many engineering students must balance their studies with part-time work, creating additional stress and time management challenges. Thomsen et al. (2013) examined how Danish working-class university students developed strategies to navigate competing demands on their time and resources.

Importantly, low-income, first-generation students bring unique strengths to engineering. When their "funds of knowledge" from growing up in low-income families are validated, they can establish belonging in engineering education and the profession (J. Smith & Lucena, 2016). Their experiences with manual labour and household maintenance can provide valuable skills for teaching and practising engineering.

Students from low-income backgrounds and first-generation students in higher education in Global South countries face complex identity negotiations and challenges to their sense of belonging that intersect with dimensions of race, class, and gender. In South Africa, African first-generation women students in STEM disciplines experience culture shock when entering academic terrains where they lack the contextually required social and cultural capital to integrate seamlessly, facing implicit expectations of prior knowledge about basic scientific equipment and having to navigate learning in a language different from their own (Mkhize & Idahosa, 2025).

Vincent and Hlatshwayo (2018) document the ambiguous role of social capital in the negotiation of university life by Black working-class first-generation South African students, evidencing how these intersectional struggles include racial identities, perceived linguistic competencies, rural geographic origins, and deficiencies attributed to their secondary education.

The neoliberal meritocratic context of universities perpetuates ideologies of uniformity and meritocracy that fail to recognise the knowledges, languages, and skills of marginalised students, reinforcing experiences of exclusion and non-belonging (Mkhize & Idahosa, 2025). In STEM disciplines specifically, Rainey et al. (2018) highlight that sense of belonging differentially influences decisions to major according to race and gender, an aspect particularly relevant for understanding the trajectories of marginalised students in historically exclusionary fields.

2.3.3.2 Chilean Context

In line with what has been reported in international research, students from low-income and marginalised backgrounds in higher education in Chile face multiple tensions in their process of identity negotiation and construction of a sense of belonging within the university context. The transition to university represents a particular challenge when the student's habitus is not aligned with the field of higher education, generating a sensation of being "like a fish out of water" that profoundly affects their integration and institutional sense of belonging (Espinoza et al., 2022). Class-based habitus determines not only educational choices but also adaptation experiences, leading first-generation students to seek spaces where they find "people like them" as a strategy to facilitate their integration (Espinoza et al., 2023).

Leyton et al. (2012) report that in elite universities, there is a stronger sense of social dislocation and denial of social origins, while in pluralistic universities, there is a risk of social closure and isolation, meaning low-income students may form exclusive social groups with peers from similar backgrounds rather than integrating with the broader university community.

Soto Hernández (2016) demonstrates through a qualitative study how first-generation students construct three primary meanings of their university experience: upward social mobility, vocation, and gratitude towards parents; revealing that their parents become a fundamental source of support through discourses and practices that emphasise the importance of studying, which naturalises the university option as part of life and mediates the construction of their student identity in contexts that are culturally alien to their social origin.

2.3.4 Institutional Factors and Potential for Change

2.3.4.1 International Literature

The concept of institutional habitus, introduced by Reay et al. (2001), extends Bourdieu's framework to examine how educational institutions embody and perpetuate certain dispositions, expectations, and practices, providing a valuable lens for understanding the interplay between students and their institutional environment.

Institutional habitus encompasses collective norms, values, and cultural practices characterising an educational institution, shaping its ethos (Edwin Smith, 2003), and influencing curriculum design, teaching methods, student support, and extracurricular activities (Tarabini et al., 2017). This concept explains how institutions unconsciously reproduce social and cultural norms, potentially advantaging students whose habitus aligns with the institutional one while creating challenges for others.

Bain (1985) and Margolis et al. (2001) discuss the "hidden curriculum" in education, unwritten, unofficial, and often unintended lessons, values, and perspectives that students absorb. This hidden curriculum impacts low-income engineering students by perpetuating cultural expectations that may not align with their backgrounds (Hafferty & Hafler, 2011), creating barriers to socialisation and potentially leading to alienation.

Boliver et al. (2018) explain universities' prioritization of research over teaching through their concept of organizational identity as a barrier to inclusive practices. Universities with "globally competitive" identities often prioritize research excellence, positioning teaching as secondary: "Distinction in research tends to be valued over distinction in teaching, partly because the former is regarded as an autonomous endeavour whereas the latter is seen as more heteronomously determined (Boliver et al., 2018, p. 3).

Fairweather (2002) examines faculty productivity in higher education, highlighting tensions between research and teaching priorities that can impact undergraduate education quality and support for disadvantaged students, particularly relevant in

engineering education where this balance significantly influences student experiences.

Recent scholarship builds upon Bourdieu's work, emphasizing reflexivity in social action (Archer, 2010; Sayer, 2009). Decoteau (2016) explores the concept of reflexive habitus, suggesting individuals can consciously modify their dispositions, offering hope for transformation and suggesting individuals can actively adapt to new social contexts.

Individuals' negotiation ease varies significantly based on mediating factors. Those with greater reflexivity and metacognitive skills navigate more smoothly by critically examining their dispositions and field demands (Archer, 2010; Sayer, 2009). Additionally, an individual's social and cultural capital significantly impacts their adaptation ability (Bourdieu, 1986).

Emison (2011) argues for transformative leadership in engineering education to address modern technological challenges, emphasising evolution beyond traditional technical focus to incorporate broader societal considerations, potentially creating more inclusive environments valuing the diverse experiences of low-income students.

Lehmann (2012) identifies key factors influencing working-class students' habitus adaptation: prior socialisation, clear career goals, chance encounters exposing students to new perspectives, and individual agency in deciding whether to embrace new experiences or maintain aspects of their original habitus.

Higher education institutions can better support low-income students by addressing institutional factors and fostering environments that value diverse perspectives. This is particularly important in contexts like Chile, where increased access efforts must be accompanied by equity and inclusion measures throughout the educational experience.

In the Global South, low-income students confront significant institutional and structural barriers rooted in the legacies of colonisation and racialization. Universities continue to operate with structures, cultures, and practices that perpetuate social exclusion through inadequate reception processes, limited student engagement initiatives, and insufficient educational support practices tailored to the needs of disadvantaged students (Badat, 2010; Norodien-Fataar, 2016).

First-generation students experience profound discomfort and a sense of unbelonging as they navigate the neoliberal meritocracy and competitive, exclusionary culture of universities, particularly in STEM fields, where they often lack institutional support and recognition of their varied needs (Mkhize & Idahosa, 2025).

The regime of social exclusion extends beyond access and admissions to encompass questions of institutional and academic cultures, epistemological and ontological issues associated with learning and teaching, curriculum development, and pedagogical practices that remain largely disconnected from students' lived realities (Badat, 2010). These environments, shaped by invisible forms of structural and institutional racism, create barriers that disproportionately affect students from marginalised backgrounds, contributing to dropout rates estimated at approximately 33% among first-generation students across all disciplines (Mkhize & Idahosa, 2025).

Research on engineering education across African contexts reveals how both individual instructor beliefs and broader institutional constraints shape pedagogical approaches and curriculum development. Pitterson et al. (2022) demonstrate that instructors' pedagogical content knowledge varies significantly across national contexts, with South African engineering educators particularly emphasising conceptual understanding over mechanical calculation. This finding aligns with the contextual pressures identified by Case et al. (2016) in their study of curriculum reform across Kenya, Tanzania, and South Africa. Case et al. (2016) demonstrate that while global engineering education trends influence all three countries, local factors such as state funding mechanisms, accreditation requirements, and

industrial contexts create distinct "situational logics" that both constrain and enable different reform possibilities.

Emerging discourse increasingly advocates for decolonising engineering education through the integration of indigenous knowledge systems (IKS) and local epistemologies. Integrating IKS into STEM education fosters a more inclusive, culturally responsive educational landscape. It enables students to connect their daily lives with their educational experiences, thereby enhancing engagement and addressing the perception that STEM curricula are often irrelevant and unengaging (Nwokocha & Legg-Jack, 2024). Localised learning experiences rooted in indigenous knowledge offer culturally sensitive pedagogical methods that enhance inclusivity and diversify the curriculum. However, implementation faces substantial barriers, including limited faculty preparedness, resource scarcity, inadequate infrastructure and equipment, and insufficient funding (Badat, 2010; Mashiyane et al., 2023). Additional challenges include unresolved tensions between maintaining global accreditation standards and achieving local contextual relevance (Case et al., 2016; Zörner et al., 2020).

Effective transformation requires strengthening industry-academia partnerships, integrating sustainability principles into curricula, and investing in faculty development through dedicated programs that support professional growth (Bagde et al., 2016; Mashiyane et al., 2023; Sackey et al., 2014). Regional harmonisation initiatives and collaborative curriculum development offer pathways for standardisation while respecting contextual diversity (Sackey et al., 2014; Zörner et al., 2020). Advancing engineering education in sub-Saharan Africa requires context-sensitive reforms that balance international competitiveness with local relevance, fostering graduates capable of addressing unique developmental challenges (Mashiyane et al., 2023; Nwokocha & Legg-Jack, 2024).

2.3.4.2 Chilean Context

In Chile, elite universities maintain a disproportionately high concentration of students from affluent backgrounds. Kuzmanic et al. (2021) identified universities as the primary drivers of this segregation, playing a crucial role in perpetuating and reproducing socioeconomic divisions within higher education. Several interconnected mechanisms drive segregation in Chilean higher education (Espinoza et al., 2024). The highly stratified secondary school system creates initial inequalities that are then reinforced by university admission tests. High tuition fees, particularly at selective private universities, create financial barriers for low-income students. Meanwhile, private universities have positioned themselves in different prestige tiers to distinguish social elites. These institutional factors combine with student self-selection, where individuals tend to choose universities that match their socioeconomic background, thereby perpetuating segregation despite expanded university access.

While university massification has expanded opportunities for these students, who view higher education as a pathway to upward social mobility (Quaresma & Villalobos, 2022), their experiences are marked by structural disadvantages. Elite universities have implemented inclusion programs targeting academically talented students from vulnerable backgrounds (Bellei, 2013; Quaresma & Villalobos, 2022), yet these initiatives occur without transforming institutional culture, ethos, or teaching-learning processes. Consequently, working-class students become "strangers in paradise" (Reay et al., 2009, as cited in both papers), experiencing a "habitus divided against itself" (Bourdieu, 1999, as cited in Quaresma & Villalobos, 2022) that requires "superhuman levels of motivation, resilience, and determination, sometimes at the cost of peer group approval" to successfully complete their degrees (Quaresma & Villalobos, 2022, p. 36). Furthermore, despite obtaining university credentials, these students face labour market disadvantages compared to their wealthier peers, as employers utilise non-educational signifiers to distinguish candidates (Bellei, 2013; Quaresma & Villalobos, 2022).

Institutional support structures, such as mentoring programs, can mitigate challenges related to habitus adaptation (Thomas, 2002). In Chile, preparatory programs facilitate disadvantaged students' transition to higher education. Díaz et al. (2021) found that these initiatives help students develop the necessary academic skills and cultural capital.

2.4 Professional Identity Formation in Engineering

Professional identity refers to individuals' sense of self and belonging to their chosen profession (Pierrakos et al., 2009). It involves the development of values, behaviours, and skills that align with society's expectations of a particular profession (Trede et al., 2012). Various factors, including socialisation, career changes, and personal experiences throughout life, mould this sense of self. Professional identity affects not only how individuals view themselves but also how others within their field perceive them (Slay & Smith, 2011).

Engineering identity is a multifaceted concept encompassing how individuals perceive themselves as engineers and how others recognise them in the engineering community (Beam et al., 2009). Various factors influence it, including personal interests, competence, recognition, and social interactions. The following sections explore key aspects of engineering identity based on insights from the literature review.

Drawing on Bourdieu and Wacquant's (1992) theoretical framework, I conceptualise engineering identity as a specialised form of professional habitus that develops through sustained engagement with the engineering field. This professional habitus encompasses distinct cognitive dispositions, including systematic approaches to problem-solving, analytical thinking patterns, and technical reasoning. It also incorporates professional values, ethical frameworks, and modes of communication specific to engineering practice.

2.4.1 The context: Engineering Field and Engineering Education

The engineering field is structured by complex hierarchies, implicit values, and established practices that students must learn to navigate and internalise (Mendoza et al., 2012). Within this field, professional identity formation occurs through the strategic accumulation and deployment of various forms of capital (Verwiebe & Hagemann, 2024). Cultural capital manifests as technical expertise, methodological knowledge, and engineering-specific skills. Social capital develops through professional networks, mentoring relationships, and collaborative endeavours within the engineering community. Symbolic capital accrues through recognition of technical competence, innovative contributions, and adherence to professional standards, conferring legitimacy within the field.

The misalignment between engineering education and industry needs represents a persistent challenge despite numerous calls for reform. As Johri and Olds (2011) point out, "engineers in the workplace often say that even technical skills are easier to learn on the job than in formal training. They often complain that very little of what they learn in school is of any use to them" (2011, p. 169). This disconnect reflects a critical "issue of situated learning and transfer" (Johri et al., 2011, p. 169). Passow and Passow's (2017) systematic review reinforces this gap, noting that "engineers are trained to do [what they call] real engineering [that is, solitary technical problem solving and design] and not the rest of their jobs" (2017, p. 501). Their research reveals that technical competence is "inseparably intertwined with effective collaboration," with engineers spending 55-60% of their workday communicating (2017, pp. 491–492).

Besterfield-Sacre et al. (2014) found that faculty value innovative pedagogies and learning environments but often fail to implement them in practice. Their survey reveals that engineering programs predominantly focus on traditional experiences like laboratories and research while undervaluing industry-relevant skills such as international programs, entrepreneurship, and service learning that are "prominently featured in many national and international reports" (2014, p. 209).

The persistence of this disconnect reflects powerful "structural and systemic features of engineering education, such as its reward structures that favour the status quo" (Besterfield-Sacre et al., 2014, p. 194). To address this gap, Passow and Passow (2017) conclude that "non-technical skills cannot be taught in isolation from the technical context in which they will be used" and that "engineering education needs a greater connection to practice from the first day" (2017, p. 501), emphasising authentic, ill-structured problems within constraints and realistic social elements.

Through this Bourdieusian lens, and based on the cited literature, I argue that becoming an engineer involves more than acquiring technical knowledge; it requires developing a professional habitus aligned with the field's expectations while accumulating the forms of capital valued within engineering practice.

2.4.2 Defining Engineering Identity

As Berge et al. (2019) described, engineering identity refers to how individuals perceive themselves within the engineering field, encompassing beliefs, values, and professional aspirations. It involves developing a sense of belonging within the engineering community while shaping one's academic, occupational, and personal identity. Tonso (2006) conceptualises engineering identity as a "figured world" constructed through campus cultures and practices, emphasising how institutional contexts shape students' understanding of what it means to be an engineer.

Lakin et al. (2020) identified four main themes in students' engineering conceptualisation: engineers as designers and innovators building and solving problems; application of mathematics and scientific knowledge; characterisation of engineering problems as complex, technical, and focused on improving efficiency; and engineering as helping society through real-world solutions.

Similarly, Berge et al. (2019) describe four archetypal engineering identities: Traditional Engineer values deep technical knowledge; Contemporary Engineer focuses on societal development and sustainability; Responsible Engineer

emphasises ethical, economic, and sustainability aspects; and Self-Made Engineer promotes individual agency in business contexts. These categories represent positions rather than rigid classifications, with individual engineers potentially exhibiting characteristics across multiple identities.

Engineering identity development begins early in life and continues through professional practice. Various factors influence this journey, including early STEM exposure, academic experiences, social recognition, and practical applications of engineering knowledge. The foundation of engineering identity traces back to pre-adolescent years, where informal STEM interactions play a crucial role (Simpson et al., 2023). Understanding young learners' initial engineering perceptions can inform educational practices supporting early identity development (Capobianco et al., 2012).

For undergraduate and graduate students, engineering interest, competence, and interpersonal skills strongly predict engineering identity (Choe et al., 2019). These elements are critical as students navigate education and envision professional futures. Peer, faculty, and family recognition also validate individuals' engineering identities, reinforcing field belonging.

The academic environment significantly influences engineering identity formation. Campus culture provides a framework through which students interpret their actions as engineers (Tonso, 2006). However, traditional academic problem-solving approaches may not fully support robust engineering identities, as they often lack real-world complexity (Koro-Ljungberg et al., 2017). This disconnect between academic and real-world engineering challenges can limit students' language use and problem-solving identities, potentially hindering creativity.

Internships and practical experiences play a crucial role in professional identity formation. Hands-on engineering experiences contribute to a stronger professional identity and often differentiate between students who persist in engineering and those who switch fields (Pierrakos et al., 2009). These experiences provide

opportunities to apply knowledge in real-world contexts, enhancing understanding of engineering practice.

Broader social and cultural contexts influence engineering identity formation. Aligning personal career values with engineering significantly impacts belonging and professional identity (Lakin et al., 2020). Recent scholarship emphasises the importance of considering ethical and social dimensions in engineering education and identity formation. Leydens and Lucena (2014) argue that social justice perspectives should be integrated into engineering curricula to prepare students for the complex societal impacts of their work.

2.4.3 Technical-Social Dualism in Engineering

A significant challenge in engineering education is the persistent technical-social dualism that divorces technical aspects from social considerations (Faulkner, 2000; Rodrigues & Seniuk Cicek, 2024). Technical-Professional and Socio-Ethical dimensions represent complementary aspects of professional development that students negotiate while constructing their identities (Khosronejad et al., 2021). This dualism portrays engineering as predominantly technical problem-solving while positioning social dimensions as secondary concerns (Cech, 2014). Technocentrism foregrounds "hard" technical dimensions while marginalising "soft" social aspects not viewed as "real engineering" (Pleasants et al., 2025). Cech (2014) argues this fosters a "culture of disengagement" where students are socialised to depoliticise their work. Engineering education often reinforces this separation through curriculum structures prioritising technical content over sociotechnical integration, creating graduates who struggle to recognise engineering's inherently social nature (Faulkner, 2000).

Mathematics is crucial in engineering education as the foundational language for solving complex engineering problems. It underpins all STEM disciplines, providing necessary skills for scientific literacy and economic competitiveness (Maass et al., 2019). In engineering education, mathematics is essential for developing critical

thinking and problem-solving skills for addressing complex real-world challenges (Osman et al., 2015). Mathematics integration into engineering curricula fosters analytical and creative thinking necessary for innovative solutions (Engelbrecht et al., 2012). Furthermore, mathematics enables students to connect abstract concepts with practical applications, achieving a more profound understanding of engineering processes (Chance et al., 2024).

Engineering identity formation involves complex boundary-crossing processes as students navigate different knowledge and practice domains. Akkerman and Bakker (2011) conceptualise boundaries as "sociocultural differences leading to discontinuity in action or interaction," highlighting how boundaries both divide and connect different practices. Crossing these boundaries requires four key learning mechanisms: identification, coordination, reflection, and transformation. This framework complements Godwin et al.'s (2016) "Critical Engineering Agency" concept, which combines subject identities with agency beliefs—students' sense that they can positively impact the world through engineering. Their research reveals that recognition from others strongly predicts developing strong subject identities, while agency beliefs significantly influence engineering career choice, especially for women.

Engineering identity formation for disadvantaged students involves complex negotiations across multiple boundaries and developing field agency. As McNair et al. (2011) demonstrate, this process can be facilitated by institutional structures balancing autonomy with appropriate scaffolding, allowing students to develop both institutional identities (based on formal roles) and affinity identities (based on shared practices) within engineering.

2.4.4 Engineering Identity in Low-Income Students

Developing engineering identity among low-income students is a complex process shaped by socioeconomic factors, institutional environments, and personal experiences. These students often face particular challenges in seeing themselves

as engineers while navigating systemic barriers and cultural expectations. As Trede et al. (2012) noted, developing a professional identity in engineering involves integrating knowledge, skills, and values. For engineering students, this means reconciling technical expertise with broader professional competencies, a process that can be particularly challenging for those from non-traditional backgrounds.

Research has highlighted several key aspects of this identity formation process. Smith and Lucena (2016) describe how low-income students develop their engineering identity by drawing on the funds of knowledge acquired from their backgrounds. These students use their unique experiences to shape innovative approaches to engineering, contributing to problem-solving and design. By recognising the value of their backgrounds and skills, low-income students establish a sense of belonging in engineering education and the profession.

Low-income Latino/a/x engineering students frequently encounter institutional barriers such as remedial placement and limited access to resources, which can impede their identity development. The concept of "arrebatos" describes the internal conflicts these students experience as they attempt to reconcile their socioeconomic realities with their engineering aspirations. This reflects a broader pattern in engineering education and practice, where the field has historically been dominated by white, middle-class males, creating systemic barriers for underrepresented groups. These experiences underscore the need for institutions, particularly Hispanic-serving institutions (HSIs), to implement supportive policies that affirm students' identities and address systemic biases (Escobar et al., 2024). The role of social class in identity formation is significant, with lower-income students often less cognizant of the structural factors contributing to their success compared to their more affluent peers. This lack of awareness can impact their occupational aspirations and self-perception as engineers (Aries & Seider, 2007).

Authentic learning environments are crucial in fostering engineering identities among low-income students. Experiences that emphasise diversity and inclusion can significantly enhance the development of STEM identities among underrepresented

students. Students can develop a stronger sense of belonging and self-identification as engineers by engaging in projects reflecting their identities and cultural backgrounds (Singer et al., 2020). Project-based learning (PBL) environments are particularly effective in this regard. Elements such as internal motivation, competence beliefs, and external support within PBL contexts help students envision themselves as future engineers. These environments encourage students to apply their knowledge in practical settings, reinforcing their identity as engineers (Chen et al., 2023).

The engineering academic environment plays a crucial role in shaping the professional identities of marginalized students, with departmental culture and peer interactions being particularly influential. While positive peer relationships and supportive institutional climates can strengthen students' sense of belonging and engineering identity (Davis et al., 2023), significant challenges persist. Women and minorities remain underrepresented among tenured/tenure-track faculty in science and engineering departments (Nelson, 2017), perpetuating a "leaky pipeline" in STEM disciplines where these groups experience higher attrition rates. This underrepresentation is exacerbated by persistent gender-science stereotypes, challenges with belonging in male-dominated environments, and inadequate diversity in hiring processes (Figueiredo, 2023).

Research suggests a relationship between faculty diversity and student outcomes in engineering departments, with faculty representation potentially influencing graduation rates among demographically similar underrepresented students (Garcia et al., 2023). These outcomes are influenced by campus engineering culture, which shapes both how students view themselves and how others perceive them as engineers. The cultural environment can either foster or impede the development of strong engineering identities, depending on its inclusivity and representativeness (Tonso, 2006).

Engaging in engineering practices from an early age can help students develop their engineering identities. Through activities that integrate engineering concepts with

personal and cultural narratives, students can begin to see themselves as part of the engineering community (Kelly et al., 2017). However, the negotiation of academic identities remains complex for low-income students, who often express uncertainty about their academic selves. This uncertainty can be mitigated by supportive educational practices that validate their experiences and aspirations (Colyar & Stich, 2011).

While these insights highlight the challenges and strategies for building engineering identities among low-income students, it is important to recognise the broader context of identity formation. Factors such as gender, ethnicity, and personal values intersect with socioeconomic status to shape how students perceive themselves as engineers.

2.4.5 Navigating Identity in a Gendered Field

In Chile, gender disparities in STEM education are evident: while overall tertiary education shows 52.6% female enrollment among new entrants, in the STEM field only 20.8% of students are women (MINEDUC, 2025).

Women's journeys in engineering are marked by unique challenges in constructing and maintaining their professional identities within a historically male-dominated field (Jorgenson, 2002). Societal expectations, institutional cultures, and individual experiences shape this complex interplay of gender and engineering identity.

The underrepresentation of women in engineering persists due to deeply ingrained gender status beliefs that influence career aspirations from an early age. Correll (2004) demonstrates how these beliefs lead women to perceive themselves as less suited for male-dominated STEM fields, affecting their educational and career choices. This perception is reinforced by the concept of gendered habitus, which explains how gender shapes individuals' dispositions, perceptions, and practices (Dumais, 2002; Reay, 2004a).

Gendered habitus, extending Bourdieu's theory, is fundamental in reproducing gender inequalities through seemingly natural everyday actions and choices. Gendered habitus refers to the dispositions and practices shaped by gender that influence individuals' behaviours and interactions within specific cultural fields (Miller, 2016). It encompasses how gender norms and expectations are internalised and expressed, affecting how individuals engage with their respective fields. Formed in early childhood and continually reinforced, it creates different expectations and dispositions for men and women (McLeod, 2005). In educational settings, this often leads to gender disparities in subject choices and experiences (Scandone, 2017; Turnbull et al., 2019). Hardtke et al. (2023) showed how girls' habitus frequently conflicts with the masculine engineering culture, making many feel they do not "fit in" with STEM subjects.

In higher education, gendered habitus continues to shape experiences. Reay et al. (2009b) found that working-class women in elite universities often experienced a "habitus tug" as they negotiated between their identities and the institutional habitus. This tension could lead to feelings of alienation or a sense of being a "fish out of water". However, gendered habitus is not deterministic; individuals can develop reflexive awareness and potentially challenge or modify it (Lois McNay, 1999; Thorpe, 2009).

Once women enter engineering programs or the profession, they face challenges in developing and asserting their identities as engineers. Faulkner (2007) explores how engineering cultures are constructed as masculine, preventing women from developing authentic professional identities. This masculine culture is often perpetuated through professional socialisation in engineering education, reproducing gender segregation by reinforcing masculine norms (Seron et al., 2015).

Despite these challenges, women in engineering construct their professional identity through various strategies as they navigate the male-dominated field. Du (2006) observes that women often openly discuss their strengths, weaknesses, and

learning expectations, while some choose to collaborate with other female students to enhance their educational experience. As they progress in their studies, these women become more adept at handling challenges and forming strong relationships with their male peers. To establish their qualifications, women in engineering consistently demonstrate intelligence, technical competence, and mental strength. They adapt to male-dominated cultural norms by managing conflicting identities and breaking boundaries, often being perceived as brave challengers who navigate a non-traditional profession with determination and capability.

Women frequently negotiate their identities within the gendered environment of engineering. Jorgenson (2002) describes how women adopt various discursive positionings to present themselves as qualified professionals. Hatmaker (2013) notes that gendered interactions in the workplace can marginalise women's engineering identity, leading to feelings of ambivalence or devaluation. To counter this, some women employ impression management strategies to assert their identities and navigate these challenges.

The persistence of gender stereotypes adds another layer of complexity to identity formation, even among women who have chosen to enter the field (Powell et al., 2012). Moreover, subtle gender biases among faculty and professionals can accumulate to disadvantage women in STEM fields (Moss-Racusin et al., 2012), highlighting the need for structural changes.

In professional settings, high-achieving women engineers often face a "double bind" between demonstrating competence and maintaining femininity (Gill et al., 2008). Despite these obstacles, research points to potential avenues for change. Schmitt (2021) explores how supportive professional networks can facilitate women's pathways to leadership roles. Cech et al. (2011) highlight the importance of developing not just technical skills but also a sense of professional role confidence.

Educational institutions play a crucial role in shaping women's engineering identities. Du (2006) emphasizes the importance of considering gender in pedagogical

approaches, particularly in problem-based learning environments. This underscores the need for educational strategies that support the development of strong engineering identities among women.

The literature from the Global South on gender in engineering shares some aspects with research from the rest of the world, such as the persistence of gender stereotypes and the need for mentorship programmes. However, it also presents contextual particularities, including the intersection of cultural, socioeconomic, and historical factors specific to these regions, which can help illuminate research situated in Chile and other Latin American contexts. In this regard, cultural norms and gender stereotypes constitute the most pervasive barriers to female participation in engineering across the Global South.

Traditional gender roles and cultural expectations strongly steer women away from engineering, which is widely perceived as masculine, technically demanding, and physically strenuous (Maccaro et al., 2024; Odebiyi et al., 2024). Societal beliefs about women's capabilities, concerns about marriage and family compatibility, and stereotypes regarding appropriateness create substantial barriers across South Asia, Sub-Saharan Africa, Latin America, and Southeast Asia. Female engineering students face unique challenges, including sexual harassment, social exclusion, and pervasive stereotypes about physical ability, contributing to enrolment rates sometimes falling below fifteen per cent in specific programmes (Jimola & Jimola, 2024). Engineering is perceived as male-dominated, with cultural gender discrimination present, whilst societal values favour male participation based on cultural beliefs that limit females (Odebiyi et al., 2024). Misconceptions about engineering's difficulty and gender roles deter females.

The absence of female role models and mentorship emerges as a critical barrier across multiple contexts. Studies identify the presence of female mentors and role models as critical facilitators for female students' persistence and interest in engineering (Bangura, 2024; Lasekan et al., 2024). Lack of mentorship is frequently cited as a barrier, especially in non-traditional specialities and male-dominated

engineering disciplines(Maccaro et al., 2024; Odebiyi et al., 2024). Programmes involving career days, motivational speakers, and peer networks prove effective in encouraging female participation. Mentorship and peer networks are critical for female persistence, with universities urged to implement gender-responsive support (Bangura, 2024). Female role models and media portrayals influence aspirations, with role models and cultural leverage suggested to increase participation (Lasekan et al., 2024).

2.5 Conclusions

This literature review has examined the multifaceted dynamics shaping engineering students' experiences and identity formation from disadvantaged backgrounds, with implications for the Chilean context. Several key themes emerge by exploring Bourdieu's theoretical framework, capital accumulation and mobilization, low-income students' experiences in higher education, and professional identity formation in engineering.

Bourdieu's concepts of habitus, field, and capital provide a robust framework for understanding the social dynamics of education. These concepts help explain how social, cultural, and economic factors influence students' educational experiences and outcomes, particularly for those from disadvantaged backgrounds. The review highlights how disadvantaged students actively work to accumulate and mobilise various forms of capital throughout their educational journeys. However, they often face challenges in acquiring and leveraging the types of capital most valued in higher education settings, particularly in elite institutions.

Numerous challenges, including financial pressure, academic adaptation, and social integration, mark low-income students' journey in higher education. These students often experience a sense of dislocation or "habitus cleavage," particularly in elite institutions. However, they also bring unique strengths and "funds of knowledge" that can be valuable in engineering education when recognised and validated.

Developing an engineering identity is an intricate process influenced by personal interests, competence, recognition, and social interactions. For low-income students, this process is further complicated by socioeconomic factors and the need to navigate a field traditionally dominated by middle and upper-class norms. Women in engineering face additional challenges in constructing and maintaining their professional identities within a historically male-dominated field. The concept of gendered habitus helps explain persistent gender disparities in engineering education and the profession.

The role of institutional habitus in perpetuating or challenging social inequalities in higher education is significant. In many contexts, including Chile, despite increased access to higher education, systems keep exhibiting high levels of socioeconomic segregation, particularly in elite universities. However, the literature also points to potential avenues for change. These include recognizing and valuing the diverse experiences of low-income students, creating more inclusive learning environments, and implementing supportive policies and practices at the institutional level.

This review underscores the need for a nuanced understanding of how disadvantaged students navigate engineering education. It highlights the importance of considering both structural factors and individual agency in shaping educational experiences and outcomes. While the literature reviewed spans various international contexts, its insights can inform and support research in the Chilean context. Future research could explore the specific strategies employed by successful low-income engineering students in Chile, the role of institutional policies in promoting equity, and the long-term impact of engineering education on social mobility.

Chapter 3: Methodology

3.1 Overview

This chapter outlines the qualitative, interpretive approach to exploring how engineering students from disadvantaged backgrounds in Chile experience their education as a means of promoting social mobility. Grounded in an interpretive paradigm (Peshkin, 2000) and a social constructionist perspective (Searle, 1995), my research recognises multiple socially constructed realities (P. Berger & Luckmann, 2012; Gallimore et al., 1993) shaped by context. This philosophical stance informed my decision to use semi-structured interviews as the primary method of data collection.

My methodology approach is designed to address the main research question regarding how engineering students from disadvantaged backgrounds in Chile perceive and experience their education as a pathway to social mobility, along with the three related sub-questions that explore the forms of capital they mobilise, the barriers and support systems they encounter, and their understanding and embodiment of the engineering profession.

The following sections outline my methodological choices, including participant selection, data collection and management strategies, analysis process, and ethical considerations. I maintain a reflexive stance, acknowledging how my role as a researcher and faculty member influences the research process.

3.2 Research Approach

3.2.1 Design

I chose a qualitative interpretive research approach (Peshkin, 2000) for this study to explore the experiences of engineering students from disadvantaged backgrounds in Chile. This approach aligns with my research questions about students' lived experiences and their perceptions of education as a means of social mobility.

My methodology reflects an ontological stance that social reality is subjective (Searle, 1995) and constructed through human interaction (Berger & Luckmann, 2012). Epistemologically, I view knowledge as co-constructed between the researcher and participants through dialogue and interpretation (Flores, 2014; Lapan et al., 2012), informing my decision to employ in-depth interviews as the primary data collection method.

This research defines its bounded case (Baškarada, 2014; Njie & Asimiran, 2014; Starman, 2013) as the School of Engineering at a regional university in Chile between 2019 and 2021, a timeframe that encompasses both social unrest and the COVID-19 pandemic. The boundaries specifically focus on undergraduate engineering students from socioeconomically disadvantaged backgrounds (those receiving free tuition under Chile's 2016 higher education reforms). This bounded approach (Bryman, 2012; Creswell, 2009) allows for an in-depth exploration of how these underrepresented students navigate engineering education within a specific institutional context while acknowledging the broader socio-political environment shaping their experiences.

The case study approach enables robust, open-ended inquiry where research questions are purposefully crafted to encourage participants to deeply explore their experiences, facilitating the identification of recurring themes and patterns (Durdella, 2017). This methodological choice aligns with the research objectives of examining barriers, supporting factors, and identity development processes in engineering students.

3.2.2 Trustworthiness

While recognising the unique contextual nature of my case study, I do not aim for broad generalizability but seek to provide rich, contextualised insights with transferability to similar settings. Trustworthiness in qualitative research consists of four criteria (Guba & Lincoln, 1982): credibility (ensures that research findings are convincing and believable), transferability (refers to whether findings can be applied

to other contexts), dependability (demonstrates that findings are consistent and could be repeated), and confirmability (shows that findings emerge from the data rather than researcher bias), recognising that multiple accounts of social reality can exist (Bryman, 2012)

To enhance trustworthiness (Bryman, 2016; Creswell, 2012; Hammersley, 2007), I employed several strategies:

Triangulation (Bryman & Burgess, 2002; Lapan et al., 2012): Comparing data across participants and with existing literature. Example: When analysing the impact of pre-university programs, I compared accounts from students with different participation experiences and related findings to existing research.

Member checking (Ahmed, 2024; Lapan et al., 2012): Sharing preliminary findings with some participants to verify interpretation accuracy. Example: I presented initial themes about first-generation engineering students' challenges to participants for feedback and clarification.

Peer debriefing (Creswell, 2012): Discussing analysis with colleagues to challenge assumptions. Example: Regular meetings with researchers studying Chilean higher education helped identify potential biases in my analysis.

Thick description (Bryman, 2012): Providing detailed accounts of contexts and experiences. Example: When describing rural students' experiences, I included rich details about educational backgrounds, family situations, and adaptation challenges.

Audit trail (Ahmed, 2024; Bingham, 2023): Maintaining detailed research process records. Example: I kept documentation of each research step, including theoretical framework choices and interview question development.

These strategies ensured my findings accurately represented Chilean engineering students' experiences and contributed to understanding engineering education and social mobility in Chile.

3.3 Research Positioning

My path to engineering was neither direct nor typical, and this has had a significant impact on how I think about and ask research questions. I did not consider becoming an engineer in high school because it was not viewed as a viable option for young women, despite my strong math aptitude. On the other hand, my younger brother had always wanted to be an engineer. He was what I thought of as the perfect engineering student: confident, focused on the technical side of things, and at home in places where I often felt like an outsider. This difference became even clearer when I first studied Design for a year before switching to Engineering. This choice demonstrated both my desire to excel academically and my growing realisation that solving technical problems was a good fit for my intellectual strengths.

These formative experiences of displacement and subsequent integration into engineering culture have profoundly shaped my research methodology. Having traversed the intersections of creative and technical fields and encountered both subtle and overt obstacles that may deter women from pursuing engineering careers, I have developed an enhanced awareness of issues related to inclusion, representation, and the social construction of technical expertise. This thesis is dedicated to my brother in recognition of his support and as a means of reconciling my engineering identity, which was earned rather than simply accepted. This personal journey has sparked a keen interest in understanding how institutional cultures and practices can either promote or hinder diverse participation in technical domains, ultimately influencing the research inquiries and analytical frameworks that underpin this study.

As an institutional insider within the School of Engineering, my position presented methodological opportunities and challenges (R. Berger, 2015). I occupied a "hybrid insider-outsider" position (Carling et al., 2014) to balance institutional familiarity with analytical distance. This positioning proved challenging when interviewing a former student I had previously viewed as conflictive, whose interview revealed a critical

and reflective nature, highlighting how preconceptions could affect data interpretation if not carefully managed.

The School's organisational structure provided what Durdella (2017) describes as an optimal setting connecting the study to my professional practice area, connecting the study directly to my professional practice area while offering rich opportunities for understanding shared patterns of behaviour and experience.

The concept of "researcher as instrument" (Mertens, 2012) acknowledges the subjective nature of qualitative research, which is particularly relevant given my institutional relationship. Bryman (2016) emphasises that researchers must consider how their methods impact knowledge generation.

I employed reflexivity to address these challenges, examining biases and assumptions (Patnaik, 2013) within cultural, political, and social contexts (Bryman, 2016). An emotional interview where a participant began crying while discussing family conflicts tested this reflexive approach, requiring me to carefully balance an empathetic response with professional distance while maintaining research integrity.

As soon as the participant started crying, I stopped the recording. This gave the student some space to move around and a break without feeling like they had to keep going. I reminded the participant that we could stop the interview at any time or continue it on another day if she preferred. After taking a moment to calm down, she said she was ready to keep talking.

As an ethical researcher, I carefully balanced being helpful with being objective in my research. I chose not to take on a therapeutic role that was outside of my training or area of expertise. I automatically wrote down how this emotional event might have changed the participant's later responses and my interpretation during later stages of analysis. This event made it clear how important it is to keep an eye on the emotional health of study participants while still protecting the integrity of the process.

It is essential to recognise that vulnerability is frequently influenced by structural inequality and the study setting (Bracken-Roche et al., 2017) . In my research, I examined vulnerability from various angles that interact with each other and shape the research process. The topic of the study is directly linked to situational vulnerability, which means that participants may have to talk about traumatic or difficult situations they did not expect to have to deal with during the interview. Contextual vulnerability looks at the power differences that exist between the researcher and the participant. Differences in power can be caused by things like institutional connection, educational background, and social positioning, all of which can affect how honest and comfortable the participant's answers are. Temporal vulnerability considers the possibility that a participant's mental state and sense of vulnerability may fluctuate throughout the research process. This means that the researcher must constantly evaluate and make changes based on what they find.

To protect myself from these various types of weakness, I created and followed strict rules for every part of the study process. I explained to the students who were going to be interviewed in clear, thorough language what we would be discussing. There would be no harm if they chose not to answer any questions or leave the study at any time, as I made that clear. During the interview, I always kept a close eye on the participants' mental health. I was ready to offer breaks or pauses as needed and was aware of both spoken and unspoken cues that they were upset or uncomfortable. As soon as the interview was over, I checked in with the people to see how they were doing and made sure they had the help they needed when they needed it.

I conducted video interviews and personally transcribed data to ensure research rigour, following standardised protocols.

To mitigate researcher bias concerns (Atkins & Wallace, 2015; Creswell, 2012), I implemented specific safeguards: excluding current or future students, avoiding participants from supervised projects, selecting participants from departments where I had no teaching responsibilities, and maintaining detailed field notes documenting

potential biases. This approach enhanced credibility while embracing the inherent subjectivity of qualitative research.

3.4 Research Setting

3.4.1 Site Selection

Drawing from Durdella's (2017) framework for qualitative site selection and Creswell's (2012) approach to bounded systems, I selected the School of Engineering at a regional Chilean university as my case study. This site, housing nine specialised engineering departments, provides what Creswell (2012) identifies as a clearly bounded system while offering diverse departmental contexts for studying underrepresented students' experiences. While sharing an overarching institutional culture, these departments exhibit distinct subcultures with varying disciplinary traditions and practices.

This selection reflected careful consideration of methodological requirements and my researcher-practitioner positionality within the institution. The School's structure created an ideal bounded case for examining how underrepresented students navigate engineering education across different specialised contexts within a single institutional framework.

The university where this research is situated emerged in the first decades of the 20th century from a philanthropic initiative with an explicit commitment to social justice. Founded on the premise of serving Chile's working classes, the institution distinguished itself by offering evening courses for port workers alongside traditional academic programs, embodying a mission to democratise higher education access.

This institution is affiliated with a religious denomination and maintains formal ties to its ecclesiastical structure, though it operates with a governance model that balances faith-based oversight with academic independence. The university is open to

individuals of all religious backgrounds and beliefs, reflecting a commitment to pluralism within its faith-based identity.

The university's role in Chile's transformative 1960s university reform movement cannot be understated. Student-led reforms originating within some of its faculties spread nationwide, establishing the institution as a catalyst for democratic change in Chilean higher education. This historical legacy underscores its influence beyond religious circles and its commitment to social transformation.

Currently serving approximately 17,000 students across nine faculties, this institution operates as a quasi-public entity, receiving substantial government funding as a member of Chile's traditional university system (CRUCH).

The Faculty of Engineering comprises eight departments that house over 6,000 undergraduate students enrolled in 19 undergraduate programs. The faculty also accommodates more than 300 graduate students pursuing advanced degrees through 12 Master's programs and 5 Doctoral programs. At the local level, the faculty's programs maintain moderate positioning without reaching the high selectivity levels characteristic of prestigious universities in the country's capital. The student population primarily originates from nearby cities, with the majority coming from public secondary education institutions.

3.4.2 Recruitment Procedure

For participant recruitment, I employed a strategic combination of institutional database access and snowball sampling (Creswell, 2009; Mason, 2002; Taylor et al., 2016), facilitated by multiple levels of gatekeepers, “ individuals who control access to something or someplace” (Lapan et al., 2012, p. 168), within the university structure.

At the institutional level, senior university administrators served as primary gatekeepers by authorising access to student data, enabling the Director of

Institutional Research, who acted as a critical intermediary gatekeeper, to provide access to a database of students meeting the established selection criteria.

At the departmental level, Engineering Department Chairs functioned as secondary gatekeepers, leveraging their knowledge of the student population to assist in the preliminary identification of potential participants. Initial contact was established through institutional email communications with these pre-selected students.

The recruitment process then expanded through the snowball technique (Taylor et al., 2016), where interviewed participants suggested additional potential candidates from their peer networks. These multilayered gatekeeping relationships were essential in establishing research legitimacy and enabling access to participants through official institutional channels. At the same time, the snowball sampling technique was able simultaneously to capitalise on and reveal the connectedness of individuals in networks (Bryman, 2012).

3.4.3 Participants

My study involved 17 engineering students from diverse backgrounds and academic levels at a regional university in Chile. I used purposive sampling (Lapan et al., 2012) to select participants who met the following criteria:

1. Current enrollment in an engineering program at the selected university

2. At least a second-year standing to ensure some experience with the degree

3. Studying free of charge

4. Attendance at secondary schools with public funding

The purposive sampling criteria align closely with my research questions, focusing on engineering students from working-class and economically disadvantaged backgrounds in Chile, groups that remain underrepresented in engineering education globally (Baird, 2018; Espinoza et al., 2023; Pawley, 2019). By selecting

current students with at least second-year standing, I ensured participants had sufficient experience to reflect on their educational journey and develop a professional identity.

The criteria of studying free of charge and attending publicly funded secondary schools are strong indicators of a low-income background in the Chilean context. Free university tuition is available to students from the bottom 60% of household incomes (Ministerio de Hacienda, 2015; Salas & Gaymer, 2017), while attendance at public or subsidised schools is strongly associated with lower socioeconomic status.

Espinoza et al. (2023) define the Chilean working class using the National Statistics Socio-Economic Classification (NS-SEC) scheme, categorising social classes based on occupations and work relations. The working class includes those in lower supervisory, technical, semi-routine, and routine occupations, typically involving manual labour. The working class forms the third tier in a broader system, below the service class (managerial and professional occupations) and intermediate class (intermediate occupations and self-employed workers). This range of backgrounds enabled exploration of how working-class students navigate engineering, mobilise various forms of capital, and perceive education as a means for social mobility.

The sample size was determined based on data saturation (Guest et al., 2020). I continued interviewing until no new significant themes were identified in the data.

As shown in Table 3.1, the participants represented various engineering specialities. To maintain confidentiality, I used a letter coding system to refer to each department or speciality within the School of Engineering. This approach protected participants' identities by ensuring their specific engineering disciplines could not be identified. Rather than naming actual departments, I assigned each department a letter designation (e.g., Department A, Department B) throughout the analysis. This anonymisation strategy was fundamental given some departments' relatively small size, where identifying the department and specific student characteristics might

have made individual participants identifiable. The letter coding system allowed me to discuss department-specific aspects of student experiences while preserving participant confidentiality and adhering to ethical research standards. The gender distribution was nine females and eight males, with ages ranging from 20 to 28 at the time of the interviews.

Table 3.1 Sample Demographic information

Interviewee	**Sex**	**Age(*)**	**Engineering Speciality**
Student 1	male	22	A
Student 2	male	23	A
Student 3	male	24	A
Student 4	female	28	A
Student 5	female	23	A
Student 6	female	20	B
Student 7	female	24	C
Student 8	female	22	A
Student 9	female	23	D
Student 10	female	24	D
Student 11	male	24	E
Student 12	male	25	E
Student 13	male	24	F
Student 14	male	27	F

Student 15	female	22	G
Student 16	male	22	H
Student 17	female	23	H

(*) At the time of the interview

This diverse sample allowed for a rich exploration of experiences across different engineering disciplines and backgrounds, aligning closely with my research questions about capital mobilisation, barriers and support, and understanding the engineer's role in the Chilean context.

3.5 Data Collection

3.5.1 Semi-structured Interviews

I selected semi-structured interviews as my primary data collection method. These interviews are commonly used in qualitative research (Bryman, 2016; Edwards & Holland, 2013; Taylor et al., 2016). Their key feature is the interactive process between researchers and informants addressing research-relevant questions (Flores, 2014). Taylor et al. (2016, p. 102) define these as "face-to-face encounters between the researcher and informants directed toward understanding informants' perspectives on their lives, experiences, or situations as expressed in their own words." According to Edwards & Holland (2013), citing Mason, qualitative interviews feature interactional dialogue, a thematic yet flexible approach, and knowledge understood as situated and contextual.

Qualitative interviews allow for gathering in-depth, nuanced information through open-ended questions and detailed descriptions (Kvale, 2007). These interviews focus on exploring the interviewee's experiences, feelings, and actions rather than quantifying data. The goal is to obtain rich, descriptive accounts of the interviewee's perspectives and life world. In my research, I found interviews particularly useful for

exploring the complex experiences of engineering students. By conducting semi-structured interviews, I could delve into topics that would have been difficult to observe directly, such as students' motivations, challenges, and personal growth throughout their academic journey.

A semi-structured interview is a research method where the interviewer uses a flexible questioning approach. While guided by a pre-planned set of topics and questions (Bryman, 2012), the interviewer can modify the sequence and add probing questions based on the participant's answers (Qu & Dumay, 2011). The questions are typically broader than in structured interviews, and the format allows for a more natural conversation flow while maintaining focus on the research objectives.

Qualitative research interviews offer benefits and challenges (Creswell, 2012; Flores, 2014). One key advantage is their ability to provide valuable insights when direct observation is not feasible, allowing participants to share detailed personal experiences. Interviewers can also steer the conversation more effectively than observers, asking specific questions to elicit targeted information.

However, interviews are not without drawbacks (Creswell, 2009; Flores, 2014). These limitations can be divided into three categories (Flores, 2014): limitations from the technique, the interviewee, and the researcher.

Interview technique limitations encompass time consumption, location constraints, costs, and geographical restrictions (Adhabi & Anozie, 2017). These factors can potentially narrow the scope of interviews and limit participant diversity, thereby impacting research findings. As the research was conducted during the Pandemic, I employed remote video conferencing as the primary interview method in this study. This approach proved advantageous in mitigating traditional limitations (Upadhyay & Lipkovich, 2020). It offered enhanced flexibility, cost-effectiveness, and the ability to include participants from diverse locations (Archibald et al., 2019), thereby broadening the reach and depth of the research. This issue will be addressed in more depth later on.

Interviewee limitations stem from filtering information through participants' perspectives and articulation abilities. Understanding becomes challenging when cultural backgrounds differ (Qu & Dumay, 2011). During my research, I tailored approaches to each participant's communication comfort, with some providing succinct responses requiring additional prompts. Contrary to expectations, confidentiality concerns were not the primary reason for brevity. Research indicates engineering students often struggle with oral communication skills (Shukla, 2024; Soto et al., 2024), particularly those from rural backgrounds who experience reticence, anxiety, and language proficiency issues that impede effective communication.

Technical challenges can also arise (Creswell, 2012), necessitating careful recording and transcription equipment preparation before the interview. During the interview, researchers must balance active listening with managing the conversation, which may involve handling emotional outbursts, using icebreakers, or knowing when to remain silent to encourage participants to elaborate.

As a relatively novice researcher, I initially underestimated the complexity of effective interviewing. I quickly learned that the process requires technical preparation, interpersonal skills, and the ability to adapt to unexpected situations during the conversation. Despite these challenges, I found that when conducted effectively, interviews are a powerful tool for gathering rich, nuanced data in qualitative research, providing invaluable insights into the lived experiences of engineering students.

3.5.2 Rapport in qualitative interviews

Rapport is crucial in qualitative interviews, fostering effective communication and enhancing data quality (Schmid et al., 2024). This becomes especially important when working with vulnerable populations like low-income engineering students, where creating a safe environment encourages open sharing of experiences and challenges.

Building rapport requires careful balance to navigate ethical tensions, ensuring students feel respected without overstepping boundaries (Schmid et al., 2024). How rapport evolves throughout the research process significantly influences data depth and quality, affecting how students share their experiences of navigating engineering education (Shahri, 2023). Given the potential cultural differences between low-income students and the dominant engineering culture, understanding and bridging these gaps through rapport is essential (Wilson et al., 2022). Strong connections allow researchers to access students' emic perspectives, providing crucial insights into their experiences of capital mobilization and identity formation. Discussing sensitive topics like financial struggles requires thoughtful rapport-building to ensure comfort in sharing personal stories (Waterhouse et al., 2023).

As a researcher, I implemented several strategies to establish strong connections with participants. I began each interview by introducing myself, explaining the study's purpose, and emphasising the value of their unique perspective. Adopting a conversational tone and sharing some of my engineering student experiences created common ground. Throughout interviews, I practised active listening (Qu & Dumay, 2011; Roulston et al., 2003), demonstrating genuine interest through verbal and non-verbal cues while remaining attentive to discomfort signals. When addressing sensitive topics, I framed questions respectfully and allowed students to share at their own pace. I ensured confidentiality and gave participants control over the process, reminding them of their right to skip questions or take breaks as needed. By consistently demonstrating empathy, respect, and cultural sensitivity (Au, 2019; Bayeck, 2021), I created an environment conducive to authentic sharing of experiences and perspectives.

During the pandemic, conducting online interviews presented distinct opportunities and challenges in demonstrating empathy and cultural sensitivity, particularly towards individuals facing adverse socio-economic conditions. It required considerable thought about digital equality and the personal implications of such an intrusion into participants' homes through virtual platforms.

I knew right away that participants who did not have much money or were concerned about their home environment might struggle with using cameras, so I made it completely optional. I made this choice because filming people on camera could make some individuals from marginalised backgrounds feel uncomfortable or left out. I changed the way I did interviews so that people in remote areas with slow internet connections could only hear the audio. This kept the network from getting too busy, which could have made the interviews less good.

Due to the pandemic, many participants had to be flexible with their plans because they were confined with their extended family. I rearranged my schedule to accommodate interviews at unusual times, including early mornings, late evenings, and weekends. I wanted to find times when the students could talk in private without worrying that family members would overhear them discussing sensitive subjects.

When participants apologised for background noise, interruptions, or technical problems, I assured them that these issues occur frequently and that their participation remains important, despite these distractions. I made it clear that I was learning from them, not telling them what to do. I rephrased terms or ideas in simpler language when participants looked confused, but I did not make anyone feel bad. This protected their dignity and made sure they understood.

I began each interview with some small talk so that the participants could become accustomed to the equipment before we discussed the study topics. I thanked them for being kind enough to let me virtually visit their homes, but I did not mention anything about noise or family issues. I thought these were safe places to be online.

3.5.3 Interview Guide

I considered individual interviews the most appropriate method for gathering data in this study, as they would facilitate a thorough investigation of individuals' personal life experiences (Bryman, 2016). I conducted these interviews using open-ended

questions and prompts, allowing participants to share their stories and insights in their own words.

I developed an interview guide based on my literature review and theoretical framework. It aligns closely with the themes and concepts I discussed in the literature review, particularly focusing on capital accumulation and mobilisation, challenges and barriers and professional identity formation.

The interview guide is structured to address the main research question and its three sub-questions, exploring how engineering students from disadvantaged backgrounds in Chile perceive and experience their education as a means of promoting social mobility.

Throughout the interview, questions about how students' perspectives have changed over time address the main research question about how they see and experience their education as a means of promoting social mobility.

Table 3.2 shows the association between the literature review and the interview guide.

Table 3.2 Research question and interview guide

Research Question	**Interview Guide Themes**	**Literature Themes/Topics**	**Related Authors**
Main Question: How do engineering students from disadvantaged backgrounds in Chile see and experience their	Overall university experience Perceptions of change over time Reflections on future opportunities	Social mobility through education Habitus transformation Educational aspirations of	Reay et al. (2009); Lehmann (2014); Archer et al. (2003)

education as a means of promoting social mobility?		disadvantaged students	
Sub-question 1: What forms of capital do students mobilise in their trajectory towards gaining an engineering degree?	Family background and education history Decision to enter university and choose engineering Comparisons with peers Key influential people	Cultural capital Social capital Capital mobilisation strategies Field-specific capital in engineering	Bourdieu (1986); Bathmaker et al. (2013); Martin et al. (2013); Gopaul (2015)
Sub-question 2: What barriers and support do they experience as related to their success?	Initial impressions and sense of belonging Critical events or periods during university Perceptions of equity in society Comparative strengths and weaknesses for job prospects	Institutional habitus Barriers in STEM education Support systems in higher education Social class and educational experiences	Thomas (2002); Seymour & Hewitt (1997); Tinto (2006); Granfield (1991)

Sub-question 3: How and why do these students understand the role of the engineer, and come to inhabit it?	Reasons for choosing engineering Personal changes attributed to university experience Perceptions of future opportunities Reflections on their place in the world	Professional identity formation Engineering culture and values Career aspirations in engineering Socialisation in engineering education	Tonso (2006); Faulkner (2007); Cech et al. (2011); Stevens et al. (2008)

3.5.4 Online Interviews

I conducted the interviews during the COVID-19 pandemic. In that period, Chile's education system faced severe challenges. The transition to distance learning created disparate experiences among students and schools, while prolonged school closures significantly impacted the system (Bellei & Contreras, 2024). Due to the closure, I conducted the interviews remotely using video conferencing tools, primarily Zoom. This decision was based on both the necessity and the potential benefits of online interviews, as outlined by researchers such as Archibald et al. (2019) and Iacono et al.(2016).

Internet-based technologies are increasingly used in research, offering various tools, from asynchronous platforms like e-mail to synchronous videoconferencing platforms like Skype or Zoom. These technologies provide several advantages: reaching participants without geographical limitations (Iacono et al., 2016; Seitz, 2016), increasing sample diversity (Upadhyay & Lipkovich, 2020), democratising

the research process (Iacono et al., 2016), facilitating inclusion of hard-to-reach or stigmatised groups (Upadhyay & Lipkovich, 2020), and reducing time and financial costs (Archibald et al., 2019; Seitz, 2016).

Online interviews proved invaluable for my research with engineering students across Chile during the pandemic. This approach enabled engagement with participants from diverse geographic locations while ensuring their safety at home during lockdowns. Additionally, the flexibility in scheduling accommodated students juggling academic responsibilities and family duties in shared living spaces.

For privacy concerns, students could choose optimal interview times or use headphones. I adapted to varying internet connectivity issues by offering audio-only options when the video was unstable, while recording capabilities facilitated later analysis. When synchronous communication proved challenging, I provided asynchronous follow-up options. This flexible approach enabled productive interviews while respecting students' complex living situations and technological constraints during this unprecedented time.

I implemented research-recommended practices to address the challenges of online technologies (technical issues, digital exclusion, and rapport concerns). Following Iacono et al. (2016) and Seitz (2016), I emphasised establishing rapport and capturing non-verbal cues by closely monitoring facial expressions and tone.

As suggested by Archibald et al. (2019), I provided clear instructions on using the video conferencing platform and conducted test calls to ensure technical quality. When connectivity issues arose, I offered alternative communication methods, aligning with Bampton & Cowton's (2002) recommendation to use complementary technologies when needed. Throughout the process, I maintained ethical standards by following procedures for informed consent and data protection, as emphasized by Iacono et al. (2016).

I conducted the interviews over a specific period, lasting between 60 and 90 minutes. Before each interview, I ensured that students read and signed an informed consent form. With the participants' permission, I audio-recorded the interviews. I transcribed these recordings verbatim and carefully anonymised the transcripts to protect the participants' identities.

3.6 Data Management

3.6.1 Ethical Considerations

Ethical considerations are of particular importance to researchers in education (Atkins & Wallace, 2015).

As a staff member at the university where the study took place, I was aware of the potential power dynamics and ethical considerations this position entailed. To address this, I:

1. Clearly communicated to participants that their participation (or non-participation) would not affect their academic standing or relationship with the university.

2. I clearly established my role as a researcher, distinct from my position as a lecturer in the university, and ensured participants understood that I had no current teaching relationship with them nor would I be involved in their future coursework.

3. Encouraged participants to speak freely and honestly, assuring them of the confidentiality of their responses.

In qualitative interviews, power dynamics can be complex as the researcher typically controls the conversation (Karnieli-Miller et al., 2009). The interviewer initiates the interview, sets the agenda, controls the guide, and decides when to end the conversation, which can create power imbalances. Participants can influence the discussion by shifting focus or deciding to terminate the interview, impacting power dynamics.

This commitment to power redistribution raises ethical dilemmas and methodological challenges, which can be addressed using a conceptual frame for reflexivity across different research stages. In my research, I applied the conceptual framework that Karnieli-Miller, Strier, and Pessach (2009) proposed to address power dynamics across the different stages of my qualitative study. The authors propose a developmental framework that views power dynamics in qualitative research as fluid rather than static, shifting across five key research stages. Researchers hold primary control in the initial recruitment stage through how they present the study and manage information disclosure, though participants can negotiate for greater transparency. During data collection, power shifts as researchers depend on participants' willingness to share experiences, requiring careful navigation of relationship-building without manipulation.

The dynamic shifts again during data analysis and report production, with control returning to researchers who must balance scholarly interpretation with ethical representation of participant voices. The validation stage may involve re-engaging participants to review findings, creating another power shift. In contrast, the final stage of additional publications raises questions about long-term data ownership and control.

Here is how I incorporated their framework:

1. Initial stage of participant recruitment:

I was transparent about the goals and nature of the study when recruiting engineering students as participants. I provided clear information about participation and how the data would be used, allowing for informed consent (Atkins & Wallace, 2015). Documents are provided in Appendices One and Two. At the same time, I acknowledged the power imbalance inherent in my control over the recruitment process and the information shared.

2. Data collection:

During the interviews, I aimed to create a welcoming, non-threatening environment that encouraged participants to share their experiences (Schmid et al., 2024). I built rapport while remaining aware of the power dynamics at play, such as my role in setting the agenda and controlling the interview guide. I gave reminders about the study's objectives and publication plans, especially during more personal parts of the interviews.

3. Data analysis and report production:

After data collection, I took full responsibility for analysing and interpreting the participants' stories. I carefully decided what parts of the analysis to share with participants, weighing the potential benefits and risks. I committed to representing their voices accurately and protecting their anonymity (Fink, 2000; Mason, 2002) in my writing. I carefully reviewed, cleaned, and anonymised interview transcripts to protect the participants' identities.

4. Validation:

I engaged in member checking (Ahmed, 2024), sharing identified themes and interpretations with a few participants to enhance the findings' trustworthiness. However, I remained aware of the challenges this could pose (Anastas, 2004), such as participants' discomfort with how they were represented or the impact on researcher-participant relationships, especially given the sensitive nature of some disclosures.

5. Additional publications:

As I pursued further publications based on the data, I reflected on questions of data ownership and my ongoing ethical obligations (Anastas, 2004; Qu & Dumay, 2011; Taylor et al., 2016) to participants. I recognised that while participants consented to the initial study, they may not have fully anticipated how their data could be used in the future, requiring my continued discretion and care.

Throughout the research process, I engaged in ongoing reflexivity, examining and re-examining my reasons for conducting the study and its potential impacts on participants and their communities. By making my methodological and ethical decision-making transparent in my writing, I aimed to be accountable to my participants, myself, and the academic community.

3.6.2 Translation

This study involves collecting data in Spanish and presenting findings in English, requiring careful consideration of translation-related decisions that could impact validity (Birbili, 2000). Addressing translation issues depends on the researcher's epistemological position and conditions concerning specific languages, including power dynamics between languages (Temple & Young, 2004).

From an objectivist perspective, the primary concern is how translation may introduce bias. This view focuses on "correct" interpretations, ethics, and neutral stances. However, from a social constructionist or interpretative approach, the researcher's positionality in translating and the power relationships within research must be acknowledged, as there is no genuinely neutral position (Temple & Young, 2004).

As both a researcher and translator, my background influences the translation process. While I have in-depth knowledge of the organizational culture, my social and cultural background may differ from participants, potentially impacting conceptual equivalence between languages (Birbili, 2000).

To address these challenges, I implemented several strategies:

1. Making translation decisions explicit:

For technical terms like "propedéutico", I would document my decision to keep it in Spanish and provide an explanation, as it refers to a specific Chilean educational program without a direct English equivalent.

2. Piloting the research instrument:

I conducted pilot interviews in Spanish with Chilean engineering students to refine question-wording and identify potential cultural misunderstandings.

3. Using back-translation:

For a concept like "vendedor ambulante" (student 16), I would use back-translation to capture the whole meaning. The initial translation might be "street vendor," but back-translating this to Spanish could reveal nuances that might be lost, such as the informal or sometimes precarious nature of this work in Chile. This process would help refine the English translation to "informal street vendor" or "itinerant seller," depending on the context.

4. Consulting with bilingual peers:

Consulting with bilingual peers would be particularly useful for colloquial expressions like "flaite" [4] (student 16) or "pesado"[5] (student 09), ensuring their connotations are accurately conveyed in English.

5. Balancing literal and free translation of quotes:

Original Spanish: "Me di cuenta que esto no es la media, que no es para nada fácil y si no estudio me va a ir mal." (student 12)

Literal translation: "I realised that this is not the intermediate, that it is not at all easy, and if I don't study, it will go badly for me."

[4] Low class person who tends to display aggressive behavior and speak in a vulgar manner

[5] Someone annoying or bothersome

Final translation: "I realised this isn't like high school. It's not easy in the slightest, and if I don't study, I'm going to struggle."

In this example, "la media" (literally "the intermediate") is a Chilean colloquialism for high school. The final translation captures the meaning and tone of the original statement while making it more comprehensible to English readers unfamiliar with Chilean expressions. This approach preserves the meaning while making it more natural in English.

By implementing these strategies, I aimed to enhance the validity and cultural sensitivity of the translation process while acknowledging my positionality as a researcher translator.

3.6.3 Transcription

Data management in qualitative research often involves transcription to organise and prepare the data for analysis (Creswell, 2009). Although the transcription step of the interviews is central to qualitative research, it has been studied superficially (Halcomb & Davidson, 2006; Oliver et al., 2005). Transcription practices vary in a continuum between two main views of the representation of language (Oliver et al., 2005): naturalism and denaturalism. In the former view, language represents the real world; "the transcript reflects a verbatim depiction of speech" (Oliver et al., 2005, p. 1); hence, everything is transcribed with detail. On the other end, the denaturalism view highlights that reality is constructed through meanings and perceptions within speech, so idiosyncratic elements of speech (e.g., stutters, pauses, nonverbals, involuntary vocalisations) are removed in the transcription process.

I transcribed all interviews, viewing this process as an important first step in data analysis. In my research, I opted for a balanced approach between naturalism and denaturalism in transcription, aligning with my research methodology and theoretical basis. I used the reflexive, iterative data management process (Halcomb & Davidson, 2006). I aimed to capture the essence of participants' experiences while

ensuring readability and focus on content relevant to my research questions. This approach was suitable due to my familiarity with the context of engineering education and the focus on thematic content rather than linguistic nuances. My process included:

1. Audio recording interviews and taking concurrent notes (Halcomb & Davidson, 2006; Rutakumwa et al., 2020)
2. Reflective journaling[6] (Borg, 2001; Engin, 2011) immediately post-interview (R. E. Roberts, 2020)
3. Listening to recordings (Bryman, 2012) and revising notes
4. Preliminary content analysis (Bryman & Burgess, 2002; Taylor et al., 2016)
5. Secondary content analysis (Halcomb & Davidson, 2006)
6. Thematic review (Halcomb & Davidson, 2006; K. Roberts et al., 2019)

This method allowed me to engage deeply with the data while being time-efficient. For example, when transcribing student 3's interview, I noted key themes like financial challenges and adaptive strategies in my reflective journal. During secondary analysis, I identified connections between these themes and theoretical concepts like economic and social capital.

I made conscious decisions about transcription details. For instance, I included pauses and tone changes when they significantly impacted meaning, such as when student 17 hesitated before discussing gender dynamics in her program. However, I omitted minor speech disfluencies that did not alter the content's substance. This approach enabled me to focus on the rich content of students' narratives while maintaining the authenticity of their voices, which is crucial for my analysis of their experiences in engineering education.

[6] Example of journal entry in Appendix Four

3.6.4 Coding Process

This study's coding process combined theory-driven and data-driven approaches, as recommended by DeCuir-Gunby et al. (2011). This allowed me to apply predetermined codes based on the theoretical framework while systematically analysing the data to identify new patterns and themes that were not initially anticipated in the theoretical framework.

For theory-driven codes, I followed these steps:

1. Generating codes based on guiding theories. Example: I created the code "Cultural Capital" based on Bourdieu's concept, defining it as "Knowledge, skills, and attitudes that provide advantages within a specific field."
2. Reviewing and revising codes in the context of the data. Example: After initial coding, I refined the "Cultural Capital" code to include subcategories such as "Embodied Cultural Capital" and "Institutionalised Cultural Capital" to capture the nuances in the data better.
3. Determining the reliability of the codes. Example: I coded a sample of interviews independently and then compared my coding with a colleague to ensure consistency in applying the "Cultural Capital" code.

For data-driven codes, I followed this process:

1. Reducing raw information. Example: I identified recurring phrases or ideas in the interviews, such as students frequently mentioning "feeling out of place" in engineering classes.
2. Identifying subsample themes. Example: I noticed that first-generation students often discussed challenges in navigating university systems.
3. Comparing themes across subsamples. Example: I compared the experiences of first-generation students with those from engineering family backgrounds to identify similarities and differences.

4. Creating codes. Example: I created a new "Institutional Navigation" code to capture students' experiences with university systems and processes based on these comparisons.
5. Determining the reliability of the codes. Example: I applied the "Institutional Navigation" code to a new set of interviews and discussed the results with my research team to ensure consistent application.

I developed a codebook (Appendix 3) that outlined key theoretical concepts, their descriptions, and examples from the data. An extract from the codebook is shown in Table 3.3.

Table 3.3 Example from Codebook (for Code: Economic Capital)

Code	**Subtheme**	**Description**	**Student Quote**
Economic Capital	Financial Aid	Access to scholarships, grants, and free tuition programs	"I could enter university and work on the weekends, but when the gratuity was approved, it was a great support." (Student 3)
Economic Capital	Part-time Work	Balancing work and study to finance education	"It was tough because I was economically responsible at home... I had to work full time to cover the house expenses." (Student 4)
Economic Capital	Family Support	Financial assistance from family members	"We had to sell our apartment. With that money, we paid off a couple of debts, and everything was happening in favour of moving here." (Student 6)

Following DeCuir-Gunby et al.'s (2011) recommendation, I coded at the "level of meaning." For example, when a student discussed their family's reaction to their choice of engineering, I coded the entire narrative as "Family Influence" rather than coding individual sentences.

I used NVivo 12 and MAXQDA software to manage and organise the data. This allowed me to efficiently code, retrieve, and analyse the large volume of interview data and visualise relationships between codes and themes.

This combination of deductive and inductive approaches enhanced the rigour and richness of the analysis, allowing for both theory testing and potential theory development within the specific context of Chilean engineering education.

3.7 Data Analysis

This section outlines the process used to analyse the qualitative data from interviews.

The analysis of the qualitative interview data in this study primarily employed a deductive approach (Bingham, 2023), while also remaining open to emerging themes. This method, which combines the advantages of deductive analysis with the flexibility to capture unexpected insights, was particularly effective in this study. It provided a structured framework for organising and interpreting data, ensured alignment with existing theories, and allowed efficient analysis of large datasets while also allowing for the discovery of new and unexpected themes.

My approach partially followed the five-phase qualitative analysis process outlined by Bingham (2023) and also resembled Deductive Qualitative Analysis (DQA) as described by Fife and Gossner (2024). Both methods emphasise a systematic, transparent, and rigorous analysis process that enhances the dependability and trustworthiness of qualitative studies.

Beginning with the Organising the Data phase, I created an organisational schema through attribute coding, sorting interview transcripts and field notes into categories like "first-generation students" and "rural/urban background." This initial step was crucial for managing the large volume of data from Chilean engineering students. In the subsequent Topic Coding phase, I refined this schema, identifying key topics

such as "academic challenges" and "cultural capital in engineering education," which helped guide my inquiry and the analysis process.

The Open/Initial Coding phase took a more exploratory approach, allowing for unexpected insights. For instance, I discovered the significant role of pre-university "propedeutic" programs in shaping students' academic trajectories. During the Memoing phase, I recorded possible responses to research questions and organised supporting evidence, bridging coding and final analysis.

In the final phase, Applying Theory and Explaining Findings, I combined deductive and inductive practices, explaining findings through Bourdieu's cultural and social capital theories within the context of Chilean engineering education. This approach aligns with Braun and Clarke's (2006) reflexive thematic analysis, emphasising my active role in identifying patterns and themes.

Throughout the process, I remained open to new insights emerging from the data, balancing theory-driven analysis with unexpected findings. This flexibility allowed me to tailor the analysis process while maintaining standards for trustworthiness and dependability (Bingham, 2023). As Egbert and Sanden (2013) argue, such theoretical frameworks ensure that qualitative research is descriptive, explanatory, and insightful, contributing to the existing knowledge base on social reproduction in higher education and providing evidence-based recommendations for improving equity in Chilean engineering programs.

3.8 Limitations

While I have taken steps to ensure the rigour and credibility of this study, it is important to acknowledge its limitations:

1. The study focuses on students from one regional university in Chile, potentially limiting the transferability of findings to other contexts.

2. Online interviews may have impacted the depth of rapport built with participants and the richness of non-verbal communication.

3. Despite efforts to mitigate this effect, my position as a university staff member may have influenced participants' responses.

4. The translation of data from Spanish to English may have resulted in some loss of nuance or cultural specificity despite careful attention to this process.

3.9 Conclusion

In this chapter, I have outlined my qualitative, interpretive approach to exploring the experiences of engineering students from disadvantaged backgrounds in Chile. Grounding my research on Bourdieu's sociological concepts, I conducted semi-structured interviews with 17 diverse students from a regional university. Due to the COVID-19 pandemic, I adapted to remote data collection, which allowed for greater geographical diversity in my sample.

My analysis combined deductive and inductive approaches, employing both theory-driven and data-driven coding. To ensure the credibility of my findings, I implemented several strategies, including triangulation, member checking, and maintaining an audit trail. I paid careful attention to ethical considerations, particularly given my position as a staff member at the university, and addressed the challenges of conducting research in Spanish while presenting findings in English.

Throughout the research process, I maintained a reflexive stance, continuously examining my potential biases and influences on the study. While acknowledging limitations such as the focus on one university and the potential impact of online interviews, my methodology provides a rigorous and transparent account of the research process.

Chapter 4: Forms of Capital Mobilised in Engineering Students' Trajectories

4.1 Overview

This chapter addresses my first research sub-question: What forms of capital do students mobilise toward gaining an engineering degree? My analysis draws upon Bourdieu's theoretical framework (1986), examining how cultural, economic, and social capital influence educational possibilities for low-income students (Ingram, 2011; Reay, Davies, et al., 2001; Walpole, 2003).

I structure this chapter around Bourdieu's main types of capital, analysing how students accumulate and mobilise each type and how this shapes their educational experiences. This approach recognises that capital's impact depends on students' active engagement with and strategic use of these resources.

By focusing on students' agency in accumulating and deploying various forms of capital while acknowledging both constraints and capabilities within Chile's social structure, I aim to understand how these resources transform into advantages or challenges throughout university experiences. This dual focus contributes to the broader discussion on social mobility through higher education in Chile, moving beyond deterministic views that might only emphasise students' disadvantaged positions.

4.2 Economic Capital: Financial Resources Enabling Educational Pursuits

My analysis reveals diverse strategies students employ to mobilise and leverage economic capital in the face of socioeconomic challenges. These strategies demonstrate the agency and resilience of students in pursuit of their educational goals.

4.2.1 Leveraging Financial Aid and Support

In this section, I examine how students strategically utilise various forms of financial assistance to navigate their educational expenses and potentially transform their economic position. I metaphorically apply the concept of 'leveraging' to illustrate how low-income students maximise their educational opportunities by strategically using available resources to access higher education, which can later be converted into different forms of capital.

Everyone who participated in this study was eligible for and received “gratuidad” financing, which was necessary for them to attend engineering school. Chile's "Gratuidad" policy (Law 20.890) was passed in 2016 in response to large student protests in 2011, which called for affordable college education. Initially, the program was only for students from families in the bottom 50% of the income distribution; however, in 2018, it was expanded to include the bottom 60% (Ministerio de Hacienda, 2015). The Ministry of Education verifies the familial and socioeconomic information that students provide on the centralised application process to determine their eligibility for this funding. Gratuity eliminates copayments for tuition and enrollment fees for the standard duration of the degree. However, it doesn't cover living costs, graduation fees, materials, or any other costs. Not all higher education institutions take part in the program. They must meet accreditation standards and follow government procedures.

Student 3 noted:

"I could enter university and work on the weekends, but when the gratuity was approved, it was a great support."

This aligns with Haveman and Smeeding's (2006) emphasis on adequate financial aid for higher education access. In Bourdieusian terms, this represents converting economic capital into educational capital, potentially transforming later into other capital forms.

Economic capital impacts students beyond covering tuition. Student 16 explained that:

"paying bills and eating was more urgent than getting a good grade," while Student 4's family viewed him as "just another expense that did not involve income."

These constraints directly shape academic engagement and family relationships.

Broton and Goldrick-Rab (2018) and Paulsen and St John (2002) noted that housing costs significantly impact university attendance. Many students developed strategies to reduce these expenses. Student 7 shared:

"I'm from … [a city 1,700 km away from the University campus], where I was born (…) . Now I live with my grandparents, who are practically like my parents,".

While Student 6's family made significant sacrifices:

"We had to sell our apartment. With that money, we paid off debts, and everything was happening in favour of moving here.".

My findings support previous research (Hamilton, 2013; Roksa & Kinsley, 2019; Walpole, 2003), which found that family financial support enhances educational stability. Without this support, significant obstacles emerge, as Student 4 experienced:

"It was tough because I was economically responsible at home... I had to work full time to cover the house expenses."

Student 16 relied on government aid during the pandemic:

"We spent most of it on car payments and could only afford internet for classes - we had to stop paying utilities."

This illustrates Bourdieu's capital conversion concept (1986), transforming economic capital into educational capital to improve social position (N. Martin & Spenner, 2009), while highlighting how economic constraints require significant sacrifices to maintain educational opportunities.

The severe trade-offs required highlight how economic constraints fundamentally shape students' ability to acquire educational capital and pursue social mobility. The student's family demonstrates agency in their strategic resource allocation while simultaneously revealing how economic constraints limit their options and require significant sacrifices to maintain educational opportunities.

Table 4.1 presents an overview of the strategies I observed students employing to leverage financial aid and support.

Table 4.1 Strategies to leverage financial aid and support

Use of Economic Resource	**Specific Strategies**	**Student N°**	**N**
Tuition & Academic Fees	- Employee dependent benefits	1	3
	- Free tuition program	3	
	- Scholarship for studying abroad	14	
Housing & Living Expenses	- Living with extended family	7	4
	- Family financial support for relocation	6	
	- Living with family while commuting	17	
	- Shared housing through family connections	15	
Supplementary Support	- University psychological services	13	2
	- Government emergency aid	16	

This table categorises how students utilised financial resources across three areas: tuition and academic fees, housing and living expenses, and supplementary support. Housing strategies were most common (5 students), followed by tuition support (3 students) and supplementary services (2 students).

4.2.2 Balancing Work and Study

In this section, I examine how students accumulate and mobilize economic capital by balancing work and study. Through this approach, I observed students earning money while pursuing their studies, often making strategic decisions about allocating their time and resources.

My research aligns with Parra's (2021) findings that a significant percentage of university students in Latin American countries work while studying. Although all interviewees in my study benefit from free tuition due to their socioeconomic status, I found that 41% of respondents work part-time to accumulate economic capital for daily living expenses or to help their families.

I observed diverse strategies for accumulating and mobilising economic capital among working students. For instance, Student 14, a 27-year-old who began his studies in 2018, has worked and studied simultaneously throughout his university career. He explained his approach to accumulating economic capital:

"I started working and studying at the same time... The truth is that I don't drink, I don't smoke, I don't go out partying, so I have the time, and my friends are quite healthy too."

Student 16, a 22-year-old from a family of street vendors, demonstrated a different strategy for mobilising economic capital within the family unit. He described his family's collective approach:

"My mom right now is the economic pillar of the family. We are street vendors, I say 'we are' because the work is hers but at home, we all wake up at 5 in the morning to make sandwiches and be able to sell."

Despite challenging circumstances, Student 16 showed remarkable resilience in mobilising his limited economic and time resources:

"I stayed watching the recorded classes, even if I had to repeat them a thousand times until everything was clear. I took the tests and did well, which I am super proud of because nobody helped me, and I still did well."

Table 4.2 presents an overview of the work-study strategies I identified:

Table 4.2 Work-study Strategies

Use of Economic Resource	**Specific Strategies**	**Student N°**	**N**
Part-time Job	General part-time jobs	2, 4	2
	Multiple jobs	1, 3, 7, 14	4
	Family Business Work	16	1
Specialised Work Related to Studies	- University innovation program	2	2
	- University teaching assistant	7	
Flexible Work Arrangements	- Weekend work	4	3
	- Freelance work (private lessons, magician)	3, 7	

The table illustrates three main work arrangements students used to balance employment and education: part-time jobs, specialized work related to studies, and flexible work arrangements. Part-time jobs were most common (7 students total), with multiple jobs being the predominant approach (4 students). Specialized work

and flexible arrangements were less common but provided important alternatives for some students. This distribution shows how students adapted their work situations to their academic needs.

4.2.3 Reframing Economic Constraints as Opportunities

In this section, I analyse how students reframe their economic constraints as opportunities for growth and development, thereby accumulating and mobilising various forms of capital. This approach involves students mentally recasting their financial limitations as motivators or opportunities for personal growth.

Students reframed economic constraints through four approaches: personal growth from challenges (5 students), strategic career planning (2 students), lifestyle improvement (1 student), and family/community motivation (1 student). The prevalence of personal growth strategies suggests that students often find ways to view their economic challenges as opportunities for development rather than purely as obstacles.

Building upon O'Shea's (2016) research on first-in-family students, my analysis shows how students simultaneously transform different forms of capital. Student 3's reflection exemplifies this: "I never saw that as a disadvantage, but it was a motivation to show that you can also get ahead with public education. In addition, this was an advantage... since it allowed me to apply to a propaedeutic program for talented students from public schools." This builds upon Reay's (2005) observations while revealing how students construct experiences as distinctive capital forms. Student 2's experience illustrates developing entrepreneurial capital through event production:

"I think that what has changed me the most in that sense was when I was developing what I told you about event production. There, I was able to realise that one could try things."

Students demonstrated sophisticated long-term planning, viewing constraints as temporary conditions for future advancement. Student 16 explains:

"What moves me and keeps me firm, so to speak, is not the now but the future. It's saying, I'm going to be an engineer, and when I'm an engineer, I'm going to be able to earn a good salary."

Student 13 emphasized maintaining academic focus despite challenges:

"I don't know, just discipline. In 2017, I felt bad, but I still studied. I mean, even if you feel bad, you still have to do things."

These findings extend O'Shea's (2016) work by revealing how students' reframing of economic constraints encompasses the deliberate accumulation of various forms of capital. Student 14's experience shows how economic constraints catalyse multiple forms of capital development:

"Even though it's hard to work, study and support myself... I know what it's like when things don't go how you want, and I don't want the same for my brothers."

These findings extend Aries and Seider's (2005) research by revealing a more complex process where students deliberately transform constraints into opportunities for developing interconnected forms of capital, going beyond mere coping mechanisms.

Table 4.3 presents an overview of the reframing strategies I identified:

Table 4.3 Reframing Strategies

Reframing Strategy	**Specific Approaches**	**Student N°**	**N**
Personal Growth from Challenges	- Viewing economic limitations as	2	5

	entrepreneurial opportunities		
	- Developing discipline despite difficulties	13	
	- Viewing work-study balance as character-building	14	
	- Adapting to challenging commute	17	
	- Using public education as motivation to succeed	3	
Strategic Career Planning	- Planning emigration for better work prospects	12	2
	- Using financial struggles as motivation for future stability	16	
Lifestyle Improvement	- Viewing relocation as chance for better quality of life	6	1
Family and Community Motivation	- Studying to provide opportunities for others	14	1

4.3 Cultural Capital: Navigating the Field of Engineering Education

I examine cultural capital in students' engineering education pathways using Bourdieu's (1986) framework, which encompasses knowledge, skills, and education that provide advantages in educational institutions. As Aries and Seider (2005) note, this includes not only "highbrow" culture but also skills and knowledge of social norms.

Bourdieu's three-state model informs my analysis: embodied capital (internalised dispositions), objectified capital (material cultural goods), and institutionalised capital (formal qualifications). In my study, 65% of participants are first-generation university students from public or subsidised education backgrounds.

Students' cultural capital significantly influenced their engineering trajectories, supporting Lehmann's (2013) observation that acquiring cultural capital increases self-confidence and belonging for lower-income students. My analysis revealed five key strategies students employ:

1. Leveraging academic excellence and study habits
2. Accessing extracurricular opportunities
3. Participating in propedeutic programs
4. Navigating linguistic and communicative challenges
5. Leveraging work experience and practical knowledge

These approaches demonstrate students' resilience in pursuing educational goals despite socioeconomic challenges.

4.3.1 Capitalising on Academic Excellence

In this subsection, I examine how students accumulate cultural capital by building on their prior academic achievements and successes. This might involve leveraging their strong academic background to access advanced courses or opportunities in their engineering program.

All students except students 1 and 15 showed this strategy.

Students' cultural capital, particularly academic achievement and scientific knowledge, plays a significant role in their educational trajectories. This aligns with Bourdieu's concept of cultural capital and its impact on educational success (Bourdieu, 1986). Students' ability to mobilise their cultural capital, particularly their

study habits and academic skills, contributes significantly to navigating university programs (Crozier et al., 2008).

Student 8's experience exemplifies how the "good student" label can shape self-perception and relationships within the educational environment. She states, "I was the one who did the best. [...] I stood out in school." This cultural capital facilitated positive relationships with teachers but also led to challenges with peers: "...there were also some classmates [...] who gave me a hard time for being the best.". This is consistent with academic literature (Aries & Seider, 2007) about how academic strengths were viewed as a form of capital that could be leveraged to overcome socioeconomic barriers.

The mobilisation of cultural capital extends to university studies. Student 17, who attended a prestigious public high school, notes, "Physics was always good for me in high school, sciences and mathematics, I also did relatively well [...] which helped me in the first years [of university]." . This strategy confirms what is reported in academic literature (Aries & Seider, 2007). Low-income students often choose majors and programs aligned with their academic strengths, seeing these as pathways to future financial stability. These students tended to be more strategic in their program choices, considering both their abilities and potential career outcomes. However, cultural capital has its limitations. Despite her strong academic background, Student 17 experienced a disconnect with her chosen field: "The truth is that I entered [the program], and I never liked the career." This highlights that while academic achievement is valuable, other factors, such as personal interests, also play crucial roles in shaping educational experiences. The influence of family background is also evident, as in Student 17's case, where her father is an engineer, representing a form of institutionalised cultural capital (Bourdieu, 1986).

The following table summarises the identified academic excellence strategies.

Table 4.4 Academic Excellence Strategies

Strategy	**Specific Approaches**	**Student N°**	**N**
Overall Academic Strength	- Consistent high performance across subjects	2, 3, 5, 7, 8, 9, 12	7
	- Recognition and awards	3	1
STEM Proficiency	- Excellence in mathematics	6, 10, 13	3
	- Strong performance in scientific subjects	16, 17	2
Strategic Academic Application	- Leveraging academic strengths for program choice	11	1
	- Adapting prior knowledge to university demands	4	1
Institutional Advantage	- Benefiting from prestigious high school education	14	1

4.3.2 Accessing Enrichment Opportunities

In my research, I found that students accumulate cultural capital through participation in various enrichment opportunities. These experiences, including preparatory programs, extracurricular activities, and additional courses, provide students with knowledge, skills, and dispositions valued in higher education and

engineering. Student 1's propedeutic[7] program experience demonstrates how such opportunities facilitate cultural capital accumulation: "I think what helped me feel comfortable was the fact that I participated in the propedeutic program and visited the university buildings (...). It was like to be inserted into university life without necessarily being within the university." This exposure developed familiarity with academic environments and norms.

Similarly, Student 3's participation in the Beta[8] program built subject-specific capital: "I was there from sixth grade to fourth year of high school. Then the modality was that we had classes on Fridays and Saturdays during the year and two weeks during the summer." Student 17 developed valuable soft skills through leadership: "In high school, I was like an average student; I did not study as much as I did in university and was always class president or group leader. I belonged to the student council."

These experiences align with Bathmaker et al.'s (2013) findings on how extracurricular activities enhance students' capital by developing employability skills. However, access to these opportunities isn't equally distributed, supporting Snellman et al.'s (2015) research on widening socioeconomic gaps in extracurricular participation.

[7] A propedeutic program is an educational initiative designed to promote the integration of talented students from vulnerable backgrounds into university life. These programs specifically target high school students who have demonstrated strong academic achievement despite their disadvantaged socioeconomic contexts.

[8] BETA is an extracurricular enrichment program initiated by a specific university that runs parallel to and complements secondary formal education. It aims to strengthen the potential of students with high intellectual ability, fostering the expression of academic talent.

Through Bourdieu's lens, these opportunities function as spaces for accumulating embodied cultural capital - knowledge and dispositions valued in academic contexts (Lareau & Weininger, 2003; Reay, 2004b). Students gain academic knowledge and less tangible aspects like institutional familiarity and confidence (Lehmann, 2013). While potentially levelling the playing field in higher education (Dumais & Ward, 2010), uneven access may reproduce existing inequalities (Hassani & Ghasemi, 2016; Kraaykamp & Van Eijck, 2010).

Table 4.5 presents an overview of the enrichment strategies I identified:

Table 4.5 Enrichment Strategies

Strategy	**Specific Approaches**	**Student N°**	**N**
Extracurricular Activities	Student council, sports, debate, music, photography	1, 2, 5, 6, 7, 12	6
Bridge Programs	Beta program, propedeutic program, pre-university courses	1, 3, 8, 13	4
Additional University-Offered Courses	Math preparation classes, professional skills courses	9, 15	2

These enrichment opportunities serve as crucial mechanisms for accumulating cultural capital, particularly for students from disadvantaged backgrounds. Extracurricular activities (6 students) were more common than bridge programs (4 students) and additional university courses (2 students), suggesting students found these more accessible or valuable.

4.3.3 Developing Language and Communication Skills:

Students in my study focused on improving their academic writing, presentation abilities, and overall communication skills. This accumulation of linguistic capital is

crucial for success in academic and professional engineering contexts (Bourdieu, 1993).

Student 15's experience exemplifies the challenges and growth in linguistic capital. Initially struggling with academic communication, she noted:

"It's difficult for me to write reports and texts. Also, even though I am not so shy anymore, it is tough to present in front of a class."

However, she developed coping strategies and acquired cultural capital through university experiences, later recognising her improvement:

"Now I can answer with reasoning." Her friends played a crucial role: "They made me participate when I was in a corner... and in the end, it happened that I participated by myself and that I could talk to other people who were not my friends." .

This aligns with literature suggesting low-income students often struggle with linguistic capital in academic contexts (Uccelli et al., 2015).

Student 3's journey further illustrates the acquisition and challenges of linguistic capital. His gradual improvement in classroom participation demonstrates the accumulation of this crucial form of capital:

"Now I can express myself, and I can talk to other people who are not my friends. It happened gradually but was very good, and I even liked it."

However, he also faced English language proficiency challenges:

"I felt at a disadvantage concerning the English language proficiency that some of my classmates had...".

In the Chilean context, Spanish is the primary language of instruction and students' first language. However, English proficiency represents a form of cultural capital valued in engineering education, particularly for accessing international literature,

participating in exchange programs, and future career opportunities. Student 3's reference to feeling “at a disadvantage concerning the English language proficiency that some of my classmates had” reflects differential access to English language education, which is often superior in private schools attended by wealthier students. This experience resonates with Schroedler's (2017) argument that foreign language skills constitute a valuable form of linguistic capital, particularly in globalised contexts and fields like engineering.

Despite initial challenges, Student 3's focus on developing other forms of cultural capital, such as technical knowledge and teamwork skills, demonstrates the multifaceted nature of cultural and linguistic capital in higher education. His growing sense of professional identity is evident:

"The truth is that I feel quite capable of getting a job where I feel happy and professionally rewarded..."

In Table 4.6, there is an overview of language and communication strategies I found.

Table 4.6 Language and Communication Strategies

Strategy	**Specific Approaches**	**Student N°**	**N**
Public Speaking	Presentations, debates, discussions	1, 2, 3	3
Interpersonal Communication	Interacting with diverse age groups, leadership roles	4, 6, 12	3
Academic Expression	Improving articulation of ideas, technical discussions	5, 10, 15, 17	4
Language Skills	Enhancing English proficiency	14	1

Overcoming Personal Barriers	Working on shyness, increasing participation	3, 5	2

The table identifies five approaches to developing communication skills: public speaking (3 students), interpersonal communication (3 students), academic expression (4 students), language skills (1 student), and overcoming personal barriers (2 students). The distribution shows that students focused more on academic and interpersonal communication than on specific language skills or personal barriers.

4.3.4 Leveraging Strong Study Habits

In my research, I found that students apply effective study techniques and time management skills they have developed over time to excel in their coursework and manage the demands of their engineering program. This mobilisation of cultural capital is crucial for their academic success. Analysing this data through the lens of Bourdieu's (1986) concept of embodied cultural capital, I interpret strong study habits as long-lasting dispositions of the mind and body that students leverage in higher education. The prevalence of effective study techniques employed by ten out of the seventeen students in my study underscores the significance of this form of cultural capital in engineering education.

Student testimonies provide rich insights into how learners mobilise these habits. For instance, Student 2's comment, "I've always liked studying a lot, for pleasure rather than obligation... At least I maintained it over time," reveals a long-standing positive attitude towards studying. This disposition aligns with Bourdieu's notion of embodied cultural capital, suggesting that Student 2's habitus, their internalised patterns of thought and behaviour, predisposed them to academic engagement.

The emphasis on organisation and systematic approaches is another key finding. Student 3's methodical approach, "I was systematic concerning each class, I said okay! I will have a Word file to take notes in each subject I have," demonstrates how

students operationalise their study habits. Similarly, Student 6's statement, "I feel superior in a way because I learned to organise myself and keep things up to date," indicates not only the presence of strong organisational skills but also a metacognitive awareness of their value - a form of cultural capital that likely enhances their academic performance.

The transition from high school to university emerges as a critical period in my analysis. Student 8's experience, "In general, I felt that my first year of university was easier than in school because they demanded a lot from me in school," aligns with research by Briggs et al. (2012) and Crede & Kuncel (2008) on the importance of pre-existing study habits in easing this transition. This finding suggests that the cultural capital accumulated in secondary education can significantly influence students' initial experiences in higher education.

While my research confirms the well-established link between study habits and academic achievement (Crede & Kuncel, 2008), it's important to note the complex relationship between socioeconomic status (SES) and study habits. The mixed results in the literature (Garbanzo, 2013; Khan, 2016) suggest that this relationship is not straightforward. In my study, I observed effective study habits across students from various backgrounds, indicating that this form of cultural capital is not exclusively tied to SES.

The following table summarises the study habit strategies I identified:

Table 4.7 Study Habits Strategies

Strategy	**Specific Approaches**	**Student N°**	**N**
Effective Study Techniques	Systematic note-taking, organised approach, consistent habits	2, 3, 4, 5, 6, 7, 9, 13, 14, 16	10

Time Management	Heavy course loads, balancing studies with other responsibilities	7, 10, 17	3
Adaptive Learning	Self-teaching, oral comprehension, problem-solving persistence	1, 12, 15	3
Prior Knowledge Utilisation	Applying high school study habits to university	8	1
Academic Commitment	Strong work ethic, prioritising studies	5, 17	2

This table presents five categories of study approaches: effective study techniques (10 students), time management (3 students), adaptive learning (3 students), prior knowledge utilisation (1 student), and academic commitment (2 students). The strong preference for effective study techniques suggests this was considered the most crucial aspect of academic success.

4.3.5 Applying Practical Knowledge

My research showed how students mobilise cultural capital by connecting their practical work experiences or technical skills to their engineering studies. This involves applying technical knowledge to academic projects or understanding theoretical concepts through real-world examples.

Student 16, from a working-class background, leveraged his vocational high school education in port operations:

"In fact, the subject they taught me on port operations is very similar to what is covered in maritime transport, port operations, ducts and belts courses, all those things I already knew."

This aligns with Smith & Lucena's (2016) concept of "funds of knowledge," which helps first-generation engineering students establish a sense of belonging and success in engineering.

Student 16's ability to connect his vocational training in port operations to theoretical engineering concepts demonstrates what Bourdieu (1984) calls 'reconversion strategies', transforming one form of capital into another. This process represents a sophisticated form of capital conversion whereby students transform embodied cultural capital from one field (vocational training) into recognized capital in another (academic engineering). This reconversion is never simply technical but deeply embedded in social class relations. For students from disadvantaged backgrounds, this translation of practical knowledge into academically valued capital represents both a strategic navigation of class-based educational hierarchies and a potential challenge to assumptions about what constitutes 'legitimate' engineering knowledge. By validating experiential knowledge gained outside elite educational pathways, such capital reconversion can potentially transform the engineering field's valuation of different knowledge forms

Student 2 found value in extracurricular activities, starting an event production company:

"When we were developing [the event production small company], we realised that we could apply what we were learning in some way. So in that sense, it was not a critical moment, but it was transformative, as a way of playing with what one was learning."

Student 7 connected diverse work experiences to her academic understanding:

"I've worked elsewhere, so I don't [lack work experience]. My classmates really learned in the internship what I've learned at work, the professional stuff, and things like that rather than the discipline of specific engineering."

Student 10 developed a strategy of active participation in laboratories and projects to navigate her engineering education. She found laboratory activities engaging: "The common core laboratories, in general, always caught my attention, including microbiology and those things."

Her involvement in group projects further evidences her commitment to accumulating cultural capital:

"I was in charge of bringing the milk. I ordered the milk from (a rural town), and they would deliver it to me, so the process was long. I felt it was a lot of work.".

In the following table, there is an overview of practical knowledge strategies I found.

Table 4.8 Practical Knowledge Strategies

Strategy	**Specific Approaches**	**Student N°**	**N**
Connecting work experience to academic learning	Technical high school experience	13, 16	2
	Job experience	2, 4, 7, 8	4
Applying technical skills to academic activities	Laboratory experiences	6, 10	2
	Internships	3	1

The table shows two main approaches: connecting work experience to academic learning (6 students) and applying technical skills to academic activities (3 students). The higher number of students leveraging work experience suggests this was a more accessible way to apply practical knowledge than through formal academic activities.

4.4 Social Capital: Support Networks Facilitating Educational Success

Social capital refers to the networks of relationships and connections that individuals can draw upon for support, information, and resources (Bourdieu, 1986). The analysis of engineering students' experiences reveals the diverse strategies

employed to accumulate and mobilise social capital in the face of socioeconomic challenges. From supportive networks to developing leadership skills to adapting social interactions, these strategies highlight students' resilience and resourcefulness in pursuing their educational goals.

4.4.1 Building Supportive Networks

In my research, I found that students accumulate social capital by creating networks of support and resources. This involves forming study groups, developing friendships within the program, and seeking mentorship from professors or older students.

Student 8 emphasised the crucial role of her friend group:

"Yes, they have been like the ones that when you don't pass the course they tell you: ah, okay, it doesn't matter, take it, here is all the material."

She also noted the challenges faced by those without strong social connections:

"It's complicated because when you have courses where you have to do group [work]..., because, for example, this semester all my courses are with teamwork and if you haven't formed it before or haven't had much contact with classmates, you don't feel confident to say: I'm alone, do you want to accept me or something like that."

This aligns with research showing that peer capital plays a crucial role in students' adaptation to university (Brouwer et al., 2016; Marra et al., 2012).

Student 12 relied more on external support:

"It was a combination of family and friends, not much from career partners or a professor in the area; in that aspect, I never approached professors to seek a little more guidance, perhaps because I never noticed that the professors were close to the students."

In contrast, Student 9 felt at home in her program:

"I love it, because you always feel more comfortable with someone of your own gender, so to speak, and the teachers have been excellent. The teachers who are Heads of Career, you feel like friends, you go to bother them in their office, and they always say: come in, come in! they talk."

This shows how low-SES students can accumulate social capital through interactions with faculty members (Walpole, 2003).

Student 7 navigated the male-dominated environment by building social capital with male peers:

"I always told my boyfriend that I felt like my male classmates took more care of me as if I were their little sister... I never saw it in any other way. It was very brotherly."

While providing social capital, this dynamic could also be interpreted as a manifestation of gender norms and stereotypes (Faulkner, 2000; Seron et al., 2015), where women are perceived as needing protection or guidance from men.

The set of supportive network strategies I found is shown in the following table.

Table 4.9 Supportive Networks Strategies

Strategy	**Specific Approach**	**Student N°**	**N**
Forming study groups	Organise group study sessions with classmates	3, 16	2
	Form partnerships with academically similar peers	6, 8	2
Developing friendships within the program	Create a core friend group	2, 10, 14, 17	4
	Connect with peers from different backgrounds	1, 5	2

	Actively connect shy/introverted students	15	1
Seeking mentorship or guidance from professors, older students, family, etc	Build connections with professors	7, 9	2
	Find support in non-academic environment	4, 12	2
	Connect with older students for guidance	1	1

This table outlines three main networking approaches: forming study groups (4 students), developing friendships within the program (7 students), and seeking mentorship (5 students). The preference for friendship development suggests students found peer relationships particularly valuable for support.

4.4.2 Developing Leadership Skills

In this section, I examine how students build social capital by taking on roles in student government or leading projects and initiatives. Students mobilise their social capital by stepping into positions of responsibility and influence within their academic community.

Several interviewed students highlighted their participation in the university's student council as a significant means to expand their social networks and leverage associated benefits. This aligns with research showing that involvement in student organisations can enhance students' sense of belonging and integration into the university community (Astin, 1999).

Student 5 emphasised how her student council experience helped develop leadership skills and confidence:

"It was no longer just academic or about showing things objectively, but rather about participating more proactively and speaking more from myself."

Furthermore, Student 5's involvement facilitated new connections:

"In the Student Center, I became friends with other girls from other generations."

This aligns with literature (Stanton-Salazar, 2011) about how social capital significantly empowers low-status students and youth, particularly those from working-class minority backgrounds.

Student 1's involvement in the student council fostered a sense of belonging:

"I started to feel a little bit more part of the School. It gave me the feeling of belonging."

It also exposed him to diverse perspectives from senior students:

"I loved talking to older students and how they used complex words.".

Participating in the propedeutic program also allowed Student 1 to build social capital:

"I used the propedeutic program a bit as a pre-university in the sense of meeting people, being able to communicate, building a social network of friends, etc."

Moreover, it introduced him to an engineering student who influenced his career choice:

"This classmate from a higher level who told me what the career was like (...) enlightened me a lot in that sense."

Sports activities also emerged as a means to widen students' social networks and offer a valuable avenue for building social capital (Spaaij, 2012). Student 13's participation in a weightlifting group allowed him to connect with students from various backgrounds:

"I would go to another campus to train, and there, the majority are from EFI (Physical Education), and I shared a lot there."

According to literature (Hollett & Brock, 2024), while sports can build social capital, careful attention must be paid to how status and power dynamics affect participation and inclusion.

The following table shows the leadership strategies I found.

Table 4.10 Leadership Strategies

Strategy	**Specific Approach**	**Student N°**	**N**
Joining student organisations	Joined student council, cultural committee, or student government	1, 3, 5	3
Participating in university events	Organised or participated in university-wide events or initiatives	2, 13	2
	Drew on past leadership roles to navigate university	6	1
Getting involved in program-related activities	Took leadership roles in coursework or projects related to their program	4, 10	2

The table presents three categories: joining student organizations (3 students), participating in university events (3 students), and getting involved in program-related activities (2 students). The relatively even distribution suggests that students found various ways to develop leadership skills.

4.4.3 Adapting Social Interactions

In my research, I have observed how students accumulate and mobilise social capital by adapting their social interactions within the university environment. This process involves students modifying their social behaviours and communication styles to build and leverage social networks effectively.

Through my analysis, I have identified several strategies students use to adapt their social interactions.

These strategies demonstrate how students actively accumulate social capital within university settings, which is crucial for higher education success (Lareau & Weininger, 2003).

Student 5's experience illustrates becoming more outgoing:

"In high school, I was super introverted... It was hard for me to make friends, but it wasn't a problem either because I always had friends in high school or a group, but here I arrived. I remember that the first talk I remember was in the hall. Someone sat next to me and started talking to me."

This represents the development of a "reflexive habitus" (Reay et al., 2009b), where students consciously adapt behaviours to new contexts.

Student 1 demonstrated mobilising social capital for collective benefit:

"I feel that within the group I am a connection, I feel that I have always been a connection with the environment, I am the one who brings groups together with other groups, I am the one who participates in the Student Council and brings the idea of the Student Council to the group, the one who includes a new friend, the one who always tries to link, a little more external than internal, like that within the same group."

This aligns with Stanton-Salazar's (2011) concept of institutional agents who facilitate resource access for others.

Student 3's gradual approach to social engagement shows deliberate capital accumulation:

"Little by little I've been letting myself participate in extracurricular activities, like playing basketball or going to parties or going to a friend's house to watch an event, things like that."

This demonstrates Bathmaker et al.'s (2013) concept of "making capital count" through strategic university engagement.

These examples show how students adapt social behaviours to accumulate capital in university settings. By expanding social circles, diversifying networks, and professional socialisation, students build relationships for academic and professional support, a process Thomas (2002) identifies as crucial for student success.

Analysis reveals how social capital accumulation influences navigation of the engineering field, Student 1's connecting role, Student 3's gradual network building, and Student 5's transformation from introversion to engagement. These patterns show how social capital facilitates access to information, support, and development opportunities, aligning with Pascarella et al.'s (2004) research while providing specific evidence in engineering education.

Understanding these processes can inform strategies to support students in building effective social networks, which is significant for those struggling with integration (Tinto, 1993).

Table 4.11 presents an overview of the social interaction strategies I found.

Table 4.11 Social Interaction Strategies

Strategy	**Specific Approach**	**Student N°**	**N**
Expanding social circles	Becoming more outgoing/participative	1, 3, 5, 6, 9, 15, 16	7
Diversifying networks	Navigating diverse peer groups	1, 2, 12, 14	4
	Treating university as professional environment	11	1

Students employed two main approaches to adapt social interactions: expanding social circles (7 students) and diversifying networks (5 students).

4.4.4 Summary of strategies used by participants to accumulate/mobilise capital

Table 4.12 summarises the eleven identified strategies across economic, cultural, and social capital domains.

Table 4.12 Summary of strategies used by participants to accumulate/mobilise capital

Type of Capital	Type of Strategy	Strategy	Students Using Strategy	n
Economic	Accumulation	Leveraging Financial Aid and Support	1, 3, 4, 6, 7, 13, 14, 15, 16, 17	10
	Mobilisation	Balancing Work and Study	1, 2, 3, 4, 7,14, 16	7
		Reframing Economic Constraints	2, 3, 6, 12, 13, 14, 16, 17	8
Cultural	Accumulation	Capitalising on Academic Excellence	2, 3, 4, 5, 6, 7, 8, 9,10, 11, 12, 13, 14, 16, 17	15
		Accessing Enrichment Opportunities	1, 2, 3, 5, 6, 7,8, 9,12, 13, 15	11
		Developing Language and Communication Skills	1, 2, 3, 4, 5, 6, 10, 12, 14,15, 17	11
	Mobilisation	Leveraging Strong Study Habits	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17	16
		Applying Practical Knowledge	2, 3, 4, 6, 7, 8, 10,13, 16	9

Social	Accumulation	Building Supportive Networks	1, 2, 3, 4, 5, 6, 7, 8, 9,10, 12, 14, 15, 16, 17	15
	Mobilisation	Developing Leadership Skills	1, 2, 3, 4, 5, 6, 10, 13	8
		Adapting Social Interactions	1, 2, 3, 5, 6, 7, 9,11, 12, 14, 15, 16, 17	13

This table shows that leveraging strong study habits was the most widely adopted strategy (16 students), while building supportive networks and capitalising on academic excellence were also highly prevalent (15 students each). The least common strategies were leveraging financial aid (10 students) and applying practical knowledge (9 students). Students generally employed multiple strategies across different forms of capital, with cultural capital strategies being the most widely utilised.

4.5 **Conclusion**

In this chapter, I explored how engineering students mobilise various forms of capital in their educational trajectories. Students demonstrated remarkable adaptability, typically employing six to eleven economic, cultural, and social strategies.

Leveraging strong study habits and capitalising on academic excellence emerged as nearly universal strategies, accentuating the importance of traditional academic skills in engineering. Interestingly, I found more variation in economic and social strategies, potentially reflecting differences in economic needs or awareness of available resources. Building supportive networks was particularly popular, while leadership development was less commonly utilised.

Most students balanced different capital forms, though some showed clear preferences. This analysis contributes to understanding the complex factors shaping engineering students' experiences and outcomes. By recognising the role of different capital forms, their interaction with habitus, and students' diverse strategies,

educators and policymakers can develop targeted interventions to support students' engineering journeys.

Future research should explore how students from different backgrounds mobilize capital across various educational contexts and investigate strategies for fostering more equitable access to these valuable resources.

In the next chapter, I will delve into the experiences, barriers, and facilitators of engineering students from disadvantaged backgrounds, examining how they move across the field of engineering education and the challenges they face in their pursuit of social mobility.

Chapter 5: Navigating Barriers and Harnessing Facilitators in Engineering Education (Habitus and Reflexivity)

5.1 **Overview**

This chapter addresses my second research question: 'What barriers and facilitators do engineering students experience?' Building on the capital analysis from Chapter 4, I examine how students' habitus mediates their higher education experiences, how the engineering field creates or denies opportunities, and how institutions influence these dynamics.

Through Bourdieu's theoretical framework of habitus, field, and reflexivity (Bourdieu, 1984; Reay, 2004c), I analyse how students make meaning of their university experiences and progression. Tables 5.1 and 5.2 summarise the barriers and facilitators identified across the 17 student interviews, providing a quantitative overview of the patterns observed.

Key barriers include limited academic capital, socioeconomic constraints, rigid educational practices, gendered field dynamics, and feelings of not belonging. Facilitators include parental encouragement, faculty support, bridge programs, and developing a reflexive habitus that enables adaptation to the engineering environment. The chapter concludes by identifying integrated strategy patterns students employ to navigate these challenges successfully.

5.2 Barriers Experienced by Engineering Students

This section is structured to examine barriers at three interconnected levels: individual habitus, institutional habitus, and field-specific challenges. This analysis highlights students' challenges and reveals the potential for transformation and adaptation within the engineering education field.

5.2.1 Individual Habitus

In my analysis, individual habitus creates significant barriers in engineering education. Bourdieu's (1990) concept of habitus—a system of durable dispositions shaping perceptions and actions—helps explain why students struggle when their dispositions misalign with engineering field expectations.

Student 11's experience exemplifies what Reay et al. (2009b) describe as being a "stranger in paradise," highlighting the complex identity negotiations disadvantaged students undergo:

"Most of them are children in their minds, psychologically, they're young kids who don't know anything about life, they're young people whom you can tell haven't worked or if they have worked, they use the money to drink or smoke or something like that."

This statement reflects precisely the type of habitus misalignment that Reay and colleagues identified as creating feelings of isolation and alienation that impede full integration into university environments.

The clash between pre-existing habitus and engineering field expectations also manifests in academic approaches. Nash (2002b) argues that habitus encompasses aspirations, academic self-concept, and perceptions of schooling that significantly influence educational interpretations. Student 12 articulates this disconnect in a way that aligns with Nash's theoretical framework:

"I felt that what the industry was asking for, I was not learning in the degree, and I think I should have taken that as a sign to be able to change in time, but in the end, I said like in the next semester I am going to see web engineering, and I think there I am going to learn what I did not learn in the previous years."

Van Rensburg (2010) would identify this as a classic case of how background-shaped habitus informs program understanding, creating the exact type of curriculum-expectation mismatch expressed by Student 12.

For disadvantaged students, these barriers intensify as their socioeconomic backgrounds create habitus formations that struggle to align with higher education norms. Student 5's experience illustrates precisely the "catch-up" phenomenon that Boles & Whelan (2017) identified in their research on educational background influence:

"Coming from an under-resourced high school, I did not have access to the same level of math and science courses as some of my classmates. I had to work twice as hard to catch up and prove that I belonged in the program."

This student's need to "prove belonging" exemplifies Boles & Whelan's findings about the additional cognitive and emotional labour required when habitus misaligns with field expectations, labour that significantly impacts retention rates and overall learning experiences.

5.2.2 Institutional Habitus and Structural Obstacles

As conceptualised by Reay (1998), institutional habitus provides a powerful lens for analysing how universities as institutions shape students' experiences and trajectories. This concept extends Bourdieu's theory to examine how institutional cultures and practices influence student attitudes, beliefs, and choices.

My analysis reveals two primary aspects of institutional habitus that create barriers for engineering students, particularly those from disadvantaged backgrounds: rigid educational practices and an unsupportive campus environment.

5.2.2.1 Rigid educational practices

Rigid educational practices affected 14 of 17 students, revealing a misalignment between institutional habitus and student needs across curriculum structure, pedagogical approaches, and assessment methods.

The curriculum structure exemplifies Bourdieu's "cultural arbitrary," which Moore (2004) defines as field positions determined by power relations rather than inherent qualities. This theoretical lens helps explain why these structures disproportionately affect students whose habitus does not align with institutional expectations. Student 15 explains: "I can see that teachers don't put effort into what they do because they recycle everything from previous years. Once, I had a test, and they put exactly the same questions from previous years with one or another piece of information changed, and it seemed wrong to me because they didn't put any effort into doing something new."

This rigidity aligns with Thomas's (2002) analysis of institutional practices that disadvantage non-traditional students.

Teaching methods prioritise traditional approaches over inclusive learning, as Student 11 observes: "I'm not sure, but I think our professors are not professionals. For example, a professor in a course called programming is not a programming professor; he's an engineer who is teaching programming and doesn't know how to deal with people or how to teach."

This critique reflects how institutional priorities contribute to rigid educational practices. Boliver et al. (2018) explain this through their concept of organisational identity as a barrier to inclusive practices. When institutions prioritise research productivity in promotion and recognition systems, teaching quality becomes subordinated to research outputs. Faculty may view teaching as an obligation that enables their research rather than as a central element of their professional role. This institutional orientation can be particularly detrimental for students from

disadvantaged backgrounds who may require more supportive teaching environments. Student 12 articulates this disconnect clearly:

"I feel that there are several faculty professors at my university who should not be teaching; they are there forced by contract issues; they have to be teaching to carry out their research... and their area to teach is not their strength."

The research-teaching tension identified by Student 12 connects directly to Fairweather's (2002) findings on faculty productivity in higher education and its impact on undergraduate education quality. This insight reveals how institutional priorities (research over teaching) contribute to rigid educational practices that can particularly disadvantage students whose habitus doesn't align with traditional academic expectations.

Reay (2004d) argues that these habitual practices reproduce social differences through pedagogical approaches. Through Moore's (2004) framework, we see these teaching methods as reflections of power relations privileging certain forms of cultural capital (Bourdieu, 1986) over others, systematically disadvantaging non-traditional students, consistent with Leyton et al.'s (2012) findings on vulnerable Chilean students.

Student 5's experience:

"I had to work twice as hard to catch up and prove that I belonged in the program", illustrates Hattingh's (2023) concerns about mark-centric approaches that create additional barriers for low-income students.

While this could reflect various factors - including differences in academic preparation, institutional expectations, or personal circumstances - the emphasis on "catching up" suggests gaps between the student's prior academic experience and university requirements.

5.2.2.2 Unsupportive Campus Environment

While fewer students explicitly mentioned an unsupportive campus environment, its impact on student experiences and success is significant. This aspect of institutional habitus manifests in several ways:

Academic Distance: The perceived distance between professors and students reflects an institutional culture that values academic hierarchy over mentorship. A student shares:

"I would like to emphasise and put in red and circle the issue of professors who are terrible, have no consideration, don't know how to teach, have no tact, are not organised, have no empathy for the student." (Student 11)

This aligns with Pascarella et al.'s (2004) findings on the importance of student-faculty interactions for college outcomes, particularly for first-generation students.

Lack of Inclusive Support Services: The university's support services often fail to address the specific needs of diverse student populations. A student mentions:

"I wanted to join the robotics club, but they met on weekends when I had to work. The same was true with many workshops and networking events - they were always scheduled, and at times, I couldn't attend because of my part-time job." (Student 6)

This reflects what Ostrove and Long (2007) describe as institutional structures that can impede students' sense of belonging, particularly for those from low-income backgrounds.

Institutional Priorities: The university's focus on research over teaching quality can leave students, especially those from disadvantaged backgrounds, without adequate support.

Student 12's observation that: "several faculty professors at my university should not be teaching; they are there forced by contract issues; they have to be teaching to carry out their research" highlights a fundamental tension within the institution's core mission. Boliver et al. (2018) provide a theoretical framework that helps explain this phenomenon through their concept of organizational identity as a barrier to inclusive practices. When institutions prioritize research productivity in promotion and recognition systems, teaching quality can become subordinated to research outputs. Faculty may view teaching as an obligation that enables their research rather than as a central element of their professional role.

This institutional orientation can be particularly detrimental for students from disadvantaged backgrounds who may require more supportive teaching environments. The research-teaching tension identified by Student 12 connects directly to Fairweather's (2002) findings on faculty productivity in higher education and its impact on undergraduate education quality.

5.2.3 Field (Engineering Education)

The field of engineering education, viewed through Bourdieu's theoretical lens, reveals itself as a complex social space with its own logic, rules, and forms of capital. My analysis uncovers how this field's structure and dynamics create distinct barriers for students, particularly those from non-traditional backgrounds.

5.2.3.1 The Technical-Social Skills Dichotomy

The technical/social dualism in engineering (Faulkner, 2000) creates a significant barrier by prioritising technical skills while marginalising social aspects—what Pleasants et al. (2025) term "technocentrism." This manifests throughout students' educational journeys in multiple interconnected ways.

The gap between technical training and professional practice emerges clearly in Student 10's reflection:

"I feel I have competencies... but they told me I would become a manager of something, and I don't know if I have the competencies to take charge of a production process... I feel I lack leadership competencies."

This perfectly illustrates Khosronejad et al.'s (2021) argument that students must simultaneously negotiate Technical-Professional and Socio-Ethical dimensions while constructing their engineering identities.

Student 9's internship experience reinforces this disconnect:

"It was very strange because that's when you realise that the things you see at university, you won't necessarily know how to do at work... sometimes you don't just have to prepare in derivatives, integrals [maths concepts] ... but also learn about the area in which the company operates."

This observation captures how engineering education's technocentrism underemphasises contextual understanding.

The preference for technical mastery over collaboration emerges in Student 10's admission:

"I've always had this trait of not knowing how to delegate... I prefer to do the work myself. I have a hard time working in groups."

This reinforces the field's elevation of individual technical prowess over collaborative skills.

Student 9 articulates how technical competence becomes the primary marker of belonging:

"I think that the greatest value in engineering would be academic merit."

This privileging of technical expertise creates what Akkerman and Bakker (2011) describe as boundaries students must cross, navigating "sociocultural differences leading to discontinuity in action or interaction"—evident in Student 1's experience:

"I've always been characterised as being quite sociable... But I've noticed that the first years [of engineering] were quite boring... and didn't capture my vocational and social reason."

This statement reflects how engineering education predominantly emphasises technical concepts from mathematics, physics, and engineering sciences during the first years. This technical focus creates a particular challenge for students from disadvantaged backgrounds in Chile, who often enter university with inadequate preparation in basic sciences, compounding the disconnect for those who value social engagement and might already be struggling with the technical content.

This barrier affects students' academic experiences and shapes their professional identities and sense of belonging in the field. Students may internalise that being a "real" engineer means excelling technically at the expense of social skills, potentially limiting their professional development and future career opportunities in a field that increasingly demands both technical expertise and social awareness.

5.2.3.2 The Gendered Nature of the Field

The engineering field remains deeply entrenched in a masculine-coded culture, creating what Bourdieu would term "symbolic violence" (Bourdieu, 1993). As Cech et al. (2011) note, the strong symbolic tie between engineering identity and hegemonic masculinity creates significant challenges for women in establishing their professional identities.

Student 17's experience vividly illustrates this dynamic:

"...being in a career where there are almost all men, you have to make an effort twice or three times to excel and do the same as men."

This reveals the additional labour required of female students navigating this male-dominated space.

Female students engage in what Faulkner (2007, 2011) calls "gender authenticity" work, striving to be seen as competent engineers while maintaining femininity, aligning with Du's (2006) observations of women adapting to masculine norms for field acceptance. Student 7 articulates this reality:

"Always I feel that they're going to prefer a man... if I go to apply to the same place where my male classmates apply, I feel like they're going to choose them, it doesn't matter if they did worse or not in university than me."

Student 17's frustration highlights the demoralising effects of gender bias:

"Something I didn't like, for example, is if I got a good grade, it was always attributed to something else... you got that grade because the professor finds you pretty because you have a nice butt... it was never due to my own merit, and the reality is that I was killing myself studying."

The gendered nature of engineering also constrains men by reinforcing narrow definitions of masculinity tied to technical prowess. Male students like Student 13 sometimes perceive that female students receive unfair advantages:

"I had a female friend at university who didn't do anything on a test and told the professor to give her a pass mark... and she ended up passing the course without knowing anything."

This perception exemplifies what Douglas (2015) identifies as "privilege blindness," where dominant groups misinterpret equity measures as unfair treatment by failing to recognise how their dominance has been normalised (Bourdieu & Passeron, 1990). This pattern reflects how masculine technical competence is treated as the neutral standard (Faulkner, 2009; Wajcman, 2009), causing inclusion efforts to be viewed as "social engineering" rather than corrections to existing biases that create

"double binds" for women (Cheryan et al., 2017; Ong et al., 2011). The defensive response works to maintain existing hierarchies (Diangelo, 2011) and perpetuates the false notion that traditional engineering approaches are objective rather than products of gendered knowledge construction and practice.

As Faulkner (2009) argues, these gendered norms are deeply embedded in institutional cultures, creating barriers to women's participation while restricting acceptable expressions of masculinity for men.

5.2.3.3 The Misalignment Between Academia and Industry

The disjunction between academic preparation and industry expectations represents a structural barrier in engineering. Student 12's observation is particularly insightful:

"I felt that what the industry was asking for, I was not learning in the degree..."

This misalignment can be understood as a form of "structural lag" within the field, where academic institutions struggle to keep pace with rapidly evolving industry needs. It reflects a deeper tension between the field's emphasis on theoretical knowledge and the practical skills demanded by the job market.

This disconnect can be analysed through Bourdieu's theoretical framework, where engineering education privileges certain forms of capital while undervaluing others essential in professional practice. Johri and Olds (2011) highlight how engineers often find workplace skills disconnected from their formal education. This perspective is reflected in Student 04's experience. Student 04 articulates this disconnect clearly when reflecting on her university experience versus workplace demands:

"It was very weird because there you realize that the things you see in university, you won't necessarily know how to do in a job... For example, I had to know about the context of the company, which was an agricultural company. I had to know about

types of vegetables, types of seeds, what an agricultural year meant—many things they won't teach you at university because it has nothing to do with it."

This reveals how academic preparation often fails to account for the contextual knowledge required in professional settings.

Student 09 echoes this concern about industry readiness:

"I think I have competencies... but if you had asked me last year, I would have said no, that I don't have competencies because I really felt that I wasn't good for anything. But now that I'm writing my thesis and taking courses for my career, I feel I have learned something."

This uncertainty about professional competence persisting until the final stages of education highlights the structural disconnection between academic achievement and workplace preparation.

Besterfield-Sacre et al. (2014) attribute this persistent disconnect to structural features of engineering education that favour the status quo. Their research shows that engineering programs predominantly focus on traditional experiences while undervaluing industry-relevant skills. This helps explain Student 06's observation that:

"I think the biggest knowledge I've acquired throughout my education has gone more through extra-academic things than through what I've learned in these six years... I think perhaps instances are missing throughout any career, beyond the internships that are like formal events in which one can apply the knowledge one is acquiring."

This observation underscores how crucial professional skills often develop outside formal curricula, disadvantaging students with limited access to such opportunities.

This barrier disproportionately affects students from disadvantaged backgrounds who may lack the social and cultural capital to bridge this gap independently.

5.2.3.4 The Myth of Meritocracy and the Reality of Social Capital

Underlying many of these barriers is the persistent myth of meritocracy within the engineering field, which is starkly contrasted by the reality of unequal access to opportunities. Student 13's frustration with the internship process reveals this tension:

"Because without connections, you can't get [an internship]. This I didn't like."

This statement exposes the gap between the meritocratic ideal and the reality of how opportunities are distributed within the field. The emphasis on "connections" points to the crucial role of social capital, which is unevenly distributed among students from different backgrounds.

Bathmaker's research provides a crucial insight into this dynamic. As she notes (Bathmaker et al., 2013), working-class students are often acutely aware of their middle-class peers' advantages regarding social capital, particularly when securing internships. This awareness, however, does not translate into an ability to overcome these disparities. It often leads to increased frustration and a sense of powerlessness.

This phenomenon was evident in my study. For instance, Student 14 shared:

"I see my classmates getting internships at big companies because their parents know someone. Meanwhile, I'm struggling just to get my application noticed. It's frustrating because I know I'm just as capable, but I don't have those connections."

This student's experience aligns closely with Bathmaker's observations. Awareness of the advantage that social capital provides does not help students from working-class backgrounds compensate for their lack of privilege. Instead, it heightens their sense of disadvantage and can lead to disillusionment with the field's supposed meritocracy.

Moreover, this dynamic creates a compounding effect. As middle-class students leverage their social capital to secure internships and other opportunities, they further enhance their employability and professional networks. Meanwhile, working-class students, despite their awareness of this process, often fall further behind in terms of professional development and industry connections.

The persistence of this myth in the face of clear evidence to the contrary suggests a form of what Bourdieu might call "symbolic violence" (Bourdieu, 1990). The field's structure implicitly validates the advantages of those with pre-existing social capital while promoting a pure meritocracy narrative. This can decrease self-efficacy among disadvantaged students and, ultimately, contribute to attrition from the field.

5.2.4 Navigational Challenges in the Engineering Field

This section examines the practical manifestations of the habitus-field mismatch in engineering education, focusing on how students navigate the complex dynamics of higher education and the engineering profession.

5.2.4.1 Lack of Sense of Belonging and Sense of Dislocation

The narratives of 15 out of 17 participants reveal what Reay et al. (2009b) call the 'fish out of water' phenomenon. As Tinto (2015, 1987) argues, sense of belonging is crucial for academic success, and students navigate this through varied strategies.

Student 7 expresses classic outsider alienation:

"At first, I felt like an outsider. Everyone seemed to know each other, understand the technical jargon, and be comfortable with the university environment. I kept questioning if I really belonged here." Student 11 occupies a liminal position: "When I arrived at the university, I felt neither rejected nor included, neither comfortable nor uncomfortable... I never felt like I was fitting in, but neither did I feel like I was out of place."

Student 17 shows pragmatic adaptation:

"The 'I don't belong here' feeling lasted until about my third year... I ended up getting used to being there... I had to finish this one no matter what." Student 15 reveals belonging through connection: "I felt that I did belong because when I got to know my friends, they did similar things to me and thought quite similarly to me."

This phenomenon represents 'habitus dislocation' (Baxter & Britton, 2001), unfamiliarity with the 'rules of the game' (Bathmaker, 2015), exemplifying Bourdieu's hysteresis concept (Bourdieu & Wacquant, 1992), where habitus is ill-suited to a new field.

Student 1's experience shows belonging as a developmental process:

"I gradually felt more part of the school. As the years went by, I started identifying my personal interests within the engineering discipline and directing myself in that sense. I realised that I could find my professional profile little by little, and now I have it very clear."

In contrast, Student 9 initially felt a strong belonging before experiencing later doubts:

"At the beginning, I felt terrific. I enjoyed it a lot, got along well with my classmates, and made friends from other careers. I always felt very at home. In those times, I was delighted to have chosen the career. Later, when it started to get more difficult, and we shared fewer courses, it became harder, and that's when one started to question: Did I choose well? However, in the end, that passes, I think these are moments that everyone questions, but that questioning didn't happen to me at the beginning."

These testimonies reveal how belonging and dislocation emerge from misalignment between individual habitus and field logic, creating ontological discomfort where internalised dispositions fail to resonate with institutional norms. When students

experience a profound sense of not belonging, they simultaneously encounter dislocation, a complex state of ontological discomfort where their internalised dispositions, accumulated cultural capital, and embodied experiences fail to resonate with the institutional environment's implicit norms and expectations.

5.2.4.2 Opportunity Gaps

The limited access to opportunities experienced by many students reveals the uneven distribution of social and cultural capital within the engineering field. Student 6's experience illustrates this:

"I wanted to join the robotics club, but they met on weekends when I had to work. The same with many workshops and networking events - they were always scheduled at times I couldn't attend because of my part-time job. I feel like I'm missing out on valuable experiences that could help my career."

This example aligns with Snellman et al. (2015) findings on how working-class students often struggle to access extracurricular opportunities due to work commitments, while their middle-class peers can more easily engage in these 'CV-building' activities. This disparity in access to opportunities can lead to the multiplication of capital, where initial advantages lead to further accumulation of valuable social and cultural capital (Bourdieu, 1986).

Student 10's experience with research opportunities further illustrates this issue:

"I didn't even know undergraduate research existed until my third year. By then, most positions were filled by students who had connections or knew how to ask early on. I feel like I'm always a step behind in understanding how to advance in this field."

This lack of insider knowledge about advancing in the field aligns with what Archer et al. (2015) describe as the science capital gap, where students from disadvantaged backgrounds often lack the knowledge, contacts, and experiences to facilitate success in STEM fields.

These navigational challenges, a sense of dislocation, difficulties in structural navigation, and limited access to opportunities are not merely individual struggles but reflect broader structural issues within engineering education. They demonstrate how the field of engineering education can reproduce social inequalities through its implicit norms, structures, and distribution of opportunities.

5.2.5 Summary of Barriers in Engineering Education

Table 5.1 Barriers in Engineering Education

Factor	Barriers	Students Affected (Barriers)	Number of students (n)
Individual	Limited academic and cultural capital	2, 4, 6, 9, 10, 11, 15, 16	8
	Low self-efficacy	1, 6, 7, 8, 10, 11, 12	7
	Socioeconomic constraints	1, 2, 3, 4, 7, 13, 14, 15, 16	9
Institutional	Rigid educational practices	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 17	14
	Unsupportive campus environment	10, 11, 12	3
Field-Specific	Strict professional norms	2, 5, 7, 8, 9, 11, 17	7
	Industry-academia misalignment	1, 2, 7, 8, 12	5
	Challenging career landscape	7, 12, 13	3
Habitus-Field Interaction	Lack of belonging	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 17	15
	Limited access to opportunities	3, 7, 10, 12, 13, 15	6

5.3 Facilitators and Enablers for Engineering Students

In my analysis of the interviews, I identified three main factors that act as facilitators for engineering students: mobilisation of primary habitus (familial and friends

support), institutional mechanisms for habitus adaptation and reflexive habitus. These factors played crucial roles in helping students navigate their educational journey.

5.3.1 Mobilisation of Primary Habitus (Familial and friends support)

Family and friend support emerges as a critical facilitator for first-generation students, reflecting Bourdieu's concept of social capital. Research shows that family members often provide encouragement, motivation, and emotional support that influences engineering identity development (Verdin et al., 2024) and mitigates stress and depression, particularly for Latino first-generation students (Suwinyattichaiporn & Johnson, 2022). Student 16's experience demonstrates how parental encouragement motivates:

"It was more of a personal thing for me, but always driven by my parents because as they never had a good education, I think it is the desire of every parent for their children to be better than them, so they always told me: If you can study, study."

However, it is important to distinguish between the specific development of an engineering identity and the broader influence of family on aspirations for higher study. According to Student 16's story, their family is very supportive of their education as a means of advancing in society. But the parental advice given: "if you can study, study", indicates that the parents want their child to advance not only in their field of study but also on the broader world. This distinction is evident from Student 6's perspective, as his parents "always stressed the importance of education, but they didn't push me towards any specific field." Ultimately, he "chose engineering because I was good at math and heard it offered good job prospects." This demonstrates that engineering identity was developed in ways other than through parental guidance during schooling. In particular, it was not shaped by parents' understanding of what engineers do, but rather by a feeling of mathematical self-efficacy and sensible career decisions.

This distinction becomes particularly significant when considering that nearly half of the interviewed students initially aspired to become teachers before being redirected toward a career in engineering. While families strongly supported education in general, they lacked the cultural capital and insider knowledge of professional fields (Bourdieu, 1986) to guide field-specific career choices. Although working-class families typically value prosocial occupations like teaching (Fang & Tilcsik, 2022; Watt et al., 2012), in the Chilean context, parents redirected their children toward engineering based on perceived higher wages and social prestige. This reveals how family aspirations operate at a different level than engineering-specific identity formation. Families provide the motivational foundation and legitimacy for pursuing higher education (Verdin et al., 2024), but the engineering dimension of professional identity emerged through distinct mechanisms: mathematical aptitude as an entry point (Major et al., 2018), institutional exposure, pragmatic labor market assessments, and recognition of engineering's symbolic capital.

However, family attitudes toward higher education vary, sometimes creating barriers (Pires & Chapin, 2022). Student 4 experienced this:

"My mother told me, 'You have to leave the house because you're just a cost,' and me being a student, I had no way to contribute. So that was it."

These variations reflect differences in cultural capital shaping educational habitus.

Peer networks are crucial support systems, representing social capital that transforms into cultural capital. Student 7's experience illustrates this:

"I always had much support from my boyfriend, family and classmates. I greatly appreciate that; they all told me to keep going..."

Social support reduces isolation and improves academic outcomes (Suwinyattichaiporn & Johnson, 2022), while providing resources and creating supportive learning environments (Verdin et al., 2024).

Student 10's collaborative relationship demonstrates how shared habitus facilitates academic navigation:

"With my classmate who I'm writing the thesis with, we work well, we learned to get along because we've known each other for 5, almost 6 years, so she already knows how I am or how I express myself... So she does understand me, like we have that connection."

This partnership, through Bourdieu's lens, represents accumulated social capital that helps Student 10 overcome communication barriers and meet the engineering field's collaborative demands.

The formation of study groups and peer networks not only aids in academic success but also validates students' learning capabilities and fosters a sense of belonging, potentially reshaping their habitus to better align with the expectations of higher education.

5.3.2 Institutional Mechanisms for Habitus Adaptation

My analysis revealed that institutional support, particularly in bridge programs, significantly facilitated students' transition to university. Student 1's experience with a propedeutic program is a prime example:

"I think what helped me feel comfortable was that I participated in the propedeutic program and visited the university buildings..."

This aligns with Díaz et al.'s (2021) findings on the role of propedeutic programs in Chile in bridging the gap between high school and university education.

Student 3's participation in the Beta program provided valuable cultural capital and shaped his habitus in ways that aligned with the engineering field. He reflects:

"In a way, yes [the Beta experience influenced my career choice], because I always liked the area of mathematics and also because I took so many tools, so to speak,

and they were all interesting to me... Going along that line, I decided on (major) engineering."

This program served as an "institutional habitus" (Reay, David, et al., 2001) that bridged the gap between his background and university expectations.

Student 16's positive initial encounters with professors illustrate the importance of institutional fit. He recounts:

"The first time I met all the professors, I think it was my first day, it was great. I saw several professors who were quite old. There was another one who was my father's age, which struck me as strange, and I met him; they told us about their experiences as professors, and it was great; I was fascinated with that vision of the professors."

The student's early exposure to the institutional habitus likely contributed to his sense of belonging and engagement.

For female students like Student 9, the presence of supportive female faculty members played a crucial role. She shares:

"The female professors we have as Heads of the program, one feels them like friends. One goes to bother them in their office, and they always say: Come in! They chat. I had an enjoyable experience concerning the female professors in my School."

This inclusive environment, shaped by a "critical mass" of women (Faulkner, 2011), contributed to a positive institutional habitus for women in her program.

These experiences demonstrate how targeted support programs, inclusive practices, and mentoring can provide students with the necessary capital and shape their habitus to navigate the engineering field successfully.

5.3.3 Reflexive Habitus

Students' ability to reflect and adjust approaches was a key facilitator for 14 of 17 participants, aligning with Decoteau's (2016) concept of "reflexive habitus." This framework explains how non-traditional students (Ingram & Abrahams, 2015), consciously modify their dispositions to navigate engineering education.

Student 3's adaptation exemplifies this process. He initially struggled:

"To be honest, my opinion at the beginning was like a bit of rejection of the university environment because I was never one to go out to parties a lot... and I felt out of place like I said, how boring I am!" Yet he gradually adapted: "Little by little, I've been letting myself participate in extracurricular activities, like playing basketball, going to parties, going to a friend's house to watch an event, and things like that."

Student 16's transformation in problem-solving demonstrates habitus evolution:

"Now, when I see a problem, I no longer say: Oh, how terrible! Now I say: how do I solve it, what do I do here, what do I do there?"

This shift from an emotional reaction to a constructive mindset reflects what Sayer (2009) describes as developing new dispositions through reflexive practice, combining conscious deliberation with semi-conscious adaptation.

The transformation described by Student 16 likely involved what Sayer calls "the whole range" of conscious deliberation and semi-conscious adaptation. The student may have engaged in focused internal conversations about their approach to problems, but the change also required practice and repeated experiences to become embodied as a new disposition.

Student 5's journey exemplifies Decoteau's (2016) concept of layered habitus[9], where an individual develops multiple coexisting dispositions rather than simply replacing their primary habitus with a new one. Coming from an introverted background, Student 5 developed several distinct but interconnected layers of habitus that she strategically deploys across different contexts:

An academic habitus focused on considering multiple perspectives: "I think that what I have adopted the most is to consider all the possibilities or all the perspectives."

A social habitus characterized by newfound assertiveness: "I feel that now I have more voice... Maybe before I stayed there, now I look for more too."

An activist habitus through Student Council involvement and feminist engagement: "That year I was part of the Student Council... participating more proactively and speaking more from myself and not so much from data."

These habitus layers function not as separate compartments but as an integrated ecosystem where developments in one area enhance functioning in others. Her growing social confidence strengthens her academic participation, while her activist experiences inform her academic perspectives. This process illustrates what Decoteau theorises about individuals positioned at the intersection of multiple

[9] According to Decoteau, A layered habitus refers to the idea that an individual's habitus is not a singular, fixed entity, but rather a complex combination of different habituses that are acquired through various experiences and social contexts. These different habituses can coexist within an individual, each with its own set of dispositions and ways of perceiving and interacting with the world. The layered habitus recognizes that individuals are situated at the intersection of multiple overlapping fields, each with its own set of values and distributions of capital.

overlapping fields—they maintain aspects of their primary habitus while developing new dispositions that enable successful field navigation.

This layered approach offers a more sophisticated understanding of habitus transformation than notions of "habitus clash" or complete replacement. Student 5's reflexive awareness of these different aspects of herself demonstrates how disadvantaged students can consciously develop a multifaceted habitus that allows them to navigate the engineering field's requirements while maintaining connections to their original dispositions. This capacity to operate across different social spaces without losing their distinctive perspective represents a significant form of agency within structural constraints.

These habitus layers coexist and interact rather than replace one another; her social confidence enhances her academic engagement and activism. This demonstrates what Decoteau theorises about individuals navigating multiple overlapping fields, maintaining aspects of primary habitus while developing new dispositions that enable success. Student 5's reflexive awareness exemplifies how disadvantaged students consciously navigate between different habitus layers, deploying appropriate dispositions across various university contexts.

This reflexive capacity was most pronounced in students who had navigated multiple semesters and overcome initial struggles. The prevalence suggests it functions as a "secondary habitus" (Sapiro, 2015) acquired through sustained field engagement. Notably, students from non-traditional backgrounds often demonstrated more explicit and articulated forms of reflexivity, perhaps because the disjuncture between their primary habitus and the engineering field necessitated more conscious adaptation.

This finding aligns with Reay's (2004d) observation that habitus transformation becomes most visible at crisis or significant field transition points. The widespread presence of reflexive habitus among successful engineering students from disadvantaged backgrounds suggests it may represent not merely an individual

psychological trait but a sociologically significant mechanism through which these students navigate and potentially transform the engineering field itself.

5.3.4 Summary of Facilitators in Engineering Education

Table 5.2 Facilitators in Engineering Education

Facilitator Factor	Students perceiving factor as facilitator	Student's number	Number of students (n)
Primary Habitus (Familial and friends support)	Parental encouragement	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	16
	Support in crisis	1, 4, 6, 9, 10,12, 14	7
Institutional Mechanisms for Habitus Adaptation	Bridge programs	1, 3, 8, 9	4
	Faculty support	2, 3, 4, 5, 6,7, 8, 9, 10, 12, 13, 14, 15, 17	14
	Institutional environment	3, 5, 6, 7, 9, 13, 15	7
Reflexive Habitus	Personal growth	1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17	14
	Problem-solving mindset	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	17
	Academic adaptation	1, 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17	15
	Identity development	1, 2, 3, 4, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17	14

5.4 Strategy Integration Patterns: How Disadvantaged Engineering Students Combine Resources for Success

My analysis of 17 student interviews revealed five distinct strategy patterns that disadvantaged engineering students use to navigate their educational journeys.

Rather than employing isolated tactics, students integrate multiple approaches across economic, cultural, and social dimensions. By carefully comparing and synthesising the data across multiple dimensions, including economic, cultural, and social capital mobilisation strategies, as well as barriers and facilitators experienced, I identified these strategy patterns that represent recurrent combinations of approaches that students employ, demonstrating how they actively integrate multiple strategies rather than relying on isolated tactics.

These five strategy patterns represent sophisticated manifestations of what Bourdieu might call 'regulated improvisations' (1990, p. 57), where students creatively navigate the field while still operating within its structural parameters. Each pattern demonstrates a different approach to managing the layered habitus described by Decoteau (2016), where students maintain multiple, sometimes contradictory dispositions that they strategically deploy in different contexts.

5.4.1 Patterns Characterisation

The Academic Achievement Approach demonstrates how students integrate primary habitus dispositions toward educational attainment with new academic expectations. The Financial Management Strategy reveals how students navigate economic necessities and academic demands, often transforming economic constraints into chosen strategies. Professional Skill Development shows how students build new dispositions while maintaining connections to their original social orientations. Enrichment Opportunity Utilisation illustrates how students actively seek experiences that bridge their primary habitus with engineering's professional demands. Finally, the Adaptive Coping Mechanism reveals how students transform challenges into opportunities for developing distinctive professional identities.

Through these integrated approaches, students embody what authors have called 'reflexive habitus' (Adkins, 2003; Decoteau, 2016; Sweetman, 2003), consciously adapting their dispositions to navigate the field of engineering education while maintaining connections to their primary habitus. This strategic adaptation process

challenges simplistic notions of social reproduction by revealing how disadvantaged students actively transform their social positioning rather than merely reproducing it.

Through Decoteau's (2016) theoretical framework, these patterns reveal both horizontal disjunctures (navigating conflicting expectations between home communities and academic culture) and vertical disjunctures (historical accumulation of disadvantage). Each pattern demonstrates different aspects of layered habitus:

Academic Achievement Approach shows how students develop dispositions reflecting both early educational experiences and university adaptations (Crozier et al., 2008; Lehmann, 2013), while demonstrating how students develop what Decoteau (2016) calls a "layered habitus", their academic dispositions reflect both early educational experiences and newer university-specific adaptations. I observed how students combine academic excellence, study habits, and social networks in ways that demonstrate the "chronologically ordered series of structures" that constitute their evolving habitus.

Financial Management Strategy exemplifies navigating "multiple, overlapping fields" (Haveman & Smeeding, 2006; Parra, 2021) as students navigate economic and academic domains simultaneously. My conversations with students revealed how their habitus becomes "destabilised" through these field intersections, leading to cognitive reframing processes that represent reflexive responses to field contradictions. This demonstrates Decoteau's argument that reflexivity can arise from both horizontal disjunctures (between simultaneous field positions) and vertical ones (across temporal experiences).

Professional Skill Development illustrates a "synthetic unity of habitus" (Decoteau, 2016) where new professional dispositions coexist with earlier competencies (Bathmaker et al., 2013; Smith & Lucena, 2016). I observed how students develop new professional dispositions while maintaining earlier academic ones, creating

layered rather than replaced competencies. This process demonstrates how habitus can constantly emerge from field dynamics.

Enrichment Opportunity Utilisation reveals "interstitial positionality" (Decoteau, 2016) between fields (Diaz et al., 2021; Tonso, 2006). My research shows how students' unique positions at the intersection of multiple fields provide them with perspectives and resources for deliberate strategy development.

Adaptive Coping Mechanism demonstrates reflexive habitus (Decoteau, 2016) development, showing how students develop what she terms "multiple (and quite often contradictory) ontological orientations and perspectives." My findings extend Ingram & Abrahams' (2015) work by showing how adaptation emerges from students' specific overlapping positions across fields.

These patterns represent complex, layered habitus emerging through students' unique positioning across multiple fields over time. By examining these in the Chilean engineering context, this research provides deeper theoretical insight into how reflexivity emerges not from an a priori self (as Archer suggests) but from students' specific positions at the intersection of multiple fields and temporal experiences. The patterns reveal how students develop what Decoteau calls "relational experiences" that cohere into distinctive forms of reflexive habitus, contributing to understanding how social change and reproduction occur through embodied practices beyond the Global North.

The data reveal considerable complexity in how these patterns operate, their relationships to one another, and what makes them distinctive to engineering education.

5.4.2 Prevalence and Foundational Relationships

The distribution of strategy patterns reveals important insights about their relative necessity. The Academic Achievement Approach emerged as the most prevalent, employed by 13 of 17 students (76%), and it serves as a fundamental prerequisite

for persistence. This dominance reflects engineering education's heavily meritocratic culture (Seron et al., 2018), where technical competence serves as the primary currency of legitimacy. The second most prevalent pattern, Enrichment Opportunity Utilisation (11 students, 65%), represents a more selective strategy requiring both awareness of opportunities and sufficient cultural/social capital to access them. Students employing this pattern typically had prior exposure through bridge programs (Students 1, 3, 8, 13) or social networks providing information about extracurricular opportunities.

The Adaptive Coping Mechanism (8 students, 47%), Professional Skill Development (8 students, 47%), and Financial Management Strategy (5 students, 29%) showed more varied deployment, reflecting students' differential positioning and diverse starting points in terms of capital.

5.4.3 Sequential and Reciprocal Relationships

Rather than operating in a fixed sequence, these patterns exhibit both sequential and reciprocal relationships. Students typically prioritized academic competence and financial viability during their first year. For those facing significant economic constraints, Financial Management necessarily preceded other approaches—Student 4's full-time work while studying (section 4.2.2) constrained engagement with enrichment opportunities. However, students whose tuition was covered through gratuidad could deploy enrichment strategies earlier.

Once students achieved basic stability, they expanded into Professional Skill Development and Enrichment Opportunity Utilisation. Student 1's trajectory exemplifies this: after establishing academic competence and achieving some financial stability, he joined the Student Council, which provided opportunities to develop leadership skills and build networks across different student groups—"I started to feel a little bit more part of the School. It gave me the feeling of belonging" (section 4.4.2). In later years, persistent students combined multiple strategies simultaneously. Student 5's evolution from introversion to student government

participation while maintaining academic performance (section 4.4.2) illustrates this integration.

The data reveal asymmetric dependencies between patterns. The Academic Achievement Approach functions as necessary but insufficient—no student succeeded without it, yet alone it did not guarantee success. The Adaptive Coping Mechanism operates differently, functioning as a "catalytic strategy" that amplifies other approaches. Student 16's reframing of economic constraints as opportunities (section 4.2.3) transformed potential barriers into motivation, enhancing both Financial Management and Academic Achievement strategies.

5.4.4 Engineering-Specific Dimensions of Strategy Deployment

Many components of these strategies—financial management, family support, basic academic achievement—likely operate similarly across disciplines, as Walker et al.'s (2022) research on South African students suggests. However, the content and emphasis within each strategy pattern reflect engineering education's particular field characteristics:

Within the Academic Achievement Approach, mathematical proficiency operates as gatekeeping capital more intensively than in many fields. All students identified mathematical ability as central to engineering identity (section 6.2.1), reflecting mathematics's role as the "specific capital" defining legitimate field participation. Additionally, the problem-solving mindset that all 17 students developed (Table 5.2) reflects engineering's technocentric culture (Pleasants et al., 2025). Student 16's transformation—"Now, when I see a problem, I no longer say: Oh, how terrible! Now I say: how do I solve it" (section 5.3.3)—represents not merely a study skill but the embodiment of engineering's fundamental epistemic orientation.

The Professional Skill Development pattern takes on engineering-specific dimensions through gendered navigation strategies. Female students developed counter-habitus approaches to navigate engineering's masculine culture (section

6.3.2). Student 17's management of having achievements attributed to appearance rather than merit (section 5.2.3.2) required navigation tactics specific to engineering's gender dynamics that would manifest differently in female-majority fields.

Within Enrichment Opportunity Utilisation, the ability to leverage hands-on experience and vocational training as legitimate capital (section 4.3.5) responds to engineering's applied nature. Student 16's conversion of vocational port operations training into recognized engineering knowledge illustrates how working-class students' "funds of knowledge" (Smith & Lucena, 2016) can serve as distinctive resources in engineering but might be devalued in more theoretically-oriented disciplines.

The Adaptive Coping Mechanism and Financial Management Strategy show less engineering-specific content, operating similarly across disciplines. However, their deployment intensity may differ—engineering's demanding curriculum and time-intensive laboratory requirements create particular challenges for students balancing work and study.

Thus, while the five strategy patterns themselves may not be unique to engineering, their specific content, relative importance, and combination reflect engineering education's distinctive field logic.

5.4.5 Patterns of Strategy Combination

Students did not deploy these five strategies equally or in identical combinations. Analysis revealed that students tended to combine the strategies in three characteristic ways:

Some students (such as Students 2, 3, 6, 7) employed four or more of the five patterns simultaneously, demonstrating sophisticated navigation across multiple domains. These students typically possessed moderate cultural capital through

strong academic preparation and sufficient economic stability through gratuidad and family support, enabling them to deploy enrichment strategies early.

Other students (such as Students 12, 13, 14, 16) concentrated their efforts on only 2-3 of the five patterns, often due to severe economic constraints requiring intensive employment. Student 4's experience working full-time while studying necessitated focus on Academic Achievement and Financial Management at the expense of enrichment opportunities. However, these students often demonstrated particularly sophisticated deployment of their selected strategies.

A third group (Students 1, 5, 8, 15) showed increasing diversification of strategies over time, beginning with primarily the Academic Achievement Approach and gradually incorporating Professional Skill Development and Enrichment Opportunity Utilisation. Student 5's evolution from introversion to student government participation (section 4.4.2) illustrates this pattern, suggesting that strategic sophistication can develop through reflexive engagement with the field.

These different combination patterns reflect students' varied starting positions in terms of capital and the field's differential impact on their trajectories. Understanding these combinations illuminates both how disadvantaged students navigate engineering and how the field might be transformed through institutional recognition and support of diverse pathways to success.

In the Table 5.3, all the strategy integration patterns are summarised.

Table 5.3 Strategy Integration Patterns

Strategy Pattern Name	Core Strategies Used Together	Students Following This Pattern	Description
Academic Achievement Approach	Capitalising on academic excellence; Leveraging strong study habits; Building supportive networks	2, 3, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17	Focus on academic performance supported by effective study techniques and peer learning networks

Financial Management Strategy	Leveraging financial aid; Balancing work and study; Reframing economic constraints	3, 4, 7, 14, 16	Comprehensive approach to managing financial challenges while maintaining academic progress
Professional Skill Development	Developing communication skills; Developing leadership skills; Applying practical knowledge	1, 2, 3, 4, 5, 6, 10, 13	Deliberate cultivation of professional competencies valued in engineering
Enrichment Opportunity Utilisation	Accessing enrichment opportunities; Building supportive networks; Accessing faculty support	1, 2, 3, 5, 6, 7, 8, 9, 12, 13, 15	Strategic engagement with extra-curricular learning opportunities and supportive relationships
Adaptive Coping Mechanism	Reframing economic constraints; Adapting social interactions; Problem-solving mindset	2, 3, 6, 12, 13, 14, 16, 17	Transformation of challenges into growth opportunities through psychological adaptation

5.5 Conclusion

In this chapter, I examined the barriers and facilitators experienced by engineering students from disadvantaged backgrounds through Bourdieu's concepts of habitus, field, and reflexivity.

Key barriers included the habitus-field mismatch (15 of 17 students experienced a lack of belonging), rigid institutional practices (affecting 14 students), gendered field dynamics (female students reported having to "make an effort twice or three times to excel"), and the technical-social skills dichotomy that marginalised students with collaborative strengths.

Crucial facilitators included primary habitus support (parental encouragement for 16 students), institutional mechanisms for adaptation such as bridge programs (4 students) and faculty support (14 students), and most significantly, the development of reflexive habitus, with students demonstrating personal growth (14 students),

problem-solving mindsets (17 students), academic adaptation (15 students), and identity development (14 students).

The analysis revealed five integrated strategy patterns: Academic Achievement Approach, Financial Management Strategy, Professional Skill Development, Enrichment Opportunity Utilisation, and Adaptive Coping Mechanism. These patterns show how students strategically combine approaches to navigate barriers and leverage facilitators as part of an interconnected system rather than isolated factors. By focusing on the Chilean engineering education context, this work may broaden our understanding beyond the North American and European contexts that dominate the literature. However, more research would undoubtedly be valuable in exploring these patterns further.

This research contributes to understanding how disadvantaged students navigate engineering education, demonstrating both institutional reproduction tendencies and individual agency. The findings highlight the need for more inclusive engineering programs that value the diverse perspectives students from disadvantaged backgrounds bring to the field.

The next chapter analyses the construction of professional identity in the interviewed students, taking the analysis carried out as input.

.

Chapter 6: Developing Professional Identity as an Engineering Student

6.1 **Overview**

This chapter addresses the third specific research question: How and why do these students understand the role of the engineer and come to inhabit it? This leads to an exploration of engineering identity in student interviews.

This professional habitus includes problem-solving approaches, ethics, and communication styles. Students develop their professional identity through accumulating cultural (technical knowledge), social (professional networks), and symbolic capital (recognition within the profession).

Engineering identity encompasses how student engineers perceive themselves and are perceived within their campus culture (Tonso, 2006), including beliefs and expectations associated with being an engineer. Through Bourdieu's theoretical framework, I analyse this identity as a specialised habitus developing within the engineering field (Bourdieu & Wacquant, 1992). This professional habitus includes engineers' typical approaches to problem-solving, professional ethics, and ways of communicating in engineering environments. Students develop their professional identity through accumulating different forms of capital: cultural (technical knowledge and skills), social (professional networks), and symbolic (recognition and prestige within the profession).

Research establishes that personal, institutional, and sociocultural factors shape engineering identity. It evolves through educational experiences and professional practice, influenced by STEM exposure and practical applications (Capobianco et al., 2012; Simpson et al., 2023). Marginalised groups face unique challenges while navigating systemic barriers (Jorgenson, 2002; Smith & Lucena, 2016). Beyond technical competence, successful identity formation requires integrating professional values and developing a sense of belonging (Trede et al., 2012).

Technical-Professional Identity (Choe et al., 2019; Lakin et al., 2020): The acquisition of technical knowledge and analytical skills that traditionally define engineering practice.

Socio-Ethical Identity (Cech & Finelli, 2024; Conlon, 2008; J. A. Leydens & Lucena, 2014): The development of understanding regarding engineers' broader societal role and ethical responsibilities.

These dimensions reflect the tension between technocentrism and sociotechnical integration in engineering education (Faulkner, 2007; Pleasants et al., 2025). Their artificial separation creates what Cech (2014) terms a "culture of disengagement" that divorces technical expertise from social consciousness. This research examines how engineering students navigate and integrate these dimensions, illuminating identity formation processes that either reinforce or challenge this dualism.

6.2 Technical-Professional Identity

Engineering is fundamentally characterised by its technical dimensions, which form the core identity of the profession. As the literature describes, "technocentrism... foregrounds 'hard' technical dimensions of engineering while marginalising 'soft' social or cultural aspects, which are frequently not viewed as 'real engineering'" (Pleasants et al., 2025). Mathematics is the essential foundation for engineering education, providing "the foundational language and toolset for understanding and solving complex engineering problems" (Maass et al., 2019). It goes beyond mere computational skills, fostering "analytical and creative thinking, which are necessary for innovative engineering solutions" (Engelbrecht et al., 2012).

The interviewees primarily referenced the technical aspect of engineering identity through two central themes. First, students consistently emphasised mathematical and scientific skills as core components of being an engineer, often describing these competencies as the fundamental toolkit distinguishing engineers from other professionals. Second, students frequently characterised engineering work as a

process of negotiation between unknown and known paths, where technical expertise enables them to navigate uncertainty. These student perspectives reinforce how deeply technical proficiency is embedded in engineering identity formation, even as they begin to recognise the sociotechnical nature of engineering practice.

6.2.1 Technical Foundation: Mathematical and Scientific Skills

Mathematical and scientific skills are fundamental in shaping the engineer's identity (Haase et al., 2013; Patrick et al., 2018; Villanueva & Nadelson, 2017). These competencies are essential for academic success and are integral to how students perceive themselves as future engineers.

Several students illustrated how mathematical aptitude serves as a foundation for engineering identity. Student 3 explained:

"I have always liked the area of mathematics; all mathematical tools interested me. So I thought, okay, I like mathematics, so I'll be an engineer, but it was tough to decide which engineering major to study."

This connection between mathematical ability and engineering choice aligns with Major et al.'s (2018) findings about the influence of math and science identities on engineering pathways.

Student 1 shared a similar experience:

"Math always came easily to me, so I thought I would be a teacher. My aspiration was always to be a teacher, a physics teacher or something like that, so I chose the elective physics course."

This demonstrates how mathematical aptitude can serve as an entry point to engineering even when initial career goals differ.

However, not recognising oneself as a pure math person can work against the development of an engineer's identity. Student 2 expresses:

"I really consider that I was a very varied student because although I did very well in the 'logical-mathematical' area, in the last two years of my high school education, I realised that I also had language and 'soft skills' so to speak, which my teachers encouraged me to develop. I also participated in debate and litigation groups, which I consider fundamental in my academic formation. That's why there was a moment in high school when I didn't know what to study because I liked many things."

This statement illustrates how Student 2 occupies a 'third space' (Ingram & Abrahams, 2015) between engineering's traditional logical-mathematical orientation and more humanities-oriented skills. It provides an important example of how technical foundations interact with other skill domains in forming engineering identity.

Student 2's ability to value both technical and social dimensions aligns with research showing that engineering practice fundamentally depends on "distributed expertise enacted through social interactions" (Trevelyan, 2010). This positioning represents a boundary-crossing phenomenon (Akkerman & Bakker, 2011), where technical foundations are a starting point for navigating different disciplinary domains. McNair et al. (2011) would characterise this as demonstrating both institutional identity (formal engineering education with its technical requirements) and affinity identity (connection to humanities-oriented skills), suggesting that such boundary-spanning positions can be particularly valuable when technical knowledge must be applied to real-world problems. Research by Godwin et al.(2016) suggests that this integration correlates positively with engineering career choice, where broader skills complement strong technical foundations.

This 'third space' highlights both opportunities and challenges in professional identity formation where technical foundations meet broader skill sets. While mathematical competencies remain the core technical foundation for engineering identity, Student

2's experience illustrates how these skills can be enhanced when integrated with communication and critical thinking abilities.

The influence of both aptitude and practical considerations is further illustrated by Student 6, who stated:

"My parents always stressed the importance of education, but they didn't push me towards any specific field. I chose engineering because I was good at math and heard it offered good job prospects."

This reflects how engineering identity formation often involves personal ability, parental support, and pragmatic career considerations, aligning with research on self-efficacy beliefs in engineering persistence (Marra et al., 2012).

6.2.2 Technical Pathways: Negotiating Career Choices

The formation of an engineering identity begins even before entering university, shaped by individual dispositions, family background, and perceived career prospects. For some students, identifying as a future engineer aligns naturally with their existing habitus and cultural capital. As Student 9 explained,

"Family examples and prior interests in biology and math guide choice of major." She added, "My dad studied something related to Systems and was very into computing. I always saw him as very skilled and organised. Before, I struggled with the order, but now I feel the engineering career has made me more systematic and organised."

This seamless identification with engineering resonates with Bourdieu's concept of reproductive patterns in academic, middle-class families (Danielsson et al., 2019). Student 1 noted,

"My father studied Engineering at this university. Even though he didn't directly influence my decision, I always liked seeing him as someone who knew about everything, who could analyse situations from a systemic perspective."

These cases exemplify what Bourdieu terms 'fish in water' (Bourdieu, 1986), where an individual's dispositions are so well-matched to the engineering field that their professional identity development appears effortless. Familial expectations, personal aspirations, and early exposure create a conducive ecosystem for developing a robust engineering identity, demonstrating how social and cultural capital influence career trajectories.

For students from non-traditional backgrounds, engineering often represents an attempt at social mobility. Student 3 stated,

"Choose the major like I want to live up to the high expectations and achieve upward mobility."

This aligns with Kaufman's (2003) concept of "associational distancing" as the student frames their educational choice as a means of differentiation from their working-class background.

A striking finding reveals a complex pattern in professional identity formation: nearly half of the interviewed students had initially identified as future teachers before being redirected toward engineering. Student 14's experience exemplifies this identity negotiation:

"I wanted to be a teacher. Since I was 5 to 6 years old I wanted to be a math teacher and that is my dream, but in the end, talking about it with my parents, they said that the best thing was to study engineering and then I could teach classes with what I knew... for a money issue they found it more important."

This pattern of redirected aspirations reveals important insights about class origins and professional identity formation. According to Fang & Tilcsik (2022), class origins

influence occupational preferences, with working-class individuals often leaning toward prosocial work like teaching. Research suggests teachers are motivated primarily by intrinsic value, perceived teaching ability, desire to make social contributions, and working with children (Watt et al., 2012). Marrero et al. (2023) highlight that first-generation college students who become teachers often share characteristics with students in high-needs schools and may be particularly motivated to serve as role models.

The transition from teaching toward engineering often reflects family aspirations for upward mobility. According to Lehmann (2009a), working-class students often approach university with a utilitarian orientation, viewing it as a means to an end rather than a transformative experience. They usually choose their careers based on their perceived identity compatibility and anticipated acceptance at low- and high-status universities. Social identity, academic achievement, and SES influence their career choices. Many working-class students may feel deterred from applying to elite universities due to perceptions of elitism and a lack of fit with their social backgrounds (Manstead, 2018).

Student 7's reflection illustrates the pull factors:

"if you say you study engineering, people are impressed and see it as much more than other careers, linking it to higher earning potential and prestige."

Similarly, Student 4 emphasised:

"There is a stigma that engineers will earn more money and that the career is more difficult or lasts longer than other, less complicated careers."

The striking finding that nearly half of the interviewed students initially identified as future teachers before being redirected toward engineering reveals what Bourdieu would identify as a "cleft habitus" (Friedman, 2016; Ingram & Abrahams, 2015). Student 14's experience captures this tension vividly:

"I wanted to be a teacher... but in the end, talking about it with my parents, they said that the best thing was to study engineering... for a money issue, they found it more important."

This redirection illustrates how field dynamics, capital distribution, and habitus interact to produce educational choices that sometimes contradict students' initial aspirations.

Rather than experiencing this disjuncture as problematic, many students develop "integrative professional identities" that synthesise these seemingly contradictory dispositions. By incorporating prosocial values from their teaching aspirations into their engineering practice, these students potentially transform both their professional trajectories and the engineering field. This integration exemplifies Decoteau's (2016) concept of layered habitus, where students maintain multiple dispositions that they strategically deploy across different contexts.

This phenomenon highlights the need for educational environments that validate diverse pathways to engineering identity, recognising that many future engineers bring valuable prosocial orientations that can enhance the profession. While Lehmann (2009) identifies a utilitarian approach to higher education among working-class students, genuine professional identification requires more than instrumental motivation. Engineering education that acknowledges these complex motivations can help students integrate technical expertise with social awareness (Cech & Finelli, 2024; Conlon, 2008; Martin et al., 2021; Trevelyan, 2010), potentially developing engineers who approach technical problems with heightened concern for their social implications and ethical dimensions.

6.3 Social-Ethical Identity

In my analysis of engineering students' identity formation, I found a significant dimension related to their growing awareness of engineers' social and ethical responsibilities. Through their educational journey, students progressively

understand that being an engineer involves more than technical expertise and requires considering social impact, ethical implications, and responsibility toward society (Cech & Finelli, 2024; Leydens & Lucena, 2018; Riley, 2008). This transformation in their professional identity emerges clearly in several interviews and aligns with current literature emphasising the importance of social awareness in engineering education.

6.3.1 Awareness of Ethical Responsibilities and Engineering Impact

6.3.1.1 Developing Awareness of Engineering's Social Impact

As I analysed the data, I found that as students progressed, many developed a broader understanding of engineering's societal impact. As students progress through the program, their evolving perspectives on being an engineer lead from technical competence to social responsibility and, eventually, towards recognising the ethical aspects of engineering. I observed that Student 8 initially viewed engineering as primarily laboratory work, but later developed a more expansive perspective:

"I thought that I was going to end up working in a laboratory... but in the progress of my career, one realises that one can simply work where there are processes, like in food, water and those kinds of things."

She also mentioned developing an interest in environmental aspects of engineering:

"I feel that more than social it is like environmental, I think it goes more that way, the carbon footprint; I feel that one can act more there than in the social area because we have more resources for that."

This development in students' ethical awareness parallels findings by Ashwin et al. (2014), who observed sociology students' progression from technical/content-focused conceptions toward more integrated perspectives recognising the relationships between their discipline, society, and themselves. Like these sociology

students, engineering students in our study demonstrate an evolution from predominantly technical approaches toward holistic understanding that incorporates ethical and environmental considerations.

The literature on engineering education suggests that transformation of ethical consciousness occurs through experiences revealing societal consequences and dilemmas of engineering work (Cech & Finelli, 2024; Pesch, 2015), particularly courses integrating ethics as an engineering dimension (Hamad et al., 2013; Herkert, 2000; Newberry, 2004), internships exposing professional realities, and projects with humanistic goals (Conlon, 2008). However, my research did not systematically capture these specific curricular mechanisms, as interview questions focused on general identity trajectories rather than particular pedagogical interventions. The available empirical evidence, though limited, suggests that some curricular spaces contributed to the development of social consciousness. Student 3 identifies courses like Macroeconomics and Organisational Behaviour as spaces for raising awareness. At the same time, Student 9 developed her thesis project on water treatment for rural areas lacking sewerage or sanitation, integrating technical and social dimensions. Nevertheless, several students note the general scarcity of such spaces:

"There are few instances to turn engineering into something social... many courses are very technical" (Student 9).

Consequently, while I can document that students developed evolving ethical awareness throughout their education, transforming their understandings from purely technical visions toward perspectives incorporating social responsibility, I cannot precisely specify the curricular mechanisms through which this occurred, nor determine whether specific ethics courses are common, mandatory, or elective in the Chilean context. This limitation represents an important direction for future research that systematically examines how the curricular structure in Chilean engineering programs facilitates or hinders the development of socio-ethical consciousness.

Student 9 showed some shift towards considering the broader impacts of engineering, particularly in environmental areas:

"My thesis I'm doing it like in... we're in a water treatment plant like designing it for a rural area that doesn't have sewerage or sanitation, so one kind of gets more into that side and could do it, although this area doesn't appeal to me as much as the water treatment area, but it exists equally."

While not a dramatic shift, this student did mention developing more awareness of engineering's role in sustainability:

"They always taught us sustainability as something that should encompass the social side as well, but it's hard to make it the protagonist in a career that's not focused on... I don't know how to explain it, not because they haven't focused it on that but because there simply isn't the space, it's more technical."

I interpret this as reflecting the growing recognition in engineering education of the need to prepare students for the complex societal impacts of their work (Emison, 2011).

The role of engineering in social justice is evidenced in a fragmented way by most students and more completely by a few. Leydens and Lucena (2014) define social justice criteria in engineering practices. The criteria focus on listening contextually, identifying structural conditions, acknowledging and mobilising power, increasing opportunities and resources, reducing imposed risks and harms, and enhancing human capabilities. For some students, such as Student 4, the societal role of engineering became apparent through experience with a community:

“Being social and working with others gave me a sense of social responsibility and desire to work on impact as an engineer”, she said.

Still, others, such as Student 9, had course experiences that changed how they saw themselves:

“Precisely, seeing how the social impact of engineering is possible, such as just seeing the environmental applications of engineering, which I sort of experienced as specific to be somehow good”.

In this way, what had previously been abstract concepts in ethics became tangible and personal for our participants. Students began seeing themselves as people who did more than solve technical problems. They were professionals whose work had impacts beyond the technical realm and carried responsibilities toward considering those impacts. I referred to this in Chapter 2 as ‘seeing 'engineering as a vehicle for positive societal contributions. This evolution aligns with Leydens and Lucena's (2014) argument for integrating social justice perspectives into engineering curricula.

Engineering continuously transforms due to changing contexts, emphasising the increased complexity and interdependence of technical and nontechnical aspects. Engineers need to consider human elements, management, political aspects, and public involvement alongside technical skills for success (Emison, 2011). This transformation in engineering values and practices is crucial for the profession's relevance and leadership role in society.

This idealism was tempered by a growing awareness of structural constraints and moral dilemmas embedded in the profession. Questions of power, equity, the limits of technological solutions to social predicaments, and the transformation of the engineering role from technical expert to one embedded in broader management roles all emerged as critical concerns for our participants.

Student 10's reflection on being:

"faced with a culture of meritocracy and competition that can sometimes seem quite alienating",

reveals the tension between their developing professional identity and the institutional habitus of engineering education. This alienation signals the recognition of field-specific values that may conflict with students' personal dispositions.

Student 13's reflection that:

"without connections, you can't get an internship, there isn't always equity or meritocracy" illustrates the recognition of the field's hidden rules, where social capital often trumps cultural capital in determining professional opportunities. This insight reveals the student's developing feel for the game within engineering practice.

The apparent contradiction between Student 10's experience of alienating "meritocracy and competition" and Student 13's critique of the lack of meritocracy in internship opportunities reflects what Sayer (2009) describes as the complex relationship between habitus and reflexivity, revealing the layered inequities embedded in higher education systems. Following Sayer's argument, these competing narratives illustrate how "the semi-conscious responses that arise from the dispositions of our habitus merge into the conscious monitoring of our internal conversations" (2009, p. 121).

Rather than representing inconsistent observations or pure structural determinism, these perspectives demonstrate students' developing capacity to embody field-specific dispositions while critically evaluating them. This tension also highlights how the field simultaneously operates through competing logic: formal meritocratic structures ostensibly reward academic achievement regardless of background, yet these same structures systematically advantage affluent students who possess the cultural, social, and economic capital to excel within institutional parameters.

Even when working-class students overcome barriers to achieve academic success, navigating what Bourdieu might term the "rules of the game", they often remain disadvantaged in securing prestigious opportunities like internships, where informal networks, unspoken cultural competencies, and financial resources to support unpaid work create invisible yet powerful selection mechanisms. This dynamic creates a particularly painful double bind where working-class students must invest in and legitimise a meritocratic system that simultaneously excludes them through both explicit and tacit mechanisms of class reproduction.

Student 14's critique of pedagogical approaches reveals competing values within the engineering habitus:

"There was a phrase that a professor said: 'We study to be bosses, and the rest are here to serve us.' So I told him I didn't agree and that in a team it's about being a person who makes everyone else want to follow you."

This contestation represents a heterodox position that challenges traditional hierarchical relationships embedded in engineering practice while simultaneously exposing the deeply classist underpinnings of professional identity formation. The professor's statement nakedly articulates an ideology that positions engineers as a middle-class managerial elite destined to direct the labour of working-class "others," reinforcing social stratification through occupational boundaries. By framing leadership as making others "want to follow you" rather than commanding obedience, Student 14 resists this explicit class-based domination and questions the naturalisation of class distinctions that position working-class workers as passive "sheep" requiring guidance from their supposedly more capable middle-class superiors.

Nevertheless, students maintain “illusio” (Bourdieu, 1998b; Bourdieu & Wacquant, 1992), the fundamental belief in the game's value despite its contradictions. Student 16's motivation that:

"What moves me and keeps me strong isn't the now but the future... when I'm an engineer, I can earn a good salary, I can help my family", demonstrates continued investment in engineering's promises despite present challenges.

Similarly, Student 11's belief that:

"Using technology, you can make an impact on everyday life", reflects an attempt to align technical knowledge with socially meaningful outcomes.

Similarly, Student 1's desire to "broaden visions about what impact as an engineer can be" demonstrates active negotiation of professional identity beyond technical competence, suggesting reflexive engagement with the engineering field's evolving boundaries.

Student 14's reflects:

"I'm a little more grounded than I was... I realise that it's not as easy as I thought, that things wouldn't just happen on their own".

This demonstrates the emergence of a more nuanced understanding of agency within structural constraints. This awareness does not necessarily lead to cynicism or disengagement but instead to what Sayer, drawing on Murdoch, describes as moral attention, "a small piecemeal business which goes on all the time and not a grandiose leaping about unimpeded at important moments" (Murdoch, 1970, as cited in Sayer, 2009, p.118).

This reflexivity represents personal growth and a sociological process through which engineering students develop a complex understanding of their position within professional power structures. Students' developing capacity for ethical reflection enables them to critically engage with engineering's social dimensions while remaining committed to their professional development. This combines what Bourdieu calls a "feel for the game" (1998b) with what Sayer identifies as our capacity for moral attention and evaluation (2009), opening possibilities for students to envision alternative professional practices and potentially reshape engineering's field from within, even as they continue to participate in its structures.

Through this developmental process, students cultivate what might be called a 'bifocal professional vision', maintaining simultaneous awareness of engineering's technical aspects and its potential for social transformation. This bifocal vision appears particularly pronounced among students from disadvantaged backgrounds, whose class experiences and motivations often create a productive tension between

desires for economic security and meaningful social contribution. Student 1's desire to 'broaden visions about what impact as an engineer can be' and Student 14's critique of hierarchical professional relationships illustrate this dual consciousness. Rather than experiencing this tension as purely problematic, many students develop integrative professional identities that synthesise these apparently contradictory dispositions. This professional vision enables them to recognise engineering's technical demands while maintaining a critical awareness of its social implications and potential for positive change.

As students progress in their engineering education, their ethical awareness often evolves beyond simply recognising engineering's social dimensions to actively questioning the field's fundamental assumptions and power structures. This deeper engagement represents what Bourdieu and Wacquant (1992) term "epistemic reflexivity", the capacity to examine the taken-for-granted premises that structure engineering practice critically. Unlike surface-level awareness that might acknowledge ethical considerations without challenging engineering's core paradigms, this reflexive stance enables students to recognise contradictions between engineering's meritocratic ideals and their lived experiences of structural inequalities. This progression from basic ethical recognition to critical reflexivity marks a significant development in students' professional identity formation, creating the potential for personal transformation and broader field change. This reflexivity emerges most clearly when students confront contradictions between engineering's meritocratic ideals and their experiences of structural inequalities.

Student 13's critique of internship access:

“Because without connections, you can't get [an internship]. I don't like this”,

This reveals a growing awareness of how social capital operates within the engineering field. Similarly, Student 14's challenge to a professor's hierarchical framing of engineering:

“[The professor said that] We study to be bosses, and the rest are here to serve us”,

Student demonstrates critical engagement with engineering's traditional power structures.

Significantly, this reflexivity does not lead to disengagement but rather to a more intentional and critical form of participation. Student 1's desire to: “broaden visions about what impact as an engineer can be” demonstrates how students maintain what Sayer (2009) calls ethical reflexivity even as they navigate the field's technical demands. This developing epistemic reflexivity represents a potential source of field transformation, as students from diverse backgrounds bring critical perspectives to engineering practice that may challenge its established assumptions and potentially reshape its values and priorities.

6.3.1.2 Conceptualising Social Justice from Lived Experience

The interviewed students articulate conceptualisations of social justice that resonate with the dimensions identified by Leydens and Lucena (2014), though emerging from their lived experience rather than formal theoretical frameworks. Student 1 conceptualises social justice as collective responsibility, noting that:

"There is no social justice because we ourselves don't allow it... it has a lot to do with the social consciousness one has," while identifying a structural problem in engineering education: "the social purpose of the engineer is completely lost, people don't have it clear."

These student narratives reveal ways that map onto specific dimensions of Leydens and Lucena's (2014) social justice framework. Student 1's recognition that "the social purpose of the engineer is completely lost" specifically highlights structural conditions within the engineering field. Student 9's "bubble" metaphor illustrates the critical importance of listening contextually: how segregated educational contexts can render injustice invisible even to well-intentioned future engineers.

Student 8 articulates how awareness of structural inequalities informs understanding of the engineer's role:

"I realised that there are things that are unjust for me, not only regarding gender but also regarding the benefits people have, the realities they live, regarding work or unemployment, how much they earn, whether they have resources or not."

Significantly, students from disadvantaged backgrounds articulate social justice not as abstract principle but as lived relationality, identifying structural conditions through embodied experience rather than theoretical instruction.

This awareness of structural conditions emerges distinctively according to students' prior educational contexts. Those from resource-limited educational settings articulate social justice from direct experience of inequality in their access to higher education. Student 3, recognises how public policies (free-tuition) transformed possibilities for access:

"when they gave the option to study for free, for my family it was great support." Once in engineering, some courses became spaces where he "learned with tangible data, the levels of inequality that exist in Chile," connecting lived experience with structural analysis.

Student 4, who worked while studying, develops awareness of how economic constraints differentiate experiences within engineering:

"(my) classmates are from families with much better economic situations... you see fewer classmates doing both things at once [working and studying]."

In contrast, students from better-resourced schools, particularly from the capital city, develop this awareness through the contrast that the regional university provides. Student 9, who attended a high school in Santiago, reflects:

"before, in my high school I felt I was in a bubble, like I didn't see that there were people who lacked things... when entering university one realises many things."

The regional university, with its greater socioeconomic diversity, thus becomes a space of confrontation with realities previously made invisible by Chile's educational segregation, functioning as what Leydens and Lucena would describe as a context enabling "listening contextually."

Student 1 identifies this structural disconnect: engineering should work "to improve society, not to make money," but recognises this vision is absent from the dominant curriculum. This tension reveals how social justice awareness frequently develops outside formal engineering education, emerging in extracurricular spaces like the Student Council, 2018 student movements, the 2019 social uprising, and organisations such as gender areas.

Student 5 explicitly articulates this extracurricular transformation:

"The engineering school, I think, has also been very important... with Macroeconomics and Organisational Behaviour and courses like that... I told myself, now it's an obligation, not even like an option, but as a citizen, 'I have to...'" but notes that feminism and the Student Council were key politicisation spaces beyond classrooms.

The condition of low resources among these students does not simply translate into deficit, but into a distinctive form of "experiential capital" that allows them to identify dimensions of injustice that remain invisible to peers from more protected educational contexts. Student 1, who describes having a "hillside[10] life," develops a specific positioning:

[10] From a working-class neighbourhood

"I feel much more capable... there are many kids who still haven't awakened because they haven't been pushed... I think it's also part of my role as an agent of change."

This agency manifests relationally:

"my role in that sense of helping my classmates awaken so that people with hunger emerge... people wanting to do things, changes, improve their life and the life of others."

Student 6 articulates how their trajectory positions them to democratize access: "there must be a communication network... that a career not be specifically for men or women, but be global."

This finding makes three analytical contributions to understanding social justice in engineering education. First, it reveals that the disadvantage faced by marginalised students paradoxically functions as an epistemic advantage; their "experiential capital" provides critical awareness that privileged peers must consciously cultivate. This inversion challenges deficit perspectives on disadvantaged students while simultaneously highlighting structural barriers within engineering education that limit explicit engagement with social justice.

Second, it demonstrates that social justice consciousness develops primarily through extracurricular spaces and peer contrast rather than formal curriculum, suggesting that technical-social integration in Chilean engineering education remains largely aspirational. The predominance of technical content and the scarcity of "instances to turn engineering into something social," as documented by students, signal a structural disconnect between discourse about engineering's social responsibility and its curricular operationalisation.

Third, it extends Godwin et al.'s (2016) concept of "critical engineering agency" by showing how this agency emerges not from individual psychology but from collective positioning within stratified educational systems. Students develop not only technical capability but also a critical awareness that they can positively impact the world

through engineering. This is precisely because their trajectory has revealed dimensions of injustice that traditional engineering education tends to naturalise or obscure.

6.3.2 Gender Dynamics in Engineering Education

Gender is a pervasive force shaping societal structures and individual choices, particularly in the context of engineering (Faulkner, 2007). In my exploration of gender dynamics in engineering education, I have found that gender plays a significant role in shaping students' experiences and identity formation. This is consistent with the idea that the engineering identity is developed in gendered forms through everyday practices, institutional activities, and symbolic representations (Du, 2006). The idea of gender neutrality is challenged, as an engineer's job is never truly gender-neutral (Gill et al., 2008).

Although student 7 reported not feeling discriminated inside her engineering school, she acknowledged the common stereotypes people held about engineering as a male-dominated field:

"If you say engineering, people ask, Is it a career for men? Are there few women or how many women are there?, they always ask the same questions but with whoever, whether they love you or not, it can be your dad, your mom, the person you trust the most, it will always be the same answer; so one gets used to what you are going to hear and what you are going to answer." (Student 7).

Student 10 is a female student who recounted several instances of gender stereotypes and discrimination.

"At high school, my math teacher always said engineering was for men and they were 'better' at it than women.".

Her experience reveals early anticipatory socialisation (Seron et al., 2015) and uncloses how girls develop their earliest conceptions of engineering and potential

career aspirations (Capobianco et al., 2012). Student 10 describes experiencing discrimination in an engineering class, where men were presumed to have more prior knowledge:

"I felt discriminated in an engineering computing course,(…) I missed the first class, and in the second class (…) it was a numerical code that I had never seen in computer science in my life. Nevertheless, for men, they made it easier because they saw women, and it was like they were lost and had to learn, but men did have the knowledge and explained it."

To understand why engineering is gendered in this way, invoking Bourdieu's notion of habitus is helpful. The habitus here is 'masculinised' and takes on 'different forms depending on the specific socialisation processes of men and women' (Bonaldi & Silva, 2014, p. 272). Masculinised work environments in engineering create additional challenges for women and underrepresented groups.

Student 17 reported:

"I struggled with sexism, with my achievements attributed to my appearance rather than my efforts and abilities. For example, if I got a good grade, it was always attributed to something else, like, for example, you got that grade because the teacher finds you pretty, because you have a good butt, etc., in the end, it was never on my own merit, and the reality is that I was killing myself studying.".

This powerful quote illustrates how women's achievements in engineering are often dismissed or attributed to factors other than their intelligence and hard work. Women engineers must make more effort to manage identities different from those of their male peers (Du, 2006). This reflects the gendered culture of engineering, where women face additional barriers to being recognised as competent engineers (Faulkner, 2007). These experiences can lead to alienation, as identities are perceived as incompatible with the dominant images of the engineer. This resonates with the 'glass obstacle course' (Welde & Laursen, 2011), a metaphor for the

gendered mechanisms women face in STEM, including exclusion, sexism, absence of role models, and difficult choices about work-life balance.

The engineering culture strongly emphasises empirical science, technical thinking, meritocracy, and individualism and tends to depoliticise issues like gender equality, considering them as social and subjective matters outside its domain (Seron et al., 2018). Within this culture, gender norms influence perceptions of authenticity in engineering roles, creating pressures for individuals to conform to existing gender expectations (Faulkner, 2007). Despite these challenges, some women commit to using engineering for socially responsible purposes and making a difference in society (Seron et al., 2015).

Female students like Student 17 and Student 7 do not simply internalise gender-based symbolic violence but actively contest it through what might be termed 'counter-habitus strategies'—conscious adaptations that challenge field assumptions while navigating its constraints. Student 7's recognition that 'I always feel that they're going to prefer a man' while maintaining her professional identity demonstrates this paradoxical position where women simultaneously acknowledge field constraints while refusing to be defined by them. Student 17's persistent focus on her academic achievements despite having them attributed to her appearance represents a form of symbolic resistance. These counter-habitus strategies extend beyond mere coping mechanisms; they actively contest the field's gendered assumptions while working within its structures. This simultaneous accommodation and resistance reveal how female students engage in sophisticated identity work to establish their legitimacy in a field that continues to be dominated by masculine norms and expectations.

6.4 Summary of Themes in Engineer Identity

The following table is an overview of the aspects and themes students addressed in relation to engineer identity.

Table 6.1 Aspects of Engineer Identity

Aspect of Engineer Identity	Theme	Student Contributors
Technical-Professional Identity	Technical Foundations: Mathematical and Scientific Skills	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
	Technical Pathways: Negotiating Career Choices	1, 2, 3, 5, 7, 8, 10, 14
Socio-Ethical Identity	Awareness of Ethical Responsibilities and Engineering Impact	1, 2, 3, 4, 5, 6, 8, 9, 10, 13, 14
	Gender Dynamics in Engineering Education	4, 5, 6, 7, 8, 9, 10, 11, 12, 17

6.5 Conclusion

In this chapter, I use Bourdieu's concepts to understand the development of engineering identity among students. The student's affinity for math and science as a valuable engineering capital represents a good starting point for building an engineering identity. However, students from non-traditional backgrounds, like Student 3, experienced a "habitus dislocation" when entering the engineering field, as their dispositions did not initially align with the dominant culture, putting the engineering identity development process at risk.

The engineering profession can be considered a field with its own rules, values, and practices that individuals must navigate to succeed. The chapter highlights how the engineering field is gendered, with a masculine habitus that can create challenges for women and underrepresented groups. Students like Student 17 and Student 10

faced gender stereotypes and discrimination, illustrating how the field's power dynamics can shape experiences of belonging or marginalisation.

Bourdieu distinguishes between different forms of capital, such as cultural, social, and economic capital, which individuals can mobilise to navigate fields. In the chapter, students leveraged various forms of capital to develop their engineering identities. For example, Student 3 accumulated social and cultural capital through extracurricular involvement and leadership roles to foster a sense of belonging. Students like Student 1 and Student 7 engaged in social activities and formed supportive peer groups, leveraging social capital to enhance their engineering experiences.

In this chapter, I also highlight how students' engineering identities evolve through their experiences and interactions within the field. Pivotal moments and crises, such as academic setbacks or existential doubts, can trigger processes of reflection and re-evaluation, leading to a more internalized sense of professional identity. Moreover, students' growing awareness of the social impact and ethical responsibilities of engineering through community engagement and transformative coursework contributes to their sense of purpose and professional identity.

Their candid narratives deliver a glimpse of this reflexive path as they become engineer identities; their journeys also demonstrate the utmost value of cultivating supportive, inclusive environments to recognise the range of experiences that students bring.

Those students leave school not just with technical skills but also with an ethos, an agency, an ability to deal with challenges, and an accountability for the outcomes of their educational experiences. The challenges are real, but so are their capabilities and the potential for them to develop as engineers, leaders and agents of change. When we support them to be who they are, be who they can be, bring their full selves to their work and lives, engage, be seen, and be heard, we can develop a new breed.

Chapter 7: Conclusions

7.1 Overview

In this concluding chapter, I reflect on how my research addresses the central question: "How do engineering students from disadvantaged backgrounds in Chile see and experience their education as a means of promoting social mobility?" Through an analysis of in-depth interviews with 17 engineering students at a regional university in Chile, I have examined their experiences through the lens of Bourdieu's theoretical framework (Bourdieu, 1986; Bourdieu & Wacquant, 1992), revealing complex patterns in how they navigate their educational journeys. My research has focused mainly on their capital mobilisation strategies, encounters with barriers and facilitators, and professional identity development.

7.2 Addressing the Main Question

This research's findings reveal that these engineering students from disadvantaged backgrounds view and experience their education as a transformative journey that extends far beyond mere academic achievement or career preparation. They see engineering education as a complex path of personal transformation that encompasses multiple dimensions of mobility - economic, social, and cultural. These students demonstrate remarkable resourcefulness in developing strategies to navigate challenges and create opportunities for success.

My research reveals that these students engage in sophisticated capital accumulation and mobilisation practices that challenge deterministic interpretations of Bourdieu's theory. Rather than being passive victims of their position within the social structure, these engineering students actively develop complex strategies that demonstrate agency within structural constraints. The five distinct patterns I've proposed —Academic Achievement Approach, Financial Management Strategy, Professional Skill Development, Enrichment Opportunity Utilisation, and Adaptive Coping Mechanism—represent what Bourdieu might call "regulated improvisations"

(1990, p. 57), where students creatively navigate the field while still operating within its structural parameters. These patterns illuminate the dialectical relationship between structure and agency that sits at the heart of Bourdieu's theory of practice. Students transform economic necessities into chosen strategies, convert cultural limitations into opportunities for distinction, and reshape social constraints into platforms for connection. Through these integrated approaches, students embody what authors have called "reflexive habitus" (Adkins, 2003; Decoteau, 2016; Sweetman, 2003), consciously adapting their dispositions to navigate the field of engineering education while maintaining connections to their primary habitus. This strategic adaptation process challenges simplistic notions of social reproduction by revealing how disadvantaged students actively transform their social positioning rather than merely reproducing it.

Following Decoteau's (2016) conceptualization, layered habitus suggests that students maintain multiple, sometimes contradictory dispositions that they deploy in different contexts. For instance, a student might display academic formality and intellectual curiosity in classroom discussions while adopting casual language and different social norms when interacting with peers outside class. Similarly, first-generation college students often navigate between the working-class dispositions of their home communities and the middle-class expectations of university settings, code-switching between these different habitus layers as they move between family and academic environments. This layering is particularly relevant for students from disadvantaged backgrounds who must navigate between their primary habitus (shaped by family and early experiences) and the new habitus demanded by the engineering field. Each strategy pattern demonstrates different approaches to managing these layers of habitus, from integration to compartmentalisation.

7.3 Key Findings

Through a Bourdieusian lens, my research reveals the complex interplay between structure and agency in engineering education, illuminating how field dynamics,

capital distribution, and habitus formation shape students' experiences and trajectories. The findings demonstrate that engineering education functions as a field of struggle. In this social space, students compete for specific forms of capital while navigating the field's implicit rules and hierarchies.

My analysis of professional identity formation in engineering reveals a dialectical process shaped simultaneously by technical-professional and social-ethical dimensions. This duality reflects what Khosronejad et al. (2021) identified as complementary dimensions of professional development, but my findings extend this understanding by revealing how class origin fundamentally shapes this dialectic. Students from disadvantaged backgrounds develop what might be called a "bifocal professional vision", maintaining simultaneous awareness of engineering's technical aspects and its potential for social transformation. This bifocal vision appears to be connected to class-based experiences and motivations, as documented in the literature. As Lehmann (2009b) demonstrates, working-class students often approach university with a more utilitarian perspective, viewing education pragmatically as a means to an end rather than a purely intellectual pursuit. This instrumental orientation coexists with what in the literature (Fang & Tilcsik, 2022; Reay, 2003) has been identified as a strong desire among working-class students to contribute to their communities and create meaningful social impact. While middle-class students may also balance technical and social dimensions in their professional identity formation, the specific tension between economic security and social contribution appears particularly salient in my sample of disadvantaged students. Further comparative research would be valuable to determine whether this represents a distinctive professional perspective or reflects broader patterns across different social backgrounds in engineering education.

This complex interplay of motivations contributes to a "habitus dislocation" (Baxter & Britton, 2001; Lehmann, 2013) that, rather than being purely disadvantageous, can foster critical awareness of both technical and social dimensions of professional practice. This "bifocal professional vision" represents what Bourdieu terms "the

hysteresis effect" (Bourdieu, 1977) —the productive tension between students' primary habitus (shaped by their social origins) and the field's technical demands.

Technical knowledge acquisition is not merely a matter of academic competence but is deeply embedded in social class relations. While mathematical proficiency serves as a form of cultural capital enabling field entry (Major et al., 2018), my findings reveal how students strategically transform this capital through what Bourdieu (1984) calls "reconversion strategies." For example, student 16's ability to connect vocational training in port operations to theoretical engineering concepts demonstrates what Smith and Lucena (2016) call "funds of knowledge". However, it further shows how students actively translate practical knowledge into academically valued capital. This process represents a sophisticated form of capital conversion whereby students transform embodied cultural capital from one field into recognised capital in another.

The gendered nature of the engineering field emerged as a potent structuring force, functioning as what Bourdieu would recognise as "symbolic violence" (Bourdieu, 1993) - the imposition of systems of symbolism and meaning upon groups in such a way that they are experienced as legitimate. Female students like Student 17 experienced this violence directly: "If I got a good grade, it was always attributed to something else, like... You got that grade because the professor finds you pretty... in the end it was never due to my own merit." What's theoretically significant is that these female students did not simply internalise this symbolic violence but actively contested it through practices of resistance. They developed "counter-habitus strategies"—conscious adaptations that challenge field assumptions while navigating its constraints. Student 7's recognition that "I always feel that they're going to prefer a man" while simultaneously maintaining her professional identity demonstrates this paradoxical position where women simultaneously acknowledge field constraints while refusing to be defined by them. This extends Faulkner's (2007) work on "gender authenticity" by revealing how female students engage in symbolic resistance even as they acquire technical competence.

The data reveal a significant tension in professional identity formation between students' origins and engineering's professional culture. Nearly half of the interviewed students initially identified as future teachers before being redirected toward engineering, revealing what Bourdieu would identify as a "cleft habitus" (Friedman, 2016; Ingram & Abrahams, 2015)—torn between the prosocial orientation associated with their class background and engineering's technical-professional emphasis. Student 14's experience captures this tension: "I wanted to be a teacher... but in the end, talking about it with my parents, they said that the best thing was to study engineering... for a money issue, they found it more important." Rather than experiencing this tension as purely problematic, many students developed what I term "integrative professional identities" that synthesise these apparently contradictory dispositions. This integration process demonstrates what Decoteau (2016) describes as "layered habitus," where students maintain multiple, sometimes contradictory dispositions that they strategically deploy in different contexts.

A crucial finding is that successful navigation of the engineering field does not simply involve acquiring dominant forms of capital but instead developing a reflexive relationship to the field itself. Students' growing awareness of engineering's social-ethical dimensions represents what Bourdieu and Wacquant (1992) term "epistemic reflexivity"—the capacity to recognise and question the field's underlying assumptions. Student 13 critiques internship access, "Because without connections, you cannot get [an internship]. This reflexivity does not lead to disengagement but rather to a more intentional and critical form of participation. Student 1's desire to "broaden visions about what impact as an engineer can be" demonstrates how students maintain what Sayer (2009) calls ethical reflexivity even as they navigate the field's technical demands.

These findings demonstrate that engineering education functions simultaneously as a site of social reproduction and potential transformation. The patterns of capital mobilisation, habitus adaptation, and field navigation identified in this research

reveal how students from disadvantaged backgrounds exhibit remarkable agency within structural constraints, challenging deterministic interpretations of Bourdieu's theory while confirming its fundamental insight that social action emerges from the dynamic interplay between embodied dispositions and structural possibilities.

7.4 Theoretical Contributions

My research extends Bourdieu's theoretical framework in several ways, which I present in terms of alignment and divergence with existing literature:

7.4.1 Expanding Understanding of Capital Mobilisation in Engineering Education

My research contributes to a more nuanced understanding of how students from disadvantaged backgrounds can accumulate and mobilise various forms of capital throughout their engineering education. While previous research has identified the importance of different capital forms in educational trajectories (Bathmaker et al., 2013; Martin & Spenner, 2009; Reay, Davies, et al., 2001), my work offers new insights into the specific strategies engineering students develop to leverage their available resources.

The strategy integration patterns I have identified extend beyond existing categorizations by providing a richer framework for understanding how students combine multiple forms of capital simultaneously. I identified twelve distinct strategies students employed across economic, cultural, and social capital domains, which they integrate into five predominant patterns: Academic Achievement Approach, Financial Management Strategy, Professional Skill Development, Enrichment Opportunity Utilisation, and Adaptive Coping Mechanism.

This contributes to knowledge by showing how students actively construct and transform capital rather than simply possessing or lacking it. As O'Shea (2016) suggested in her work on first-generation students, individuals can draw upon and repurpose existing resources in novel ways. My research extends this understanding

by revealing the dynamic ways students integrate multiple forms of capital simultaneously, particularly in the context of engineering education.

7.4.2 Reconceptualising Habitus Through the Lens of Engineering Education

My research contributes to theoretical conversations about habitus by applying Decoteau's (2016) concept of layered habitus to engineering education. This perspective provides new insights into how students maintain and integrate multiple identities rather than simply adopting a new professional habitus at the expense of their original dispositions.

Through analysis of student experiences, I found evidence of how habitus operates in the specific context of engineering education, where technical competence and social-ethical awareness must be developed simultaneously. This context creates unique tensions for students from disadvantaged backgrounds who must navigate between the dispositions formed through their primary socialisation and those demanded by the engineering field.

By examining these tensions through Bourdieu's conceptual framework, I extend my understanding of how habitus functions at the intersection of social class, gender, and professional identity formation. My findings suggest that successful navigation of engineering education involves developing a "reflexive habitus" (Adkins, 2003; Decoteau, 2016; Sweetman, 2003), the conscious awareness of and ability to adapt one's dispositions to different contexts, which aligns with research on the role of reflexivity in social action (Archer, 2010; Sayer, 2009)

7.4.3 Illuminating the Complex Dynamics of Professional Identity Formation

My research contributes to scholarly conversations about engineering identity by revealing the complex interplay between identity formation, capital mobilisation strategies, and institutional barriers and facilitators. This integrated analysis illuminates how professional identity development is not merely a personal

psychological process but a deeply sociological one embedded within field dynamics and institutional structures.

Engineering identity development emerges through what Tonso (2006) calls a "figured world" of engineering education. In this socially and culturally constructed realm, students learn technical content and what it means to be an engineer. My findings extend this understanding by demonstrating how students' engineering identities develop by strategically navigating field-specific barriers and resourcefully activating available capital. The five strategy patterns I have proposed, Academic Achievement Approach, Financial Management Strategy, Professional Skill Development, Enrichment Opportunity Utilisation, and Adaptive Coping Mechanism, function simultaneously as means of capital accumulation and as pathways to professional identity formation.

For students employing the Academic Achievement Approach, academic performance serves not merely as a credential but as what Bourdieu (1986) calls "embodied cultural capital", internalised dispositions that become part of their professional self-concept. Student 8's reflection clearly illustrates this approach: "In general, I felt that my first year of university was easier than in school because they demanded a lot from me in school." This statement reveals how prior academic excellence creates a foundation for engineering identity by providing confidence and competence in navigating technical coursework. Student 8 further emphasises the centrality of academic performance to her identity when she states, "I was the one who did the best... I stood out in school." This process aligns with what Choe et al. (2019) identified as perceived competence—a key factor in engineering identity development encompassing students' beliefs in their abilities to understand and apply engineering concepts. The effectiveness of this approach is enhanced by institutional facilitators like bridge programs and faculty support, which, according to Tonso (2006), provide crucial symbolic resources for being recognised as an engineer within campus cultures. Simultaneously, rigid educational practices and unsupportive campus environments function as barriers that necessitate greater

identity work, particularly for students who experience what Faulkner (2000) describes as the technical-social dualism in engineering education that can limit how engineering competence is recognised and valued.

The Professional Skill Development strategy reveals how communication and leadership abilities function not merely as professional competencies but as essential components of engineering identity. Student 1's evolution from feeling disconnected from engineering's technical emphasis to finding meaning through leadership and social engagement demonstrates how this strategy can bridge what Faulkner (2000) identifies as the technical-social dualism in engineering. This strategy often emerges in response to the barrier of strict professional norms that privilege technical expertise over social capabilities, allowing students to develop what Trevelyan (2010) recognises as the often-hidden social core of engineering practice.

For students from disadvantaged backgrounds, the Financial Management Strategy represents more than economic survival—it fundamentally shapes their professional self-concept. Student 14's experience of working while studying does not merely demonstrate economic necessity. However, it reveals how economic constraints become incorporated into professional identity: "Even though it's hard to work, study and support myself... I know what it's like when things don't go how you want." This integration of economic challenges into professional identity aligns with what Lehmann (2013) identifies as working-class students' tendency to view economic hardship as character-building. However, my research extends this insight by revealing how these students transform economic barriers into distinctive professional capabilities.

The Enrichment Opportunity Utilisation strategy illustrates how students actively seek additional resources to supplement their formal education, building institutionalised cultural capital (Bourdieu, 1986). Student 3's participation in the Beta program demonstrates this deliberate accumulation of cultural capital: "I was there from sixth grade to fourth year of high school. Then the modality was that we had

classes on Fridays and Saturdays during the year and two weeks during the summer." This strategic pursuit of educational enrichment aligns with what Bathmaker et al.(2013) identified in their research as students' intentional efforts to accumulate and mobilise capital that distinguishes them within competitive educational fields. Institutional facilitators such as bridge programs and faculty mentorship significantly enhance this strategy's effectiveness, as Díaz et al. (2021) found in their research on propedeutic programs in Chile. However, as my research shows, limited access to such opportunities creates significant barriers that disproportionately affect students from disadvantaged backgrounds, particularly when economic constraints require prioritising paid work over enrichment activities, a pattern documented by Snellman et al. (2015) in their study of extracurricular participation gaps.

Perhaps most significant is the Adaptive Coping Mechanism strategy, which reveals how students transform barriers into opportunities for identity development. Student 3's reframing of public education as motivation rather than disadvantage exemplifies what Reay (2005) calls the emotional and psychic costs of social mobility but also demonstrates how these costs can be productively channelled into distinctive professional identities. "I never saw that as a disadvantage, but it was a motivation to show that you can also get ahead with public education," exemplifies how students actively construct meaning from their challenges. This process aligns with Tonso's (2006) observation that engineering identity develops through students' interpretation of their experiences within campus cultures and practices. The transformation of perceived disadvantage into motivation reflects what Ingram and Abrahams (2015) describe as students negotiating their identities when confronted with educational environments that differ from their primary habitus. Student 3's approach also demonstrates what Godwin et al. (2016) identified as agency beliefs, students' perceptions that they can make a difference through engineering, which their research found to be a significant predictor of engineering career choice, particularly for underrepresented students. This adaptive strategy contributes to fostering the process of engineering identity formation, where students actively

negotiate their place within the profession's technical culture while maintaining a connection to their social backgrounds.

These strategic approaches to identity formation interact with the barriers and facilitators identified in my research in complex ways. The technical-social dualism barrier in engineering education necessitates additional identity work from students whose strengths lie in collaboration and communication. Similarly, the gendered nature of the field requires female students to develop what I term "dual consciousness", maintaining awareness of gender biases while developing authentic professional identities. The lack of belonging barrier described by 15 of 17 participants fundamentally shapes identity development by requiring what Reay et al. (2009b) call "emotional work" to establish legitimacy within the field.

These findings can potentially extend the understanding of engineering identity formation by revealing it as a dynamic process shaped by the strategic mobilisation of capital in response to field-specific barriers and facilitators. This perspective challenges deficit-oriented views of disadvantaged students by highlighting how their strategic responses to structural challenges can generate distinctive and valuable professional identities.

This integrated analysis of identity formation, capital mobilisation strategies, and navigational barriers/facilitators fully explains how students from disadvantaged backgrounds experience engineering education. It reveals professional identity not as a fixed outcome or static attribute but as an ongoing accomplishment achieved through strategic action within structuring fields. This perspective extends Bourdieu's framework by emphasising the transformative potential of strategic action even within constraining structures.

7.4.4 Advancing Understanding of Gendered Experiences in Engineering Education

My research contributes to understanding gender dynamics in engineering education by revealing sophisticated strategies female students employ to develop professional identities within a masculine-structured field. While previous research established engineering as gendered (Du, 2006; Faulkner, 2007; Jorgenson, 2002), my work offers novel insights specific to the Chilean context.

A key original contribution is the identification of "strategic identity bifurcation"—how female students simultaneously acknowledge gender discrimination while refusing to let it define their professional self-concept. Student 17's experience exemplifies this: despite having achievements attributed to her appearance ("you got that grade because the professor finds you pretty"), she maintained a robust technical identity. This extends beyond previous characterisations of women either adapting to male norms (Jorgenson, 2002) or experiencing marginalisation (Hatmaker, 2013).

My research reveals how female students develop "parallel legitimacy structures", alternative frameworks for establishing professional competence when traditional pathways are obstructed by gender bias. Student 7 strategically accepted being treated as a "little sister" by male classmates while simultaneously establishing professional legitimacy through external work experience.

Female engineering students in Chile also demonstrate "proactive gender consciousness," incorporating awareness of gender discrimination into their professional identities as a transformative perspective rather than a limitation. This consciousness enables them to develop engineering identities, integrating both technical mastery and social-ethical awareness.

My work examines how gender intersects with social class in engineering identity formation. Female students from disadvantaged backgrounds leverage class-based

resilience to navigate gender barriers, mobilising aspects of their class habitus, such as persistence and practical problem-solving, to overcome gender obstacles.

These findings transcend the binary of either assimilation to masculine norms or rejection of engineering identity, revealing how female students develop "integrative resistance", simultaneously building technical competence while maintaining a critical awareness of gender barriers. This represents a significant advancement in understanding how female students navigate engineering education, particularly within Chile's distinctive cultural context.

7.4.5 Contextualising Engineering Education Within Chilean Higher Education

My research makes distinctive contributions to understanding engineering education within the specific context of Chilean higher education. While most Chilean studies have focused on elite universities in Santiago (Kuzmanic et al., 2021; Villalobos et al., 2023), my work provides insights into how students navigate a high-quality regional institution - an understudied context that better represents the experiences of many Chilean students.

Previous Chilean research has emphasised structural barriers and segmentation in higher education (Bellei, 2013; Espinoza et al., 2024; Venegas-Ramos & Sánchez Lara, 2024), while my study reveals how students in regional contexts demonstrate agency in accumulating and mobilising different forms of capital, even without access to elite networks and resources. This regional university context likely shapes these expressions of agency in particular ways. Had this research been conducted with working-class students at elite universities in Santiago, their experiences might have revealed different patterns of capital mobilisation in response to potentially more pronounced feelings of dislocation and class contrast.

As Reay et al. (2009b) found in elite UK institutions, working-class students often experience being "fish out of water" when surrounded predominantly by privileged peers. The regional context of this study may provide a less stark class contrast than

would be found in Chile's most prestigious universities, potentially enabling different forms of agency. This contextual distinction represents both a limitation of the current study and an opportunity for future comparative research across different institutional settings within the Chilean higher education landscape.

This research extends beyond the traditional focus on access and economic barriers found in Chilean studies of regional universities by examining how students develop professional identities and navigate academic cultures in non-metropolitan settings.

My work contributes to understanding how regional universities with good accreditation levels can serve as spaces for social mobility and professional development, challenging the Santiago-centric narrative often dominating Chilean higher education research. However, this potential for mobility must be understood within the context of persistent labour market hierarchies that often privilege graduates from top Santiago universities. Employer preferences can reproduce educational stratification even after degree completion. Nevertheless, the agency demonstrated by students in this study suggests that regional universities create valuable pathways for professional development, even if graduates may face additional challenges in employment markets compared to their counterparts at elite universities. These insights help build a more complete picture of student experiences across Chile's diverse institutional contexts while maintaining attention to the structural constraints that extend beyond graduation and the individual agency that can navigate these constraints, though not entirely overcome.

While previous Chilean studies on engineering education have primarily focused on academic performance, retention rates, and curricular aspects (Espinoza et al., 2023), my research helps to understand how engineering students develop their professional identities and navigate the field's technical and social demands.

My work describes how gender dynamics operate in Chilean engineering education, showing how female students can strategically manage discriminatory practices and develop professional identities in male-dominated environments - an aspect that has

been understudied in the Chilean context. Additionally, while existing literature has documented the challenges of first-generation students in Chilean engineering programs (Leyton et al., 2012), my analysis illuminates how these students actively develop strategies to accumulate and mobilise different forms of capital, challenging deficit-based perspectives.

My study also contributes to understanding how engineering students negotiate between technical-professional identity and socio-ethical responsibilities. It provides insights into how future Chilean engineers conceptualise their role in society, a crucial aspect given the country's development challenges and social inequalities.

7.5 Practical Implications

My research findings have implications for educational practice and policy in engineering education, particularly for supporting students from disadvantaged backgrounds.

7.5.1 Institutional Implications

For institutions, while recognising the context-specific nature of this study and the limitations in generalizing from a single case, my findings suggest several directions:

- More Flexible and Inclusive Educational Practices: Engineering programs should recognise and value students' diverse experiences and knowledge from their backgrounds (Crozier et al., 2008). This includes validating alternative forms of cultural capital (Archer et al., 2015; Prieur & Savage, 2013; Smith & Lucena, 2016) and creating more diverse pathways to engineering competence.
- Targeted Support Programs: Institutions should develop support mechanisms that recognise students' different capital mobilisation strategies. Rather than assuming all students lack the same resources, programs should be tailored to complement students' existing strategies, as Thomas (2002) suggests in her research on institutional practices that support student retention.

- Spaces for Developing Both Technical and Social-Ethical Identity: Engineering curricula should create deliberate opportunities for students to integrate technical knowledge with ethical awareness and social responsibility, recognising that both dimensions are essential to professional identity development (Khosronejad et al., 2021; Pleasants et al., 2025).
- Recognition of Layered Habitus: Support programs should help students develop reflexivity while validating their primary habitus rather than assuming it must be replaced. This includes creating spaces where students can discuss and navigate the tensions between different aspects of their identity, following Ingram and Abrahams' (2015) research on habitus interruptions.
- Addressing Gender Dynamics: Institutions should acknowledge and address the gendered nature of engineering culture, creating support mechanisms specifically designed to validate women's technical competence and challenge stereotypes about who can be a "real" engineer (Faulkner, 2009; Schmitt, 2021).

7.5.2 Policy Implications

For policymakers, my research highlights several key considerations:

- Comprehensive Financial Support Systems: Given the importance of economic capital in students' educational strategies, policies should ensure adequate financial support that extends beyond tuition to cover living expenses, materials, and participation in extracurricular activities, as suggested by Haveman and Smeeding (2006) and Broton and Goldrick-Rab (2018).
- Recognition of Diverse Paths to Success: Policy frameworks should acknowledge and support multiple pathways through engineering education, avoiding narrow definitions of success that privilege traditional trajectories (Lehmann, 2012).
- Support for Regional Institutions: Policies should strengthen regional universities as spaces for social mobility, recognising their potential to provide high-quality engineering education outside metropolitan centres.

- Integration of Technical and Social-Ethical Dimensions: Accreditation and quality assurance mechanisms should evaluate engineering programs not only on technical components but also on how they prepare students to address social-ethical dimensions of engineering practice (Emison, 2011; J. A. Leydens & Lucena, 2014).

7.5.3 Implications for Educators

For engineering educators, my findings suggest:

- Validating Diverse Forms of Capital: Educators should recognise and build upon the various forms of capital that students bring to their education rather than focusing solely on what they lack (Smith & Lucena, 2016).
- Supporting Professional Identity Development: Teaching approaches should deliberately address both technical-professional and social-ethical dimensions of engineering identity, helping students integrate these aspects (Cech, 2014; Trede et al., 2012).
- Addressing Implicit Biases: Educators should examine their own assumptions about what constitutes engineering competence and who can be an engineer, working to challenge rather than reinforce gender and class stereotypes (Moss-Racusin et al., 2012).
- Creating Inclusive Learning Environments: Teaching methods should accommodate diverse learning approaches and recognise the additional challenges students face navigating between different habitus (Reay et al., 2009a).

7.6 Limitations

I acknowledge several limitations in my research. First, the study focused on a single regional university in Chile, which limits the generalizability of findings to other contexts. Second, the reliance on online interviews due to pandemic constraints may have affected the depth of interaction with participants. Third, while appropriate for

qualitative research, the sample size limits the breadth of experiences captured. Finally, my position as a researcher and staff member at the university may have influenced participants' responses and my interpretation of the data.

7.7 Future Research Directions

My research suggests several promising directions for future investigation:

- Longitudinal Studies: Research tracking students' trajectories beyond graduation would provide valuable insights into the long-term impacts of their educational experiences and capital mobilisation strategies.
- Comparative Institutional Studies: Comparing student experiences across different institutions (elite vs. regional, public vs. private) would help identify common patterns and context-specific factors.
- Evaluation of Support Interventions: Research into the effectiveness of different support interventions could help institutions better target their resources to enhance student success.
- Professional Identity Development Over Time: Studies examining how layered habitus develops throughout engineering education and early career experiences would deepen understanding of identity formation processes.
- Transformation of the Engineering Field: Research investigating how increased participation of students from diverse backgrounds potentially transforms the engineering field itself would provide insights into processes of social change.
- Regional University Contributions: Studies focusing specifically on how regional universities contribute to social mobility in engineering education would help address the gap in Santiago-centric research.

7.8 Final Reflections

As I conclude this research, I am struck by the profound resilience and resourcefulness of the students I interviewed and how deeply this research journey has transformed my understanding and perspective as a researcher. Through

engaging with these students' stories and applying Bourdieu's theoretical framework, I have recognised my position within the academic field and how it shapes my interpretations and interactions.

My journey as an engineer venturing into qualitative social research represents its own form of boundary crossing between distinct epistemological territories. Engineering education shaped my habitus to value precision, quantification, and technical problem-solving—dispositions that initially made qualitative inquiry seem foreign and uncomfortable. As I embraced interpretive methodologies, I experienced what Bourdieu might call my own "hysteresis effect"—the productive dissonance between my engineer's habitus and the dispositions required for qualitative social research. This crossing between technical and interpretive fields created a unique vantage point, revealing how my engineer's tendency toward structural analysis could be transformed into a strength when examining social phenomena through Bourdieu's framework of fields, capital, and habitus.

This boundary-spanning position has illuminated for me the subtle ways engineering's technical-social dualism shapes students' experiences and the methodologies we use to understand those experiences. Like the students in my study who developed a "bifocal professional vision," I found myself cultivating a dual perspective, maintaining the systematic analysis characteristic of engineering while developing the interpretive sensibilities necessary for understanding lived experiences. This dual consciousness has deepened my appreciation for how knowledge is constructed differently across disciplinary boundaries and how these differences might be bridged to create a more complete understanding of engineering education.

This research has challenged my initial assumptions about social mobility through engineering education. While I began with a relatively straightforward view of education as a pathway to social advancement, my participants' experiences revealed a far more nuanced and complex reality. Their stories have taught me that successful navigation of engineering education requires not just academic ability but

also a sophisticated understanding of unwritten rules and expectations - what Bourdieu would term the "rules of the game".

Through this process, I have developed as a researcher and as someone who better understands the multifaceted nature of educational inequality and social reproduction. My participants' experiences have made me more attentive to how institutional practices and cultures can either support or hinder students' success. This heightened awareness has changed how I think about my own role in academia and my responsibility to contribute to positive institutional change.

While my findings provide a foundation for improving engineering education practices and policies, they have also profoundly shaped my professional identity and research approach. I have learned to move beyond simple narratives of individual merit to understand how social, cultural and institutional factors intersect to shape educational experiences and outcomes. This deeper understanding will inform my future work as I continue to advocate for more equitable and inclusive engineering education.

The insights gained from this study suggest that by better understanding and responding to students' experiences and needs, we can create educational environments that support both excellence and equity in engineering education. However, perhaps most importantly, this research has taught me that meaningful change requires institutional reforms and continuous critical reflection from those of us working within academia about our assumptions, practices and potential to challenge or reinforce existing inequalities.

Appendix One

Lancaster University

Participant Information Sheet (Spanish)

Para obtener más información sobre cómo Lancaster University procesa los datos personales con fines de investigación y sus derechos sobre los datos, visite nuestra página web: www.lancaster.ac.uk/research/data-protection

Soy estudiante de doctorado en Lancaster University (United Kingdom) y me gustaría invitarte a participar en una investigación sobre transformación individual y social a través de la educación en ingeniería.

Por favor dedica un tiempo a leer cuidadosamente la siguiente información antes de decidir si participar o no en este estudio.

¿De qué se trata esta investigación?

Este estudio busca entender la experiencia de los estudiantes de ingeniería, en especial cómo la educación en ingeniería cambia algunos aspectos de la vida de los estudiantes de este tipo de carreras.

¿Por qué fui invitado a participar?

Te he contactado porque me interesa comprender las experiencias de los estudiantes de diferentes escuelas de ingeniería. Necesito entrevistar a estudiantes de niveles superiores de educación en ingeniería porque tienen más experiencias que contar. Estaría muy agradecida de que aceptaras y poder contar contigo en este estudio.

¿Qué se me pedirá que haga si participo?

La participación implicaría lo siguiente: una entrevista en profundidad que durará entre 60 y 90 minutos. Te preguntaré sobre tus experiencias como estudiante de ingeniería. Me interesa conocer tus opiniones sobre tu escuela de ingeniería, tus profesores y tus compañeros.

¿Cuáles son los posibles beneficios de participar?

Participar en este estudio te permitirá compartir tus experiencias como estudiante de ingeniería. Si participas en este estudio, tus conocimientos podrían contribuir a nuestra comprensión del impacto de la educación en ingeniería en la vida de los estudiantes.

¿Tengo que participar?

No. Depende completamente de ti decidir si participas o no. Tu participación es voluntaria.

Si decides no participar en este estudio, esto no afectará tus estudios ni la forma en que se te evalúa en los cursos actuales o posteriores.

¿Qué pasa si cambio de opinión?

Si cambias de opinión, puedes retirarte en cualquier momento durante tu participación en este estudio. Si deseas retirarte, házmelo saber y extraeré cualquier idea o información (= datos) que haya contribuido al estudio y la eliminaré. Sin embargo, es difícil y, a menudo, imposible extraer información proporcionada por un participante específico cuando ésta ya ha sido anonimizada o agrupada con aquella proporcionada por otras personas. Por lo tanto, solo puedes retirarte hasta 4 semanas después de participar en el estudio.

¿Cuáles son las posibles desventajas y riesgos de participar?

Es poco probable que la participación tenga desventajas o riesgos.

¿Serán identificables mis datos?

Después de la entrevista, solo yo, la investigadora que realiza este estudio, tendré acceso a las ideas que compartas conmigo. La única otra persona que tendrá acceso a tus contribuciones será un transcriptor profesional que escuchará las grabaciones y producirá un registro escrito de lo que has dicho. El transcriptor firmará un acuerdo de confidencialidad.

Mantendré toda la información personal sobre los entrevistados (por ejemplo, sus nombres y otra información que pueda identificarlos) en forma confidencial, es decir, no la compartiré con otros. Eliminaré cualquier información personal del registro escrito de las contribuciones hechas por los participantes. Se tomarán todas las medidas razonables para proteger el anonimato de los participantes involucrados en este proyecto.

¿Cómo usaremos la información que has compartido con nosotros y qué sucederá con los resultados del estudio de investigación?

Usaré la información que se haya compartido conmigo solo con fines de investigación. Esto incluirá mi tesis de doctorado y otras publicaciones como artículos para revistas. También es posible que presente los resultados de mi estudio en conferencias académicas.

Al redactar los hallazgos de este estudio, me gustaría reproducir algunas de las opiniones e ideas que se hayan compartido conmigo. Solo usaré citas anónimas (por ejemplo, de mi entrevista contigo), por lo que, aunque usaré las palabras exactas, se tomarán todas las medidas razonables para proteger el anonimato en las publicaciones.

¿Cómo se almacenará la información que proporcione?

Los datos se almacenarán en archivos cifrados (nadie más que yo, el investigador podrá acceder a ellos) y en computadoras protegidas con contraseña. Guardaré copias impresas de todos los datos de forma segura en armarios cerrados con llave en mi oficina. Mantendré los datos que puedan identificarlo por separado de la información no personal (por ejemplo, sus opiniones sobre un tema específico). De acuerdo con las pautas de Lancaster University, mantendré los datos de forma segura durante un mínimo de diez años.

¿Qué pasa si tengo una pregunta o inquietud?

Si tienes alguna pregunta o si no estás satisfecho con cualquier cosa que suceda con respecto a su participación en el estudio, puedes comunicarte conmigo a mi mail p.jimenez@lancaster.ac.uk y / o con mi supervisor: el Dr. Richard Budd a su correo r.budd@lancaster.ac.uk

Si tienes alguna inquietud o alguna queja que desees discutir con una persona que no esté directamente involucrada en la investigación, también puedes comunicarte con:

Dr. Jo Warin
Director de Estudios, Educación y Justicia Social,
Departamento de Investigaciones Educativas.
Universidad de Lancaster.
j.warin@lancaster.ac.uk

Este estudio ha sido revisado y aprobado por el Comité de ética en Investigación de la Facultad de Artes y Ciencias Sociales y de la Escuela de Administración de Lancaster University.

Muchas gracias por considerar participar en este proyecto.

Appendix Two

Consent Form

Título del Proyecto: Social Mobility Through Engineering Education
Nombre del investigador: Patricia Jimenez
Email: p.jimenez@lancaster.ac.uk

Por favor marca cada casilla

1. Confirmo que he leído y entendido la hoja de información sobre este estudio. He tenido la oportunidad de considerar la información y hacer consultas que han sido respondida en forma satisfactoria.	☐
2. Entiendo que mi participación es voluntaria y que tengo la libertad de retirarme en cualquier momento durante mi participación en este estudio y dentro de las 4 semanas desde esta entrevista sin dar ninguna razón, en cuyo caso todos mis datos serán removidos.	☐
3. Entiendo que cualquier información proporcionada por mí puede ser utilizada en futuros informes, artículos académicos, publicaciones o presentaciones por parte del investigador, pero mi información personal no será incluida y se tomarán todas las medidas razonables para proteger el anonimato de los participantes involucrados en este proyecto.	☐
4. Entiendo que mi nombre / el nombre de mi organización no aparecerá en ningún informe, artículo o presentación sin mi consentimiento.	☐
5. Entiendo que todas las entrevistas serán grabadas en audio y transcritas y que los datos se protegerán en dispositivos cifrados y se mantendrán seguros.	☐
6. Entiendo que los datos serán conservados durante un mínimo de 10 años después de la finalización del estudio, de acuerdo con las pautas de la Universidad.	☐
7. Acepto participar en este estudio.	☐

_____ _____ _____
Nombre del Participante Fecha Firma

Confirmo que al participante se le dio la oportunidad de hacer preguntas acerca de estudio y que éstas fueron respondidas correctamente y de la mejor forma posible. Confirmo que

el individuo no ha sido forzado a dar el consentimiento, sino que este consentimiento ha sido otorgado de manera libre y voluntaria.

Sección reservada al investigador

Firma del Investigador _____ **Fecha** _____ Día/mes/año

Una copia de este formulario ha sido entregada al participante y el original se mantiene en los archivos del investigador en Lancaster University

Appendix Three

Coding Book

Code	Subtheme	Description	Literature Reference	Student Quote (example)
Economic Capital	Financial Aid	Access to scholarships, grants, and free tuition programs	Bourdieu (1986), Strutz & Ohland (2012)	"I could enter university and work on the weekends, but when the gratuity was approved, it was a great support." (Student 3)
Economic Capital	Part-time Work	Balancing work and study to finance education	Pascarella et al. (2004), Thomsen et al. (2013)	"It was tough because I was economically responsible at home... I had to work full time to cover the house expenses." (Student 4)
Economic Capital	Family Support	Financial assistance from family members	Roksa & Kinsley (2019)	"We had to sell our apartment. With that money, we paid off a couple of debts, and everything was happening in favour of moving here." (Student 6)
Cultural Capital	Academic Preparation	Prior knowledge and skills from high school	Bourdieu (1986), Aries & Seider (2005)	"Physics was always good for me in high school, sciences and mathematics, I also did relatively well [...] which helped me in the first years [of university]." (Student 17)
Cultural Capital	Study Habits	Effective learning strategies and time management	Crede & Kuncel (2008)	"I was systematic concerning each class, I said okay! I will have a Word file to take notes in each subject I have." (Student 3)
Cultural Capital	Extracurricular Activities	Participation in non-academic activities that build skills	Bathmaker et al. (2013)	"Developing entrepreneurial mindset and real-world skills through projects." (Student 2)
Social Capital	Peer Networks	Supportive relationships with classmates	Brouwer et al. (2016)	"Yes, they have been like the ones that when you don't pass the course they tell you: ah, okay, it doesn't matter, take it, here is all the material." (Student 8)

Social Capital	Faculty Relationships	Connections with professors and academic staff	Walpole (2003)	"I love it, because you always feel more comfortable with someone of your own gender, so to speak, and the teachers have been excellent." (Student 9)
Social Capital	Institutional Support	Access to university resources and support services	Thomas (2002)	"I went to a psychologist at Student Service and she helped me a lot because I am rather introverted and I didn't talk much about the things that happened to me.." (Student 13)
Habitus	Class-based Dispositions	Attitudes and behaviors shaped by social class background	Reay (2004)	"I felt comfortable, even though it was something I had not experienced before. And it was noticeable that there was a different aura compared to high school, where we were more closed off, so to speak." (Student 5)
Habitus	Academic Self-concept	Beliefs about one's academic abilities	Lehmann (2013)	"Now I can express myself, and I can talk to other people who are not my friends. It happened gradually, but it was very good, and I even liked it." (Student 3)
Habitus	Sense of Belonging	Feeling of fitting in within the university environment	Ostrove & Long (2007)	"I always felt at home, which I didn't feel at the other university because there was a lot of diversity, anyone could enter at that time, and I always felt like I was at home." (Student 7)
Field	Academic Expectations	Norms and standards within the engineering discipline	Bourdieu & Wacquant (1992)	"I feel that there are several faculty professors at my university who should not be teaching; they are there forced by contract issues; they have to be teaching to carry out their research." (Student 12)
Field	Professional Culture	Values and practices of the engineering profession	Seron et al. (2018)	"What I thought is that I was going to end up working in a laboratory because it's quite common to think that studying (major) engineering one would end up working in a laboratory, but in the

				progress of my career one realizes that one can simply work where there are processes." (Student 8)
Field	Competitive Environment	Dynamics of competition within engineering education	Seymour & Hewitt (1997)	"I think they always expect an engineer to be a man; it's like a rather sexist career actually, but it has been changing." (Student 17)
Gendered Habitus	Gender Stereotypes	Internalized beliefs about gender roles in engineering	Faulkner (2007)	"My math teacher was like engineering was for men and they were 'better' at it than women." (Student 10)
Gendered Habitus	Proving Competence	Pressure to demonstrate abilities due to gender	Seron et al. (2018)	"I struggled with sexism, with my achievements attributed to my appearance rather than my efforts and abilities." (Student 17)
Gendered Habitus	Navigating Male-dominated Spaces	Strategies for operating in gender-imbalanced environments	Du (2006)	"I would say that it changed me in the sense that I studied in a school for girls and the fact of being in a career where there are only men you have to make an effort twice or three times many times to excel and do the same as men." (Student 15)
Professional Identity	Engineering Self-efficacy	Confidence in one's ability to perform as an engineer	Cech et al. (2011)	"The truth is that I feel quite capable of getting a job where I feel happy and professionally rewarded..." (Student 3)
Professional Identity	Career Aspirations	Goals and expectations for future professional roles	Samuelson & Litzler (2016)	"The area that I like is electrical machines and I think that in Chile this area is not very developed" (Student 13)
Professional Identity	Ethical Awareness	Understanding of social and ethical responsibilities of engineers	Leydens & Lucena (2014)	"As I progressed through the program, I began to develop a clearer vision for my career. In particular, the talk with a social entrepreneur inspired me to pursue work at a B Corporation or another organization focused on

				creating significant social impact".(Student 2)

Appendix Four

RESEARCH JOURNAL ENTRY

Interview: Student 1

Date: [Date of interview]

Key Themes & Observations:

Identity Development:

Notable transformation from being primarily focused on teaching (wanted to be a physics teacher) to embracing engineering identity through university experience

Strong social identity maintained throughout - describes self as a "connector" between groups both in high school and university

Engineering education seems to have enhanced rather than replaced his teaching aspirations

Critical Moments:

Third year crisis appears to be pivotal turning point

Student involvement (Center of Students) played crucial role in overcoming crisis period

Family support (especially mother) and relationship support important for persistence

Social Class & Mobility:

Comes from municipality-funded school background

First generation university student

Expresses awareness of socioeconomic differences among peers but doesn't seem to feel excluded

Shows strong drive for social contribution through engineering

Notable Quotes:

"I used to want to be a teacher to change lives...now I want to be an engineer to improve the lives of many people" [approximate translation]

Methodological Notes:

- Very articulate and reflective participant
- Provided rich narrative without much prompting
- Strong emotional component when discussing family support
- Clear before/after narrative structure in describing transformation

Follow-up Areas:

- Explore more about how specific engineering courses shaped his worldview
- Probe further about experience of being first-gen student
- Consider comparing with other students' third year experiences

Initial Analysis Thoughts:

The interview suggests engineering education can enhance rather than replace previous aspirations when students find ways to integrate multiple identities. Social support networks appear crucial for persistence through crisis periods. The transformation narrative is particularly clear in this case.

List of abbreviations

CRUCH	Council of Rectors of Chilean Universities (Consejo de Rectores de las Universidades Chilenas)
HSIs	Hispanic-Serving Institutions
NS-SEC	National Statistics Socio-Economic Classification
OECD	Organisation for Economic Co-operation and Development
PBL	Project-Based Learning
SES	Socioeconomic Status
STEM	Science, Technology, Engineering, and Mathematics

References

Adhabi, E. A. R., & Anozie, C. B. L. (2017). Literature Review for the Type of Interview in Qualitative Research. *International Journal of Education*, *9*(3), 86. https://doi.org/10.5296/ije.v9i3.11483

Adkins, L. (2003). Reflexivity: Freedom or Habit of Gender? *Theory, Culture & Society*, *20*(6), 21–42. https://doi.org/10.1177/0263276403206002

Afolabi, O. S., & Idowu, H. A. (2019). African universities quality management challenges and higher education agenda. *Quality Management Implementation in Higher Education: Practices, Models, and Case Studies*, *August 2019*, 257–279. https://doi.org/10.4018/978-1-5225-9829-9.ch013

Ahmed, S. K. (2024). The pillars of trustworthiness in qualitative research. *Journal of Medicine, Surgery, and Public Health*, *2*(January), 100051. https://doi.org/10.1016/j.glmedi.2024.100051

Akkerman, S. F., & Bakker, A. (2011). Boundary crossing and boundary objects. *Review of Educational Research*, *81*(2), 132–169. https://doi.org/10.3102/0034654311404435

Alarcón, M., & Brunner, J. J. (2024). Multi-governance in higher education: The case of Chile 2018-2023. *Research in Education*, *119*(1), 97–118. https://doi.org/10.1177/00345237241248535

Allard, A. C. (2005). Capitalizing on Bourdieu How useful are concepts of'social capital' and 'social field' for researching 'marginalized' young women? *Theory and Research in Education*, *3*(1), 63–79. https://doi.org/10.1177/147787850504

Anastas, J. W. (2004). Quality in Qualitative Evaluation: Issues and Possible Answers. *Research on Social Work Practice*, *14*(1), 57–65. https://doi.org/10.1177/1049731503257870

Archer, L., Dawson, E., DeWitt, J., Seakins, A., & Wong, B. (2015). "Science

capital": A conceptual, methodological, and empirical argument for extending bourdieusian notions of capital beyond the arts. *Journal of Research in Science Teaching*, *52*(7), 922–948. https://doi.org/10.1002/tea.21227

Archer, L., Hollingworth, S., & Halsall, A. (2007). "University's not for me - I'm a Nike person": Urban, working-class young people's negotiations of "style", identity and educational engagement. *Sociology*, *41*(2), 219–237. https://doi.org/10.1177/0038038507074798

Archer, M. (2010). Routine, Reflexivity, and Realism ∗. *Sociological Theory*, *28*(3), 272–303.

Archibald, M. M., Ambagtsheer, R. C., Casey, M. G., & Lawless, M. (2019). Using Zoom Videoconferencing for Qualitative Data Collection: Perceptions and Experiences of Researchers and Participants. *International Journal of Qualitative Methods*, *18*, 1–8. https://doi.org/10.1177/1609406919874596

Aries, E., & Seider, M. (2005). The Interactive Relationship Between Class Identity and the College Experience: The Case of Lower Income Students. *Qualitative Sociology*, *28*(4), 419–443.

Aries, E., & Seider, M. (2007). The role of social class in the formation of identity: A study of public and elite private college students. *Journal of Social Psychology*, *147*(2), 137–157. https://doi.org/10.3200/SOCP.147.2.137-157

Ashley, L. (2022). 4: Scarcity and Similarity. In *Highly Discriminating* (pp. 86–113). Bristol University Press. https://doi.org/10.51952/9781529209655.ch004

Ashwin, P., Abbas, A., & McLean, M. (2014). How do students' accounts of sociology change over the course of their undergraduate degrees? *Higher Education*, *67*(2), 219–234. https://doi.org/10.1007/s10734-013-9659-z

Astin, A. W. (1999). Student involvement: A developmental theory for higher

education. *Journal of College Student Development*, *40*(5), 518–529.

Atkins, A. L., & Wallace, S. (2015). *Qualitative Research in Education*. Sage Research Methods.

Atkinson, W. (2011). From sociological fictions to social fictions : some Bourdieusian reflections on the concepts of ' institutional habitus ' and ' family habitus '. *British Journal of Sociology of Education*, *32*(3), 331–347. https://doi.org/10.1080/01425692.2011.559337

Atwood, S. A., Gilmartin, S. K., Harris, A., & Sheppard, S. (2020). Defining first-generation and low-income students in engineering: An exploration. *ASEE Annual Conference and Exposition, Conference Proceedings*, *2020-June*. https://doi.org/10.18260/1-2--34373

Au, A. (2019). Thinking about cross-cultural differences in qualitative interviewing: Practices for more responsive and trusting encounters. *Qualitative Report*, *24*(1), 58–77. https://doi.org/10.46743/2160-3715/2019.3403

Badat, S. (2010). *The challenges of transformation in higher education and training institutions in South Africa by Saleem Badat*.

Bagde, S. K., Epple, D., & Taylor, L. (2016). Does affirmative action work? Caste, gender, college quality, and academic success in India. *American Economic Review*, *106*(6), 1495–1521. https://doi.org/10.1257/aer.20140783

Bahna, M. (2018). Study choices and returns of international students: On the role of cultural and economic capital of the family. *Population, Space and Place*, *24*(2), 1–10. https://doi.org/10.1002/psp.2082

Baillie, C., Pawley, A. L., & Riley, D. (2012). *Engineering and Social Justice: In the University and Beyond*. Purdue University Press. http://www.jstor.org/stable/j.ctt6wq5pf

Bain, L. L. (1985). The hidden curriculum. Re-examined. *Quest*, *37*, 14–153. https://doi.org/10.2277/0521540461

Baird, C. L. (2018). Male-dominated stem disciplines: How do we make them more attractive to women? *IEEE Instrumentation and Measurement Magazine*, *21*(3), 4–14. https://doi.org/10.1109/MIM.2018.8360911

Ball, S. J. (2003). Class Strategies and the Education Market: The middle classes and social advantage. In *Class Strategies and the Education Market: The Middle Classes and Social Advantage*. Taylor & Francis Group. https://doi.org/10.4324/9780203218952

Ball, S. J., Davies, J., David, M., & Reay, D. (2002). “Classification” and “judgement”: Social class and the “cognitive structures” of choice of higher education. In *British Journal of Sociology of Education* (Vol. 23, Issue 1). https://doi.org/10.1080/01425690120102854

Bampton, R., & Cowton, C. J. (2002). The E-Interview. *FORUM : QUALITATIVE SOCIAL RESEARCH SOZIALFORSCHUNG*, *3*(2), Art. 9.

Bangura, M. (2024). Sociology of Engineering: Exploring Female Students Social Quest of Engineering at University of Sierra Leone, Fourah Bay College, Freetown, Sierra Leone. *European Journal of Applied Science, Engineering and Technology*, *2*(4), 106–116. https://doi.org/10.59324/ejaset.2024.2(4).07

Barba del Horno, M. (2020). Enfoques consensuales y conflictuales del capital: un intento de síntesis. *Aposta. Revista de Ciencias Sociales*, *85*, 111–128.

Baškarada, S. (2014). Qualitative Case Study Guidelines. *The Qualitative Report*, *19*, 1–18. https://doi.org/10.46743/2160-3715/2014.1008

Bathmaker, A. M. (2015). Thinking with Bourdieu: thinking after Bourdieu. Using ‘field’ to consider in/equalities in the changing field of English higher education. *Cambridge Journal of Education*, *45*(1), 61–80. https://doi.org/10.1080/0305764X.2014.988683

Bathmaker, A. M., Ingram, N., & Waller, R. (2013). Higher education, social class and the mobilisation of capitals: recognising and playing the game. *British Journal of Sociology of Education*, *Sept*, 1–16.

Bautista, M. A., González, F., Martinez, L., Muñoz, P., & Muñoz, F. (2024). Dictatorship, Higher Education, and Social Mobility. In *Higher Education, and Social Mobility. IZA Discussion Paper* (Issue 16989). https://doi.org/10.2139/ssrn.4827163

Baxter, A., & Britton, C. (2001). Risk, identity and change: Becoming a mature student. *International Studies in Sociology of Education*, *11*(1), 87–104. https://doi.org/10.1080/09620210100200066

Bayeck, R. Y. (2021). The Intersection of Cultural Context and Research Encounter: Focus on Interviewing in Qualitative Research. *International Journal of Qualitative Methods*, *20*, 1–8. https://doi.org/10.1177/1609406921995696

Beam, T. K., Pierrakos, O., Constantz, J., Johri, A., & Anderson, R. (2009). Preliminary findings on freshmen engineering students' professional identity: Implications for recruitment and retention. *ASEE Annual Conference and Exposition, Conference Proceedings*. https://doi.org/10.18260/1-2--5112

Becker, R., & Hecken, A. E. (2009). Why are working-class children diverted from universities? - An empirical assessment of the diversion thesis. *European Sociological Review*, *25*(2), 233–250. https://doi.org/10.1093/esr/jcn039

Bellei, C. (2013). El estudio de la segregación socioeconómica y académica de la educación chilena. *Estudios Pedagógicos XXXIX, Nº 1*(1), 325–345. https://scielo.conicyt.cl/pdf/estped/v39n1/art19.pdf

Bellei, C., & Contreras, M. (2024). Post-Pandemic Crisis in Chilean Education. The Challenge of Re-institutionalizing School Education. In F. Reimers

(Ed.), *Schools and Society During the COVID-19 Pandemic* (pp. 43–62). Springer. https://doi.org/10.1007/978-3-031-42671-1

Bellei, C., & Munoz, G. (2023). Models of regulation, education policies, and changes in the education system: a long-term analysis of the Chilean case. *Journal of Educational Change*, *24*(1), 49–76. https://doi.org/10.1007/s10833-021-09435-1

Bennett, T. (2007). Habitus clivé: Aesthetics and politics in the work of Pierre Bourdieu. *New Literary History*, *38*(1), 201–228. https://doi.org/10.1353/nlh.2007.0013

Berge, M., Silfver, E., & Danielsson, A. (2019). In search of the new engineer: gender, age, and social class in information about engineering education. *European Journal of Engineering Education*, *44*(5), 650–665. https://doi.org/10.1080/03043797.2018.1523133

Berger, P., & Luckmann, T. (2012). *La construcción social de la realidad* (Amorrortu (ed.)).

Berger, R. (2015). Now I see it, now I don't: researcher's position and reflexivity in qualitative research. *Qualitative Research*, *15*(2), 219–234. https://doi.org/10.1177/1468794112468475

Bernasconi, A. (2017). Desafíos del futuro de la educación superior chilena Desafíos del futuro de la educación superior chilena. *Temas de La Agenda Publica*, *12*(96), 1–13.

Besterfield-Sacre, M., Cox, M., Borrego, M., Beddoes, K., & Zhu, J. (2014). Changing Engineering Education Views of U S Faculty Chairs and Deans. *Journal OfEngineering Education*, *103*(2), 193–219.

Bingham, A. J. (2023). From Data Management to Actionable Findings: A Five-Phase Process of Qualitative Data Analysis. *International Journal of Qualitative Methods*, *22*(April). https://doi.org/10.1177/16094069231183620

Birbili, M. (2000). Translating from one language to another. *Social Research Update*, *31*(1), 1–7.

Boat, A. A., Miranda, A., & Syvertsen, A. K. (2022). Enhancing Education and Career Pathways Through Peer and Near-Peer Social Capital. *Journal of Youth and Adolescence*, *51*(7), 1287–1304. https://doi.org/10.1007/s10964-021-01540-x

Boles, W., & Whelan, K. (2017). Barriers to student success in engineering education. *European Journal of Engineering Education*, *42*(4), 368–381. https://doi.org/10.1080/03043797.2016.1189879

Boliver, V., Powell, M., & Moreira, T. (2018). Organisational identity as a barrier towidening access in Scottish universities. *Social Sciences*, *7*(151), 1–16. https://doi.org/10.3390/SOCSCI7090151

Bonaldi, Eduardo. (2017). “Eu e meus amigos”: capital social, estilos de vida e trajetórias educacionais. *Política & Sociedade*, *16*(37), 348–376. https://doi.org/10.5007/2175-7984.2017v16n37p348

Bonaldi, EV, & Silva, E. (2014). Gendered Habitus in Engineering: Experiences of Brazilian Students. *International Journal of Gender, Science and Technology*, *6*(1), 21. http://genderandset.open.ac.uk/index.php/genderandset/article/viewArticle/295

Borg, S. (2001). The research journal: A tool for promoting and understanding researcher development. *Language Teaching Research*, *5*(2), 156–177. https://doi.org/10.1177/136216880100500204

Bourdieu, P. (1977). *Outline of a Theory of Practice* (Vol. 16). Cambridge university press.

Bourdieu, P. (1984). *Distinction A Social Critique of the Judgement of Taste*. Harvard University Press.

Bourdieu, P. (1986). The forms of Capital. In J. Richardson (Ed.), *Handbook of Theory and Research for the Sociology of Education* (pp. 241–258). Greenwood. https://doi.org/10.15639/teflinjournal.v29i1/45-71

Bourdieu, P. (1990). *The logic of practice*. https://doi.org/10.4324/9781003115083-9

Bourdieu, P. (1993). *Language and Symbolic Power*. Polity Press. https://doi.org/10.2307/3685295

Bourdieu, P. (1998a). La distinción. Criterios y bases sociales del gusto. In *La distinción. Crítica social del gusto*. Santillana S.A.

Bourdieu, P. (1998b). Practical Reason：On the Theory of Action. In *Practical Reason. On the Theory of Action*. Stanford University Press. https://monoskop.org/images/a/aa/Bourdieu_Pierre_Practical_Reason_On_the_Theory_1998.pdf

Bourdieu, P. (2001). *Masculine domination*. Stanford University Press.

Bourdieu, P., & Passeron, J.-C. (1990). Reproduction in Education, Society and Culture. In *The British Journal of Sociology* (Vol. 30, Issue 2). SAGE Publications. https://doi.org/10.2307/589547

Bourdieu, P., & Wacquant, L. (2005). Una invitación a la sociología reflexiva. In *Science* (1a ed.). Siglo XXI Editores.

Bourdieu, P., & Wacquant, L. J. D. (1992). *An Invitation to Reflexive Sociology*. Polity Press. https://doi.org/10.2307/3340841

Bracken-Roche, D., Bell, E., Macdonald, M. E., & Racine, E. (2017). The concept of “vulnerability” in research ethics: An in-depth analysis of policies and guidelines. *Health Research Policy and Systems*, *15*(1), 1–18. https://doi.org/10.1186/s12961-016-0164-6

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology.

Qualitative Research in Psychology, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Briggs, A. R. J., Clark, J., & Hall, I. (2012). Building bridges: Understanding student transition to university. *Quality in Higher Education*, *18*(1), 3–21. https://doi.org/10.1080/13538322.2011.614468

Broton, K. M., & Goldrick-Rab, S. (2018). Going Without: An Exploration of Food and Housing Insecurity Among Undergraduates. *Educational Researcher*, *47*(2), 121–133. https://doi.org/10.3102/0013189X17741303

Brouwer, J., Jansen, E., Flache, A., & Hofman, A. (2016). The impact of social capital on self-efficacy and study success among first-year university students. *Learning and Individual Differences*, *52*, 109–118. https://doi.org/10.1016/j.lindif.2016.09.016

Brown, P. (1995). Cultural capital and social exclusion: Some observations on recent trends in education, employment and the labour market. *Work Employment & Society*, *9*(1), 29–51. https://doi.org/10.1177/095001709591002

Brown, P. (2003). The Opportunity Trap: Education and Employment in a Global Economy. *European Educational Research Journal*, *2*(1), 141–179. https://doi.org/10.2304/eerj.2003.2.1.4

Brunner, J. J. (2009). *Educación Superior en Chile: instituciones, mercados y políticas gubernamentales, 1967-2007* (Issue December 2008) [Universiteit Leiden]. https://doi.org/10.13140/RG.2.2.24108.26247

Brunner, J. J., & Alarcón, M. (2023). Evolution of Chilean higher education from a governance equaliser perspective. *Education Policy Analysis Archives*, *31*, 1–19. https://doi.org/10.14507/epaa.31.8271

Bryman, A. (2012). *Social Research Methods* (4th ed.). Oxford.

Bryman, A. (2016). *Social research methods*. Oxford university press.

Bryman, A., & Burgess, R. G. (2002). *Analyzing qualitative data* (A. Bryman & R. G. Burgess (eds.)). Routledge imprint of the Taylor & Francis Group. https://doi.org/10.1207/s15430421tip3903_5

Bullot, N. J., & Reber, R. (2013). The artful mind meets art history: Toward a psycho-historical framework for the science of art appreciation. *Behavioral and Brain Sciences*, *36*(2), 123–137. https://doi.org/10.1017/S0140525X12000489

Cabalin, C. (2012). Neoliberal education and student movements in Chile: Inequalities and Malaise. *Policy Futures in Education*, *10*(2), 219–228. https://doi.org/10.2304/pfie.2012.10.2.219

Calderon, A. (2018). Massification of higher education revisited. *RMIT University*, *June*, 30. https://www.academia.edu/36975860/Massification_of_higher_education_revisited

Camacho, M. M., & Lord, S. M. (2011). “Microaggressions” in engineering education: Climate for Asian, Latina and White women. *Proceedings - Frontiers in Education Conference, FIE*, 1–6. https://doi.org/10.1109/FIE.2011.6142970

Canales, A., Cortez, M. I., Sáez, M., & Vera, A. (2022). Brechas de género en carreras STEM. *Propuestas Para Chile. Concurso de Políticas Públicas 2021*, 115–150.

Canales, A., & De los Ríos, D. (2009). Retención de estudiantes vulnerables en la educación universitaria. *Calidad En La Educación*, *30*, 50–83. https://doi.org/10.31619/caledu.n30.173

Capobianco, B. M., French, B. F., & Diefes-Dux, H. A. (2012). Engineering identity development among pre-adolescent learners. *Journal of Engineering Education*, *101*(4), 698–716. https://doi.org/10.1002/j.2168-9830.2012.tb01125.x

Carling, J., Erdal, M. B., & Ezzati, R. (2014). Beyond the insider–outsider divide in migration research. *Migration Studies*, *2*(1), 36–54. https://doi.org/10.1093/migration/mnt022

Case, J. M. (2017). The historical evolution of engineering degrees: competing stakeholders, contestation over ideas, and coherence across national borders. *European Journal of Engineering Education*, *42*(6), 974–986. https://doi.org/10.1080/03043797.2016.1238446

Case, J. M., Fraser, D. M., Kumar, A., & Itika, A. (2016). The significance of context for curriculum development in engineering education: a case study across three African countries. *European Journal of Engineering Education*, *41*(3), 279–292. https://doi.org/10.1080/03043797.2015.1056103

Cauce, A. M., & Gordon, E. W. (2012). Toward the Measurement of Human Agency and the Disposition to Express It. *Gordoncommission.Org*, 23. http://www.gordoncommission.org

Cech, E. (2014). *Culture of Disengagement in Engineering Education?*

Cech, E., & Finelli, C. J. (2024). Learning to prioritize the public good: Does training in classes, workplaces, and professional societies shape engineers' understanding of their public welfare responsibilities? *Journal of Engineering Education*, *113*(2), 407–438. https://doi.org/10.1002/jee.20590

Cech, E., Rubineau, B., Silbey, S., & Seron, C. (2011). Professional Role Confidence and Gender Persistence in Engineering. *American Sociological Review*, *76*(5), 641–666. https://doi.org/10.1177/0003122411420815

Cerón-Martínez, A. U. (2019). Habitus, campo y capital. Lecciones teóricas y metodológicas de un sociólogo bearnés. *Cinta de Moebio*, *66*, 310–320. https://doi.org/10.4067/s0717-554x2019000300310

Chance, S., Fayyaz, F., Campbell, A. L., Pitterson, N. P., & Nawaz, S. (2024). Guest Editorial Special Issue on Conceptual Learning of Mathematics-

Intensive Concepts in Engineering. *IEEE Transactions on Education*, *67*(4), 491–498. https://doi.org/10.1109/TE.2024.3416649

Chen, J., Hasan, M. A., Du, X., & Kolmos, A. (2023). Exploring Students' Perception of the Influence of PBL Elements on the Development of Engineering Identity. *IEEE Transactions on Education*, *66*(4), 393–403. https://doi.org/10.1109/TE.2023.3258548

Cheryan, S., Ziegler, S. A., Montoya, A. K., & Jiang, L. (2017). Why are some STEM fields more gender balanced than others? *Psychological Bulletin*, *143*(1), 1–35. https://doi.org/10.1037/bul0000052

Choe, N. H., Martins, L. L., Borrego, M., & Kendall, M. R. (2019). Professional Aspects of Engineering: Improving Prediction of Undergraduates' Engineering Identity. *Journal of Professional Issues in Engineering Education and Practice*, *145*(3), 1–29. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000413

Chubin, D. E., May, G. S., & Babco, E. L. (2005). Diversifying the engineering workforce. *Journal of Engineering Education*, *94*(1), 73–86. https://doi.org/10.1002/j.2168-9830.2005.tb00830.x

Coleman, J. S. (1988). Social Capital in the Creation of Human Capital. *The American Journal of Sociology*, *94*, S95–S120.

Colorado-Carvajal, A. (2008). El capital cultural y otros tipos de capital. *X Congreso Nacional de Investigación Educativa*, 1–21.

Colyar, J. E., & Stich, A. E. (2011). Discourses of remediation: Low-income students and academic identities. *American Behavioral Scientist*, *55*(2), 121–141. https://doi.org/10.1177/0002764210381870

Conlon, E. (2008). The new engineer: Between employability and social responsibility. *European Journal of Engineering Education*, *33*(2), 151–159. https://doi.org/10.1080/03043790801996371

Connell, R. (2007). *Southern Theory. The global dynamics of knowledge in social science* (Vol. 17). Taylor & Francis Group.

Cook, S., Watson, D., & Webb, R. (2019). 'It's just not worth a damn!' Investigating perceptions of the value in attending university. *Studies in Higher Education*, *44*(7), 1256–1267. https://doi.org/10.1080/03075079.2018.1434616

Correll, S. J. (2004). Constraints into preferences: Gender, status, and emerging career aspirations. *American Sociological Review*, *69*(1), 93–113. https://doi.org/10.1177/000312240406900106

Costa, C., Burke, C., & Murphy, M. (2019). Capturing habitus: theory, method and reflexivity. *International Journal of Research and Method in Education*, *42*(1), 19–32. https://doi.org/10.1080/1743727X.2017.1420771

Côté, J. (2016). The Identity Capital Model: A Handbook Of Theory, Methods, And Findings Paradoxes of purpose: The contradictions of growing up and living in identity societies. *Sociology Publications*, *38*. https://www.researchgate.net/publication/305698905

Cotten, S. R., & Wilson, B. (2006). Student-faculty interactions: Dynamics and determinants. In *Higher Education* (Vol. 51, Issue 4). https://doi.org/10.1007/s10734-004-1705-4

Cox, B. E., & Orehovec, E. (2007). Faculty-student interaction outside the classroom: A typology from a residential college. *Review of Higher Education*, *30*(4), 343–362. https://doi.org/10.1353/rhe.2007.0033

Crede, M., & Kuncel, N. R. (2008). Study Habits , Skills , and Attitudes. *Perspectives on Psychological Science*, *3*(6), 425–453.

Creswell, J. W. (2009). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (3rd ed.). SAGE Publications, Inc.

Creswell, J. W. (2012). *Educational Research. Planning, Conducting and*

Evaluating Quantitative and Qualitative Research (4th ed.). Pearson. http://library1.nida.ac.th/termpaper6/sd/2554/19755.pdf

Crozier, G., Reay, D., Clayton, J., Colliander, L., & Grinstead, J. (2008). Different strokes for different folks: Diverse students in diverse institutions - experiences of higher education. *Research Papers in Education*, *23*(2), 167–177. https://doi.org/10.1080/02671520802048703

Cuellar, S. (2024). Cultural Wealth Coping as Protective Factors of Resilience for Latine Students. *Journal of Hispanic Higher Education*, *23*(1), 56–68. https://doi.org/10.1177/15381927231186567

Cunninghame, I. (2017). The role of higher education in social mobility. *International Studies in Widening Participation*, *4*(1), 74–85. https://doi.org/10.1353/foc.2006.0015

Danielsson, A. T., Gonsalves, A. J., Silfver, E., & Berge, M. (2019). The Pride and Joy of Engineering? The Identity Work of Male Working-Class Engineering Students. *Engineering Studies*, *11*(3), 172–195. https://doi.org/10.1080/19378629.2019.1663859

Davis, S. C., Nolen, S. B., Cheon, N., Moise, E., & Hamilton, E. W. (2023). Engineering climate for marginalized groups: Connections to peer relations and engineering identity. *Journal of Engineering Education*, *112*(2), 284–315. https://doi.org/10.1002/jee.20515

Decoteau, C. L. (2016). The reflexive habitus: Critical realist and Bourdieusian social action. *European Journal of Social Theory*, *19*(3), 303–321. https://doi.org/10.1177/1368431015590700

DeCuir-Gunby, J. T., Marshall, P. L., & McCulloch, A. W. (2011). Developing and using a codebook for the analysis of interview data: An example from a professional development research project. *Field Methods*, *23*(2), 136–155. https://doi.org/10.1177/1525822X10388468

Denton, M., & Borrego, M. (2021). Funds of Knowledge in STEM Education: A

Scoping Review. *Studies in Engineering Education*, *1*(2), 71. https://doi.org/10.21061/see.19

Devine, J. (2012a). Digging deeper using 'habitus'-a fresh approach to understanding student behaviour. *AAEE 2012 Conference: Digging Deeper Using 'Habitus'-a Fresh Approach to Understanding Student Behaviour*, 1–9. www.aaee.com.au/conferences/2012/

Devine, J. (2012b). Work in progress: Can Bourdieu's Habitus provide a theoretical framework for engineering education research? *Proceedings - Frontiers in Education Conference, FIE*, 1–2. https://doi.org/10.1109/FIE.2012.6462386

Dhunpath, R., & Subbaye, R. (2018). Student success and curriculum reform in post- apartheid South Africa. *International Journal of Chinese Education*, *7*(1), 85–106. https://doi.org/10.1163/22125868-12340091

Diangelo, R. (2011). White Fragility. *International Journal of Critical Pedagogy*, *3*(3), 54–70.

Diaz, M., Peralta, M., Cortes, J., Cabrera, E., Ramos, F., & Bernal, A. (2021). "You are going to have to level out. You are going to have to study more than the others". Voices of students who attended a preparatory program at the Universidad Católica del Norte, Coquimbo, Chile. *Estudios Pedagogicos*, *47*(3), 207–227. https://doi.org/10.4067/S0718-07052021000300207

Dimaggio, P. (1982). Cultural Capital and School Success : The Impact of Status Culture Participation on the Grades of US High School Stundets. *American Sociological Review*, *47*(2), 189–201.

Donoso-Bravo, J. (2021). Experiencias y aspiraciones educacionales de estudiantes de educación secundaria de distinta clase social en Valparaíso, Chile: similares aspiraciones, desiguales condiciones. *Revista de Sociología de La Educación-RASE*, *14*(2), 171.

https://doi.org/10.7203/rase.14.2.16667

Douglas, E. P. (2015). Engineering as a Space of White Privilege. *Understanding and Dismantling Privilege*, *V*(1), 36–44. http://www.wpcjournal.com/article/view/13097

Dryburgh, H. (1999). Work Hard , Play Hard : Women and Professionalization in Engineering-Adapting to the Culture. *Gender and Society*, *13*(5), 664–682.

du Preez, P., Simmonds, S., & Verhoef, A. H. (2016). Rethinking and researching transformation in higher education: A meta-study of South African trends. *Transformation in Higher Education 1(1), 1*(1), 1–25.

Du, X. Y. (2006). Gendered practices of constructing an engineering identity in a problem-based learning environment. *European Journal of Engineering Education*, *31*(1), 35–42. https://doi.org/10.1080/03043790500430185

Dumais, S. A. (2002). Cultural capital, gender, and school success: The role of habitus. *Sociology of Education*, *75*(1), 44–68. https://doi.org/10.2307/3090253

Dumais, S. A., & Ward, A. (2010). Cultural capital and first-generation college success. *Poetics*, *38*(3), 245–265. https://doi.org/10.1016/j.poetic.2009.11.011

Dunne, M., King, R., & Ahrens, J. (2014). Applying to higher education: comparisons of independent and state schools. *Studies in Higher Education*, *39*(9), 1649–1667. https://doi.org/10.1080/03075079.2013.801433

Durbin, S., & Lopes, A. (2018). Will the Head of Engineering Please Stand Up? The Underrepresentation of Women in Engineering. In K. Broadbent (Ed.), *Gender and the Professions: International and Contemporary Perspectives* (pp. 169–183). Routledge. https://doi.org/10.4324/9781315563954-11

Durdella, N. R. (2017). *Qualitative dissertation methodology: A guide for*

research design and methods. Sage Publications.

Edwards, R., & Holland, J. (2013). What do the key terms used about qualitative interviews mean? In *What is Qualitative Interviewing?* https://doi.org/10.5040/9781472545244.ch-001

Egbert, J., & Sanden, S. (2013). *Foundations of education research: Understanding theoretical components*. Routledge.

Emison, G. A. (2011). Transformative leadership for engineering in a time of complexity. *Leadership and Management in Engineering*, *11*(2), 97–102. https://doi.org/10.1061/(ASCE)LM.1943-5630.0000108

Engelbrecht, J., Bergsten, C., & Kågesten, A. (2012). Conceptual and procedural approaches to mathematics in the engineering curriculum: Student conceptions and performance. *Journal of Engineering Education*, *101*(1), 138–162. https://doi.org/10.1002/j.2168-9830.2012.tb00045.x

Engin, M. (2011). Research Diary: A Tool for Scaffolding. *International Journal of Qualitative Methods*, *10*(3), 296–306. https://doi.org/10.1177/160940691101000308

Engström, S. (2018). Differences and similarities between female students and male students that succeed within higher technical education: profiles emerge through the use of cluster analysis. *International Journal of Technology and Design Education*, *28*(1), 239–261. https://doi.org/10.1007/s10798-016-9374-z

Escobar, C., Mejia, J., & Tess Perez. (2024). Arrebatos and institutionalized barriers encountered by low-income Latino a x.pdf. *Journal of Engineering Education*, 1–21.

Espinoza, O., Corradi, B., González, L., Sandoval, L., McGinn, N., & Vera, T. (2024). Segmentation in higher education in Chile: Massification without equality. *Higher Education Quarterly*, *78*(3), 536–550. https://doi.org/10.1111/hequ.12465

Espinoza, O., & González, L. E. (2016). La educación superior en chile y la compleja transición desde el régimen de autofinanciamiento hacia el régimen de gratuidad. *Revista Latinoamericana de Educación Comparada*, *7*(10), 35–51.

Espinoza, O., González, L. E., Sandoval, L., McGinn, N., & Corradi, B. (2022). Reducing inequality in access to university in Chile: the relative contribution of cultural capital and financial aid. *Higher Education*, *83*(6), 1355–1370. https://doi.org/10.1007/s10734-021-00746-z

Espinoza, O., González, L., Sandoval, L., Corradi, B., Larrondo, Y., Maldonado, K., & McGinn, N. (2023). The relationship between class-based habitus and choice of university and field of study. *British Journal of Sociology of Education*, *44*(4), 649–668. https://doi.org/10.1080/01425692.2023.2194563

Fairweather, J. S. (2002). The Mythologies of Faculty Productivity: Implications for Institutional Policy and Decision Making. *The Journal of Higher Education*, *73*(1), 26–48. https://doi.org/10.1353/jhe.2002.0006

Fang, R. T., & Tilcsik, A. (2022). Prosocial Occupations , Work Autonomy , and the Origins of the Social Class Gap. *Academy of Management Journal*, *65*(3), 1–62.

Faulkner, W. (2000). Dualisms, Hierarchies and Gender in Engineering Author(s): *Social Studies of Science*, *30*(5), 759–792.

Faulkner, W. (2007). “Nuts and bolts and people”: Gender-troubled engineering identities. *Social Studies of Science*, *37*(3), 331–356. https://doi.org/10.1177/0306312706072175

Faulkner, W. (2009). Doing gender in engineering workplace cultures. II. Gender in/authenticity and the in/visibility paradox. *Engineering Studies*, *1*(3), 169–189. https://doi.org/10.1080/19378620903225059

Faulkner, W. (2011). Gender (In)Authenticity, Belonging and Identity Work in

Engineering. *Brussels Economic Review - Cahiers Economiques De Bruxelles*, *54*(2/3), 277–293.

Fife, S. T., & Gossner, J. D. (2024). Deductive Qualitative Analysis: Evaluating, Expanding, and Refining Theory. *International Journal of Qualitative Methods*, *23*, 1–12. https://doi.org/10.1177/16094069241244856

Figueiredo, D. (2023). Walking through the Leaky Academic Pipeline in STEM: Equity Not Equality Needed for Women and under Represented Minorities (URMs). In IntechOpen (Ed.), *Gender Inequality – Issues, Challenges and New Perspectives compared*. https://doi.org/10.5772/intechopen.111538

Fink, A. S. (2000). The Role of the Researcher in the Qualitative Research Process. A Potential Barrier to Archiving Qualitative Data. *Forum: Qualitative Social Research / Qualitative Sozialforschung*, *1*(3). https://doi.org/10.17169/fqs-1.3.1021

Fitzpatrick, E., Adams, I., Baldwin, H., Chin, M. Y., & Deters, J. (2024). *What Universities Should Know About Minoritized Undergraduate Engineering Students' Mental Health*. https://doi.org/10.18260/1-2-610.1139-46383

Fleet, N., Flores, A., Montiel, B., & Palma, A. (2024). Regional Inequalities among State Universities in Chile: Perspectives on Centralization and Neoliberal Development. *Education Policy Analysis Archives*, *32*, 1–25. https://doi.org/10.14507/epaa.32.8193

Flores, R. (2014). *Observando observadores: una introducción a las técnicas cualitativas de investigación social*. Ediciones UC.

Forbes, M. H., Bielefeldt, A. R., & Sullivan, J. F. (2015). The choice opportunity disparity: Exploring curricular choice opportunities for engineering vs. Non-engineering majors. *ASEE Annual Conference and Exposition, Conference Proceedings*, *122nd ASEE*(122nd ASEE Annual Conference and Exposition: Making Value for Society). https://doi.org/10.18260/p.24850

Friedman, S. (2016). Habitus clivé and the emotional imprint of social mobility.

Sociological Review, *64*(1), 129–147. https://doi.org/10.1111/1467-954X.12280

Galiani, S. (2013). Social mobility: what is it and why does it matter? *Economica*, *LIX*, 167–229.

Gallardo, G., Lorca, A., Morrás, D., & Vergara, M. (2014). High School to College Transition Experiences of Students Admitted in a Chilean Traditional University (CRUCH) through Inclusive Special Admission. *Pensamiento Educativo: Revista de Investigación Educacional Latinoamericana*, *51*(2), 135–151. https://doi.org/10.7764/pel.51.2.2014.23

Gallimore, R., Goldenberg, C. N., & Weisner, T. S. (1993). The social construction and subjective reality of activity settings: Implications for community psychology. *American Journal of Community Psychology*, *21*(4), 537–560. https://doi.org/10.1007/BF00942159

Garbanzo, G. (2013). Factores asociados al rendimiento académico en estudiantes universitarios desde el nivel socioeconómico: Un estudio en la Universidad de Costa Rica. *Revista Electronica Educare*, *17*, 57–87. http://www.una.ac.cr/educare

Garcia, C. V., Rincon, R., & Chand, D. E. (2023). Work in Progress: Exploring the Relationship between Female Engineering Faculty and Degree Attainment of Women in Engineering. *ASEE Annual Conference and Exposition, Conference Proceedings*, *Cv*. https://doi.org/10.18260/1-2--44264

Geisinger, B. N., & Raman, D. R. (2013). Why they leave: Understanding student attrition from engineering majors. *International Journal of Engineering Education*, *29*(4), 914–925.

Giannakis, M., & Bullivant, N. (2016). The massification of higher education in the UK: Aspects of service quality. *Journal of Further and Higher Education*, *40*(5), 630–648.

https://doi.org/10.1080/0309877X.2014.1000280

Giddens, A. (1984). The Constitution of Society. Outline of the Theory of Structuration. In *Social Forces*. University of California Press. https://doi.org/10.2307/2579442

Gilbert, A. (2009). Disciplinary cultures in mechanical engineering and materials science. *Equal Opportunities International*, *28*(1), 24–35. https://doi.org/10.1108/02610150910933613

Gill, J., Mills, J., Franzway, S., & Sharp, R. (2008). “Oh you must be very clever!” High-achieving women, professional power and the ongoing negotiation of workplace identity. *Gender and Education*, *20*(3), 223–236. https://doi.org/10.1080/09540250801968990

Godfrey, E., & Parker, L. (2010). Mapping the Cultural Landscape in Engineering Education. *Journal of Engineering Education*, *99*, 5–22.

Godwin, A., Potvin, G., Hazari, Z., & Lock, R. (2016). Identity, Critical Agency, and Engineering: An Affective Model for Predicting Engineering as a Career Choice. *Journal of Engineering Education*, *105*(2), 312–340. https://doi.org/10.1002/jee.20118

Goldthorpe, J. H. (2013). Understanding - And misunderstanding - Social mobility in Britain: The entry of the economists, the confusion of politicians and the limits of educational policy. *Journal of Social Policy*, *42*(3), 431–450. https://doi.org/10.1017/S004727941300024X

Grenfell, M., & James, D. (2003). *Bourdieu and education: Acts of practical theory*. Routledge.

Guba, E. G., & Lincoln, Y. S. (1982). Epistemological and methodological bases of naturalistic inquiry. *Educational Communication & Technology*, *30*(4), 233–252. https://doi.org/10.1007/BF02765185

Guest, G., Namey, E., & Chen, M. (2020). A simple method to assess and

report thematic saturation in qualitative research. *PLoS ONE*, *15*(5), 1–17. https://doi.org/10.1371/journal.pone.0232076

Gupta, N. (2019). Intersectionality of gender and caste in academic performance: quantitative study of an elite Indian engineering institute. *Gender, Technology and Development*, *23*(2), 165–186. https://doi.org/10.1080/09718524.2019.1636568

Guzmán-Concha, C. (2017). Undoing the Neoliberal Higher Education System? Student Protests and the Bachelet Reforms in Chile. *World Economic Review*, *8*(8), 32–43. https://www.researchgate.net/publication/319968606

Haase, S., Chen, H. L., Sheppard, S., Kolmos, A., & Mejlgaard, N. (2013). What does it take to become a good engineer? Identifying cross-national engineering student profiles according to perceived importance of skills. *International Journal of Engineering Education*, *29*(3), 698–713.

Hafferty, F. W., & Hafler, J. P. (2011). The Hidden Curriculum, Structural Disconnects, and the Socialization of New Professionals. In J. P. Hafler (Ed.), *Extraordinary Learning in the Workplace* (pp. 17–35). Springer Netherlands. https://doi.org/10.1007/978-94-007-0271-4_2

Halcomb, E. J., & Davidson, P. M. (2006). Is verbatim transcription of interview data always necessary? *Applied Nursing Research*, *19*(1), 38–42. https://doi.org/10.1016/j.apnr.2005.06.001

Hall, M. (2015). Institutional Culture of Mergers and Alliances in South Africa. In A. Curaj, L. Georghiou, J. C. Harper, & E. Egron-Polak (Eds.), *Mergers and Alliances in Higher Education* (pp. 145–173). https://doi.org/10.1007/978-3-319-13135-1

Hamad, J. A., Hasanain, M., Abdulwahed, M., & Al-Ammari, R. (2013). Ethics in engineering education: A literature review. *Proceedings - Frontiers in Education Conference, FIE*, 1554–1560. https://doi.org/10.1109/FIE.2013.6685099

Hamilton, L. T. (2013). More Is More or More Is Less? Parental Financial Investments during College. *American Sociological Review*, *78*(1), 70–95. https://doi.org/10.1177/0003122412472680

Hammersley, M. (2007). The issue of quality in qualitative research. *International Journal of Research and Method in Education*, *30*(3), 287–305. https://doi.org/10.1080/17437270701614782

Harahap, M. E., Suhendra, N., Masmui, Triwibowo, B., Suryadi, & Mutmainah. (2023). *Influences of Parental Cultural Capital on Support for Students' Music Activities* (pp. 107–128). https://doi.org/10.1007/978-981-19-9032-8_6

Hardtke, M., Khanjaninejad, L., Lang, C., & Nasiri, N. (2023). Gender Complexity and Experience of Women Undergraduate Students within the Engineering Domain. *Sustainability (Switzerland)*, *15*(1). https://doi.org/10.3390/su15010467

Hassani, M., & Ghasemi, S. J. M. (2016). Investigating Stratification within Higher Education through Examining the Status of Students in Different Academic Majors in Terms of Cultural, Social and Economic Capital. *Educational Research and Reviews*, *11*(8), 676–685. https://doi.org/10.5897/ERR2016.2629

Hatmaker, D. M. (2013). Engineering identity: Gender and professional identity negotiation among women engineers. *Gender, Work and Organization*, *20*(4), 382–396. https://doi.org/10.1111/j.1468-0432.2012.00589.x

Hattingh, T. (2023). Exploring the social aspects of assessment practices in an engineering context. *SOTL in the South*, *7*(3), 5–24. https://doi.org/10.36615/sotls.v7i3.349

Haveman, R., & Smeeding, T. (2006). The role of higher education in social mobility. *Future of Children*, *16*(2), 125–150. https://doi.org/10.1353/foc.2006.0015

Hee, P. K., & Shuhan, L. (2022). Influences of Economic Capital, Cultural Capital, and Social Capital on Asian High School Students' Academic Achievement. *Journal of Educational and Social Research*, *12*(3), 1–11. https://doi.org/10.36941/jesr-2022-0062

Heller, P. (2022). Democracy in the Global South. *Annual Review of Sociology*, *48*, 463–484. https://doi.org/10.1146/annurev-soc-030320-123449

Herkert, J. R. (2000). Engineering ethics education in the USA: content, pedagogy and curriculum. *European Journal of Engineering Education*, *25*(4), 303–313. https://doi.org/10.1080/03043790050200340

Hogan, E., & Patrick, S. (2024). A closer look at the Global South. *Carnegie Endowment for International Peace*. https://doi.org/10.11604/pamj.2019.33.308.18232

Hollett, N., & Brock, S. J. (2024). 'What makes you the boss?' Understanding student perceptions of social status in sport education. *Sport, Education and Society*, *29*(6), 699–711. https://doi.org/10.1080/13573322.2023.2174965

Hunt, V., Prince, S., Dixon-Fyle, S., & Yee, L. (2018). Delivering through Diversity. *McKinsey Report 2018*, *January*.

Hvozdetska, B., Varha, N., Kocsis, Z., Nechitailo, I., & Bartosh, O. (2022). East and Central European Students' Financial Self-Sufficiency During Their University Years. *Corvinus Journal of Sociology and Social Policy*, *13*(2), 53–78. https://doi.org/10.14267/CJSSP.2022.2.3

Iacono, V. Lo, Symonds, P., & Brown, D. H. K. (2016). Skype as a tool for qualitative research interviews. *Sociological Research Online*, *21*(2), 1–15. https://doi.org/10.5153/sro.3952

Ilie, S., & Rose, P. (2016). Is equal access to higher education in South Asia and sub-Saharan Africa achievable by 2030? *Higher Education*, *72*(4), 435–455. https://doi.org/10.1007/s10734-016-0039-3

Ingram, N. (2011). Within school and beyond the gate: The complexities of being educationally successful and working class. *Sociology*, *45*(2), 287–302. https://doi.org/10.1177/0038038510394017

Ingram, N., & Abrahams, J. (2015). Stepping outside of oneself: How a cleft-habitus can lead to greater reflexivity through occupying “the third space.” In Jenny Thatcher et al. (Ed.), *Bourdieu: The Next Generation: The Development of Bourdieu’s Intellectual Heritage in Contemporary UK Sociology* (pp. 140–156). Taylor & Francis Group. https://doi.org/10.4324/9781315693415

Instituto de Ingenieros de Chile. (2002). *Educación en Ingeniería una visión integradora de las perspectivas profesional y académica*.

Instituto de Ingenieros de Chile. (2018). *La formación de ingenieros civiles en Chile*. Editorial Universidad de Concepcion.

Instituto de Ingenieros de Chile. (2025). *Práctica y Academia. El gran desafío en la formación de los futuros ingenieros civiles*.

Jackson, K., Faroa, B. D., Augustyn, N. A., & Padmanabhanunni, A. (2023). What motivates South African students to attend university? A cross-sectional study on motivational orientation. *South African Journal of Psychology*, *53*(4), 565–575. https://doi.org/10.1177/00812463231196297

Jessop, B. (1996). Interpretive Sociology and the Dialectic of Structure and Agency. *Theory, Culture & Society*, *13*(1), 119–128.

Jimola, A. M., & Jimola, F. E. (2024). Female Students and the Field of Engineering: Stemming the Tide of Gender Underrepresentation for Sustainable Development. *International Journal of Research in Education and Science*, *10*(3), 641–652. https://doi.org/10.46328/ijres.3459

Jin, J., & Ball, S. J. (2021). Precarious success and the conspiracy of reflexivity: questioning the ‘habitus transformation’ of working-class students at elite universities. *Critical Studies in Education*, *62*(5), 608–623.

https://doi.org/10.1080/17508487.2019.1593869

Jin, L. (2022). The Implications of Massification and Marketisation on Access and Widening Participation. *Proceedings of the 2022 5th International Conference on Humanities Education and Social Sciences (ICHESS 2022)*, 2238–2246. https://doi.org/10.2991/978-2-494069-89-3_257

Johnstonbaugh, M. (2018). Conquering with capital: social, cultural, and economic capital's role in combating socioeconomic disadvantage and contributing to educational attainment. *Journal of Youth Studies*, *21*(5), 590–606. https://doi.org/10.1080/13676261.2017.1406069

Johri, A., Olds, B. M., Esmonde, I., Madhavan, K., Roth, W. M., Schwartz, D. L., Tsang, J., Sørensen, E., & Tabak, I. (2011). Situated engineering learning: Bridging engineering education research and the learning sciences. *Journal of Engineering Education*, *100*(1), 151–185. https://doi.org/10.1002/j.2168-9830.2011.tb00007.x

Jorgenson, J. (2002). Engineering Selves: Negotiating Gender an Identity in Technical Work. *Management Communication Quarterly*, *15*(3), 350–380.

Kamphuis, C. B. M., Jansen, T., Mackenbach, J. P., & Van Lenthe, F. J. (2015). Bourdieu's cultural capital in relation to food choices: A systematic review of cultural capital indicators and an empirical proof of concept. *PLoS ONE*, *10*(8). https://doi.org/10.1371/journal.pone.0130695

Karnieli-Miller, O., Strier, R., & Pessach, L. (2009). Power relations in qualitative research. *Qualitative Health Research*, *19*(2), 279–289. https://doi.org/10.1177/1049732308329306

Kaufman, P. (2003). Learning to not Labor: How Working-Class Individuals Construct Middle-Class Identities. *The Sociological Quarterly*, *44*(3), 481–504.

Kelly, G. J., Cunningham, C. M., & Ricketts, A. (2017). Engaging in identity work through engineering practices in elementary classrooms. *Linguistics*

and Education, *39*, 48–59. https://doi.org/10.1016/j.linged.2017.05.003

Kelly, M. P., & Glover, I. A. (1990). The Engineering Dimension. *International Journal of Sociology & Social Policy.*, *10*(1), 27–45.

Khan, Z. N. (2016). Factors Effecting on Study Habits. *World Journal of Educational Research*, *3*(1), 145. https://doi.org/10.22158/wjer.v3n1p145

Khosronejad, M., Reimann, P., & Markauskaite, L. (2021). 'We are not going to educate people': how students negotiate engineering identities during collaborative problem solving. *European Journal of Engineering Education*, *46*(4), 557–574. https://doi.org/10.1080/03043797.2020.1821174

Knight, R. (2024). Oracy and cultural capital: the transformative potential of spoken language. *Literacy*, *58*(1), 37–47. https://doi.org/10.1111/lit.12343

Koenings, F., Di Meo, G., & Uebelmesser, S. (2020). University rankings as information source: do they play a different role for domestic and international students? *Applied Economics*, *52*(59), 6432–6447. https://doi.org/10.1080/00036846.2020.1795075

Kolluri, S. (2023). Patchwork capital and postsecondary success: Latinx students from high school to college. *Race Ethnicity and Education*, *26*(6), 793–813. https://doi.org/10.1080/13613324.2020.1798389

Koro-Ljungberg, M., Douglas, E. P., McNeill, N. J., Therriault, D. J., Lee, C. S., & Malcolm, Z. (2017). Academic problem-solving and students' identities as engineers. *Qualitative Report*, *22*(2), 456–478. https://doi.org/10.46743/2160-3715/2017.2567

Koul, R., Lerdpornkulrat, T., & Poondej, C. (2017). Gender contentedness in aspirations to become engineers or medical doctors. *European Journal of Engineering Education*, *42*(6), 1422–1438. https://doi.org/10.1080/03043797.2017.1303450

Kraaykamp, G., & Van Eijck, K. (2010). The intergenerational reproduction of

cultural capital: A threefold perspective. *Social Forces*, *89*(1), 209–231. https://doi.org/10.1353/sof.2010.0087

Kramer, A. (2024). Board 74: Are All Engineers Brilliant White Men? What Television Tells Us About Engineers. *ASEE Annual Conference and Exposition, Conference Proceedings*. https://doi.org/10.18260/1-2--48373

Kumba, H., Olanrewaju, O., Akpan, J., Mafuratidze, F., & Ndiyamba, D. (2024). Engineering Education and Industry Synergy in Zimbabwe: A Divide and Redirection. In X. Liu (Ed.), *Innovation and Evolution in Higher Education* (pp. 1–15). IntechOpen eBooks. https://doi.org/10.5772/intechopen.1004886

Kuzmanic, D., Valenzuela, J. P., Villalobos, C., & Quaresma, M. L. (2021). Socioeconomic Segregation in Higher Education: Evidence for Chile (2009–2017). *Higher Education Policy*, *36*(2), 329–350. https://doi.org/10.1057/s41307-021-00258-6

Kvale, S. (2007). *Doing interviews*. SAGE Publications.

LaDue, N. D., Zocher, E., & Dugas, D. (2024). “It Just Makes It Feel Like You’re Not Alone”: A Qualitative Study of a Social Support Group for High-Achieving, Low-Income STEM Majors. *Journal for STEM Education Research*, *7*(2), 227–256. https://doi.org/10.1007/s41979-024-00116-1

Lakin, J. M., Wittig, A. H., Davis, E. W., & Davis, V. A. (2020). Am I an engineer yet? Perceptions of engineering and identity among first year students. *European Journal of Engineering Education*, *45*(2), 214–231. https://doi.org/10.1080/03043797.2020.1714549

Lamont, M., & Lareau, A. (1988). Cultural Capital : Allusions , Gaps and Glissandos in Recent Theoretical Developments. *Sociological Theory*, *6*(2), 153–168.

Lapan, S. D., Quartaroli, M., & Riemer, F. (2012). *Qualitative Research. An Introduction to Methods and Designs* (Stephen D. Lapan, M. T. Quartaroli,

& F. J. Riemer (eds.)). Jossey-Bass A Wiley Imprint.

Lareau, A., & Horvat, E. M. (1999). Moments of Social Indusion and Exdusion Race , Class , and Cultural Capital in Family-School Relationships. *Sociology of Education*, *72*(1), 37–53.

Lareau, A., & Weininger, E. B. (2003). Cultural capital in educational research: A critical assessment. *Theory and Society*, *32*(5–6), 567–606. https://doi.org/10.1023/B:RYSO.0000004951.04408.b0

Lasekan, O. A., Godoy Pena, M. T., Odebode, A. J., Mabica, A. P., Mabasso, R. A., & Mogbadunade, O. (2024). Fostering Sustainable Female Participation in STEM Through Ecological Systems Theory: A Comparative Study in Three African Countries. *Sustainability (Switzerland)*, *16*(21). https://doi.org/10.3390/su16219560

Lehmann, W. (2009a). Becoming Middle Class : How Working-class University Students Draw and Transgress Moral Class Boundaries Author (s): Wolfgang Lehmann Published by : Sage Publications , Ltd . Stable URL : https://www.jstor.org/stable/42857296 Class Boundaries Becoming M. *Sociology*, *43*(4), 631–647.

Lehmann, W. (2009b). University as vocational education: Working-class students' expectations for university. *British Journal of Sociology of Education*, *30*(2), 137–149. https://doi.org/10.1080/01425690802700164

Lehmann, W. (2012). Working-class students, habitus, and the development of student roles: A Canadian case study. *British Journal of Sociology of Education*, *33*(4), 527–546. https://doi.org/10.1080/01425692.2012.668834

Lehmann, W. (2013). Habitus Transformation and Hidden Injuries: Successful Working-class University Students. *Sociology of Education*, *87*(1), 1–15. https://doi.org/10.1177/0038040713498777

Leydens, J. A., & Lucena, J. (2014). Social Justice: A Missing, Unelaborated Dimension in Humanitarian Engineering and Learning Through Service.

International Journal for Service Learning in Engineering, Humanitarian Engineering and Social Entrepreneurship, *9*(2), 1–28. https://doi.org/10.24908/ijsle.v9i2.5447

Leydens, J., & Lucena, J. (2018). Engineering Justice: Transforming Engineering Education and Practice. In I. The Institute of Electrical and Electronic Engineers (Ed.), *Engineering Justice: Transforming Engineering Education and Practice*. John Wiley & Sons. https://doi.org/10.1002/9781118757369

Leyton, D., Vásquez, A., & Fuenzalida, V. (2012). La experiencia de estudiantes de contextos vulnerables en diferentes instituciones de Educación Superior Universitaria (IESU): Resultados de investigación. *Calidad En La Educación*, *37*, 61–97. https://doi.org/10.31619/caledu.n37.87

Lezotte, S. (2023). 'We're supposed to be at the forefront': a multiple case study exploring how institutional context shapes engineering diversity and inclusion initiatives. *Engineering Studies*, *15*(3), 221–239. https://doi.org/10.1080/19378629.2023.2267045

Lichtenstein, G., Chen, H. L., Smith, K. A., & Maldonado, T. A. (2015). Retention and persistence of women and minorities along the engineering pathway in the United States. *Cambridge Handbook of Engineering Education Research*, 311–334. https://doi.org/10.1017/CBO9781139013451.021

Lois McNay. (1999). Gender, Habitus and the Field. Pierre Bourdieu and the Limits of Reflexivity. *Theory, Culture & Society*, *16*(1), 95–117.

Maass, K., Geiger, V., Ariza, M. R., & Goos, M. (2019). The Role of Mathematics in interdisciplinary STEM education. *ZDM - Mathematics Education*, *51*(6), 869–884. https://doi.org/10.1007/s11858-019-01100-5

Mabokela, R. O., & Mlambo, Y. A. (2017). Access and equity and South African

higher education: A review of policies after 20 years of democracy. *Comparative Education Review*, *61*(4), 780–803. https://doi.org/10.1086/693913

Maccaro, A., Oronti, I. B., Zito, E., Piaggio, D., & Pecchia, L. (2024). Women in engineering, science and technology in sub-Saharan Africa: cultural attitudes, challenges, and gaps affecting clinical engineering and medical devices maintenance practices. *Health and Technology*, *14*(4), 683–694. https://doi.org/10.1007/s12553-024-00871-6

Major, J., Godwin, A., & Sonnert, G. (2018). STEM experiences of engineering students from low-socioeconomic neighborhoods. *ASEE Annual Conference and Exposition, Conference Proceedings*, *2018-June*. https://doi.org/10.18260/1-2--30990

Mallman, M. (2017). Disruption in the working-class family: The early origins of social mobility and habitus clivé. *Social Mobility for the 21st Century: Everyone a Winner?*, 25–36. https://doi.org/10.4324/9781315276588

Manly, C. A., Wells, R. S., & Bettencourt, G. M. (2017). Financial Planning for College: Parental Preparation and Capital Conversion. *Journal of Family and Economic Issues*, *38*(3), 421–438. https://doi.org/10.1007/s10834-016-9517-0

Manstead, A. S. R. (2018). The psychology of social class: How socioeconomic status impacts thought, feelings, and behaviour. *British Journal of Social Psychology*, *57*(2), 267–291. https://doi.org/10.1111/bjso.12251

Marginson, S. (2016). The worldwide trend to high participation higher education: dynamics of social stratification in inclusive systems. *Higher Education*, *72*(4), 413–434. https://doi.org/10.1007/s10734-016-0016-x

Margolis, E., Soldatenko, M., Acker, S., & Gair, M. (2001). Peekaboo: Hiding and Outing the Curriculum. In *The Hidden Curriculum in Higher Education* (pp. 1–20).

Marra, R. M., Rodgers, K. A., Shen, D., & Bogue, B. (2012). Leaving engineering: A multi-year single institution study. *Journal of Engineering Education*, *101*(1), 6–27. https://doi.org/10.1002/j.2168-9830.2012.tb00039.x

Marrero, M. E., Brandon, L. T., Gunning, A. M., & Riccio, J. F. (2023). Supporting First-Generation College Students to Become Teachers in High-Needs Schools. *Teacher Educator*, *58*(2), 130–152. https://doi.org/10.1080/08878730.2022.2107128

Martin, D. A., Conlon, E., & Bowe, B. (2021). A Multi-level Review of Engineering Ethics Education: Towards a Socio-technical Orientation of Engineering Education for Ethics. *Science and Engineering Ethics*, *27*(5), 1–38. https://doi.org/10.1007/s11948-021-00333-6

Martin, J. P., Miller, M. K., & Simmons, D. R. (2014). Exploring the theoretical social capital “deficit” of first generation college students: Implications for engineering education. *International Journal of Engineering Education*, *30*(4), 822–836.

Martin, J. P., Simmons, D. R., & Yu, S. L. (2013). The role of social capital in the experiences of hispanic women engineering majors. *Journal of Engineering Education*, *102*(2), 227–243. https://doi.org/10.1002/jee.20010

Martin, N., & Spenner, K. (2009). Capital Conversion and Accumulation: A Social Portrait of Legacies at an Elite University. *Research in Higher Education*, *50*(7), 623–648. https://doi.org/10.1007/sl

Martinez-García, J. S. (2017). El Habitus. Una revisión analítica. *Revista Internacional de Sociologia*, *75*(3). https://doi.org/10.3989/ris.2017.75.3.15.115

Mashiyane, T., Salifu, S., Ogunbiyi, O., & Oketola, A. (2023). Challenges, Strategies and Recommendations for Reengineering Engineering Education in Sub-Saharan Africa: A Review. *Science, Engineering and*

Technology, *4*(1), 137–153. https://doi.org/10.54327/set2024/v4.i1.102

Mason, J. (2002). *Qualitative Researching* (2nd ed.). SAGE Publications.

Matemba, E., & Lloyd, N. (2019). Constructing the bourdieusian field of engineering education: Engineering education transformation as a field phenomena. *Proceedings of the 8th Research in Engineering Education Symposium, REES 2019 - Making Connections*, *December*, 378–387.

Mavhunga, C. C. (2022). 3 - Modelling an African Research University: Notes towards an Interdisciplinary, Cross-Cultural and Anticipative Curriculum. *Journal of Higher Education in Africa*, *16*(1–2), 25–50. https://doi.org/10.57054/jhea.v16i1-2.1471

May, G. S., & Chubin, D. E. (2003). A Retrospective on Undergraduate Engineering Success for Underrepresented Minority Students. *Journal OfEngineering Education*, *January*, 27–39. https://doi.org/10.18260/1-2--31987

McLeod, J. (2005). Feminists re-reading Bourdieu Old debates and new questions about gender habitus and gender change. *Theory and Research in Education*, *3*(1), 11–30. https://doi.org/10.1177/147787850504

McNair, L. D., Newswander, C., Boden, D., & Borrego, M. (2011). Student and Faculty Interdisciplinary Identities in Self-Managed Teams. *Journal of Engineering Education*, *100*(2), 374–396.

Mendoza, P., Kuntz, A., & Berger, J. B. (2012). Bourdieu and academic capitalism: Faculty “Habitus” in materials science and engineering. *Journal of Higher Education*, *83*(4), 558–581.

Mertens, D. M. (2012). Ethics in Qualitative Research in Education and Social Sciences. In S. D. Lapan, M. T. Quartaroli, & F. J. Riemer (Eds.), *Qualitative Research. An Introduction to Methods and Designs*. Jossey-Bass A Wiley Imprint.

Meuleman, R., & Jæger, M. M. (2023). Cultural talk or cultural walk? Highbrow tastes and network quality. *Social Science Research*, *111*(December 2022), 102855. https://doi.org/10.1016/j.ssresearch.2023.102855

Miller, D. L. (2016). Gender, Field, and Habitus: How Gendered Dispositions Reproduce Fields of Cultural Production. *Sociological Forum*, *31*(2), 330–353. https://doi.org/10.1111/socf.12247

Mills, C. (2008). Reproduction and transformation of inequalities in schooling: The transformative potential of the theoretical constructs of Bourdieu. *British Journal of Sociology of Education*, *29*(1), 79–89. https://doi.org/10.1080/01425690701737481

MINEDUC. (2025). *Brechas de género en educación superior 2024*.

Ministerio de Hacienda. (2015). *Ley de gratuidad Chile 20.890*.

Mkhize, Z. V., & Idahosa, G. E. (2025). Intersectionality, neoliberal meritocracy and the lived experiences of African first-generation women students in STEM in South African universities. *Gender and Education*, *37*(2), 137–155. https://doi.org/10.1080/09540253.2024.2445029

Mok, K. H., & Jiang, J. (2016). *Massification of higher education: challenges for admissions and graduate employment in China Massification of higher education: challenges for admissions and graduate employment in China* (Working Paper Series, Issue 5). www.researchcghe.org

Moll, L. C., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of Knowledge for Teaching: Using a Qualitative Approach to Connect Homes and Classrooms. *Theory into Practice*, *31*(2). https://liberty.alma.exlibrisgroup.com/discovery/openurl?institution=01LIBU_INST&vid=01LIBU_INST:Services&sid=google&auinit=LC&aulast=Moll&atitle=Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms&id=doi:10.1080%25

Moore, R. (2004). Cultural capital: Objective probability and the cultural

arbitrary. *British Journal of Sociology of Education*, *25*(4), 445–456. https://doi.org/10.1080/0142569042000236943

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(41), 16474–16479. https://doi.org/10.1073/pnas.1211286109

Mudaly, R., & Chirikure, T. (2023). STEM education in the Global North and Global South: competition, conformity, and convenient collaborations. *Frontiers in Education*, *8*(October), 1–13. https://doi.org/10.3389/feduc.2023.1144399

Murphy, M., & Costa, C. (2015). Introduction: Bourdieu and education research. In *Theory as Method in Research: On Bourdieu, Social Theory and Education* (Issue 2015, pp. 1–13). https://doi.org/10.4324/9781315707303

Naidoo, R. (2004). Fields and institutional strategy: Bourdieu on the relationship between higher education, inequality and society. *British Journal of Sociology of Education*, *25*(4), 457–471. https://doi.org/10.1080/0142569042000236952

Nash, R. (2002a). Numbers and narratives: Further reflections in the sociology of education. *British Journal of Sociology of Education*, *23*(3), 397–412. https://doi.org/10.1080/0142569022000015436

Nash, R. (2002b). The educated habitus, progress at school, and real knowledge. *Interchange*, *33*(1), 27–48. https://doi.org/10.1023/A:1016399826766

Nelson, D. J. (2017). Diversity of Science and Engineering Faculty at Research Universities. In *Diversity in the Scientific Community Volume 1: Quantifying Diversity and Formulating Success* (Vol. 1255, pp. 2–15). American Chemical Society. https://doi.org/doi:10.1021/bk-2017-1255.ch002

Newberry, B. (2004). The dilemma of ethics in engineering education. *Science and Engineering Ethics*, *10*(2), 343–351. https://doi.org/10.1007/s11948-004-0030-8

Njie, B., & Asimiran, S. (2014). Case Study as a Choice in Qualitative Methodology. *IOSR Journal of Research & Method in Education (IOSRJRME)*, *4*(3), 35–40. https://doi.org/10.9790/7388-04313540

Nolan, K. (2012). Dispositions in the field: Viewing mathematics teacher education through the lens of Bourdieu's social field theory. *Educational Studies in Mathematics*, *80*(1–2), 201–215. https://doi.org/10.1007/s10649-011-9355-9

Norodien-Fataar, N. (2016). The pre-university pathways of disadvantaged students for gaining entry to university study. *Education as Change*, *20*(1), 85–103. https://doi.org/10.17159/1947-9417/2016/568

Ntsanwisi, S. (2024). Bridging Gaps in STEM Education: The Case for Dedicated Learning Centres in South African Townships and Rural Areas. *European Journal of STEM Education*, *9*(1), 1–14. https://doi.org/10.20897/ejsteme/15481

Nuñez, A. M. (2009). Latino students' transitions to college: A social and intercultural capital perspective. *Harvard Educational Review*, *79*(1), 22–48. https://doi.org/10.17763/haer.79.1.wh7164658k33w477

Nwokocha, G. C., & Legg-Jack, D. (2024). Reimagining STEM Education in South Africa: Leveraging Indigenous Knowledge Systems Through the M-Know Model for Curriculum Enhancement. *International Journal of Social Science Research and Review*, *7*(1), 173–189. http://dx.doi.org/10.47814/ijssrr.v6i11.642%0AAbstract

O'Shea, S. (2016). Avoiding the manufacture of 'sameness': first-in-family students, cultural capital and the higher education environment. *Higher Education*, *72*(1), 59–78. https://doi.org/10.1007/s10734-015-9938-y

Odebiyi, O. A., Odebiyi, O. S., Osawu, B. T., Kindikah, I., Ainaf, G. O., Ogunyemi, F. B., Wang, S., Iwuagwu, O., Bargi, W. A. AL, & Afam, U. C. (2024). Examining Females Participation in Engineering as a Discipline: A Case Study of Uganda and Nigeria. *International Journal of Academic Research in Progressive Education and Development*, *13*(4), 2951–2971. https://doi.org/10.6007/ijarped/v13-i4/24083

OECD. (2018). *Why social mobility matters What exactly is social mobility ? " S ticky floors " and " sticky ceilings " – How parents pass on privilege and disadvantage to their children Privilege and disadvantage also persist over the life course*. *June*, 1–4.

OECD. (2024). *Education at a Glance 2024. Country note*.

Okoroigwe, E. C., Agbasi, I. S., Okoroigwe, F. C., & Okoroigwe, C. N. (2022). University-Industry Linkages: The Gateway for Accelerating National Development in Africa. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, 544–554. https://doi.org/10.46254/af03.20220094

Oliver, D. G., Serovich, J. M., & Mason, T. L. (2005). Contraints and Opportunities with Intervew Transcription: Towards Reflection in Qualitative Research. *NIH Public Access*, *84*(2), 1273–1289. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3624763/pdf/nihms412728.pdf

Ong, M., Wright, C., Espinosa, L. L., & Orfield, G. (2011). Inside the double bind: A Synthesis of empirical research on undergraduate and graduate women of color in science, technology, engineering, and mathematics. *Harvard Educational Review*, *81*(2), 172–208. https://doi.org/10.17763/haer.81.2.t022245n7x4752v2

Orellana, V., Guzman, C., Bellei, C., Gareca, B., & Torres, F. (2017). Elección de carrera y universidad en Chile: sentido y utilidad de la acreditación. In *Serie Cuadernos de Investigación en Aseguramiento de la Calidad* (Vol. 7).

Comisión Nacional de Acreditación.

Osman, S., Abu, M. S., Mohammad, S., & Mokhtar, M. (2015). Identifying pertinent elements of critical thinking and mathematical thinking used in civil engineering practice in relation to engineering education. *Qualitative Report*, *21*(2), 212–227. https://doi.org/10.46743/2160-3715/2016.2203

Østergaard, C. R., Timmermans, B., & Kristinsson, K. (2011). Does a different view create something new? the effect of employee diversity on innovation. *Research Policy*, *40*(3), 500–509. https://doi.org/10.1016/j.respol.2010.11.004

Ostrove, J. M., & Long, S. M. (2007). Social class and belonging: Implications for college adjustment. *Review of Higher Education*, *30*(4), 363–389. https://doi.org/10.1353/rhe.2007.0028

Öztürk, S. (2005). Pierre Bourdieu's theory of social action. *Sosyal Bilimler Enstitüsü Dergisi*, *15*, 143–156.

Pagulayan, E. S., Asuncion, J. E. L., Tamayao, A. I., Vecaldo, R. T., Mamba, M. T., & Paat, F. M. G. (2021). The value of economic and cultural capital to college readiness among filipino senior high school graduates. *International Journal of Evaluation and Research in Education*, *10*(1), 174–184. https://doi.org/10.11591/ijere.v10i1.20963

Panaia, M. (2014). *La inclusión de la mujer en la profesión de ingeniería*. *16*(1), 19–43.

Pantoja de Prada, V., Ulloa Valenzuela, G., Diaz Cabezas, D., Valenzuela Carvajal, K., Ortíz Matamala, F., & Rebolledo Díaz, C. (2024). Asociación entre género y la elección de especialidades médicas en Chile. *Revista de Cirugía*, *76*(4), 334–341. https://doi.org/10.35687/s2452-454920240042124

Parra, M. (2021). Perfil del Estudiante Latinoamericano. *Unesco*. https://asociacionvenezolanadesociologia.org/wp-content/uploads/2022/05/Perfil-del-estudiante-universitario-

latinoamericano.pdf

Pascarella, E. T., Pierson, C. T., Wolniak, G. C., & Terenzini, P. T. (2004). First-Generation College Students: Additional Evidence on College Experiences and Outcomes. *The Journal of Higher Education*, *75*(3), 249–284. https://doi.org/10.1353/jhe.2004.0016

Passow, H. J., & Passow, C. H. (2017). What Competencies Should Undergraduate Engineering Programs Emphasize? A Systematic Review. *Journal of Engineering Education*, *106*(3), 475–526. https://doi.org/10.1002/jee.20171

Patnaik, E. (2013). Reflexivity: Situating the researcher in qualitative research. Reflexivity: Situating the Researcher in Qualitative Research. *Humanities and Social Science Studies*, *2*(2), 98–106. https://www.researchgate.net/publication/263916084

Patrick, A. D., Borrego, M., & Seepersad, C. C. (2018). A combined model for predicting engineering identity in undergraduate students. *ASEE Annual Conference and Exposition, Conference Proceedings*, *2018-June*. https://doi.org/10.18260/1-2--29660

Paulsen, M. B., & St John, E. P. (2002). Social Class and College Costs: Examining the Financial Nexus between College Choice and Persistence. *The Journal of Higher Education*, *73*(2), 189–236.

Pawley, A. L. (2017). Shifting the “Default”: The Case for Making Diversity the Expected Condition for Engineering Education and Making Whiteness and Maleness Visible. *Journal of Engineering Education*, *106*(4), 531–533. https://doi.org/10.1002/jee.20181

Pawley, A. L. (2019). Learning from small numbers: Studying ruling relations that gender and race the structure of U.S. engineering education. *Journal of Engineering Education*, *108*(1), 13–31. https://doi.org/10.1002/jee.20247

Pelley, E., & Carnes, M. (2020). When a Specialty Becomes “women’s Work”:

Trends in and Implications of Specialty Gender Segregation in Medicine. *Academic Medicine*, *95*(10), 1499–1506. https://doi.org/10.1097/ACM.0000000000003555

Perna, L. W. (2005). The benefits of higher education: Sex, racial/ethnic, and socioeconomic group differences. *Review of Higher Education*, *29*(1), 23–52. https://doi.org/10.1353/rhe.2005.0073

Pesch, U. (2015). Engineers and Active Responsibility. *Science and Engineering Ethics*, *4*, 925–939. https://doi.org/10.1007/s11948-014-9571-7

Peshkin, A. (2000). The Nature of Interpretation in Qualitative Research. *Educational Researcher*, *29*(9), 5–9. https://doi.org/10.3102/0013189X029009005

Pierrakos, O., Beam, T. K., Constantz, J., Johri, A., & Anderson, R. (2009). On the development of a professional identity: Engineering persisters vs engineering switchers. *Proceedings - Frontiers in Education Conference, FIE*, 1–6. https://doi.org/10.1109/FIE.2009.5350571

Pires, C., & Chapin, L. (2022). Barriers support and resilience of prospective first-in-family university. *Journal Community Psychology*, *50*, 3221–3236.

Pitka, E., & Tézli, A. (2024). Bridging the Gender Gap: A Canadian Study Examining Gender Inequality in Engineering Workplaces. *Spectrum*, *12*. https://doi.org/10.29173/spectrum222

Pitterson, N., Abdalla, A., Agrawal, A., Case, J., Goldschneider, B., & McArthur, J. (2022). Making knowledge accessible: A comparative study of engineering teaching across three countries. *Proceedings - Frontiers in Education Conference, FIE*, *2022-Octob*, 1–5. https://doi.org/10.1109/FIE56618.2022.9962466

Pleasants, J., Velasco, R., Colonnello, C., Glenn, S., Crapitto, S., Raymond, K., & Abbott, B. (2025). Promoting sociotechnical perspectives of engineering

during a summer bridge program. *Journal of Engineering Education*, *114*(1), 1–22. https://doi.org/10.1002/jee.20626

Postill, J. (2010). Introduction: Theorising media and practice. In B. Bräuchler & J. Postill (Eds.), *Theorising Media and Practice* (pp. 1–27). Berghahn.

Powell, A., Dainty, A., & Bagilhole, B. (2012). Gender stereotypes among women engineering and technology students in the UK: Lessons from career choice narratives. *European Journal of Engineering Education*, *37*(6), 541–556. https://doi.org/10.1080/03043797.2012.724052

Prakasam, G. R., Mukesh, & R, G. (2019). Enrolment by academic discipline in higher education: differential and determinants. *Journal of Asian Business and Economic Studies*, *26*(2), 265–285. https://doi.org/10.1108/JABES-12-2018-0104

Pret, T., Shaw, E., & Drakopoulou Dodd, S. (2016). Painting the full picture: The conversion of economic, cultural, social and symbolic capital. *International Small Business Journal: Researching Entrepreneurship*, *34*(8), 1004–1027. https://doi.org/10.1177/0266242615595450

Prieur, A., & Savage, M. (2013). Emerging Forms of Cultural Capital. *European Societies*, *15*(2), 246–267. https://doi.org/10.1080/14616696.2012.748930

Qu, S. Q., & Dumay, J. (2011). The qualitative research interview. *Qualitative Research in Accounting and Management*, *8*(3), 238–264. https://doi.org/10.1108/11766091111162070

Quaresma, M. L. (2023). Tensions and reconfigurations in higher education: the neoliberal Chilean experiment. *Sociologia, Problemas e Praticas*, *102*, 41–57. https://doi.org/10.7458/SPP202310227452

Quaresma, M. L., & Villalobos, C. (2022). Elite universities in Chile: Between social mobility and reproduction of inequality. *Tuning Journal for Higher Education*, *9*(2), 29–62. https://doi.org/10.18543/tjhe.1920

Quaresma, M. L., Villalobos Dintrans, C., & Torres-Cortes, F. (2022). The Massification of Higher Education and the Promise of Social Mobility. In R. Baikady, S. M. Sajid, J. Przeperski, V. Nadesan, M. R. Islam, & J. Gao (Eds.), *The Palgrave Handbook of Global Social Problems* (pp. 1–27). Springer International Publishing. https://doi.org/10.1007/978-3-030-68127-2_258-1

Rainey, K., Dancy, M., Mickelson, R., Stearns, E., & Moller, S. (2018). Race and gender differences in how sense of belonging influences decisions to major in STEM. *International Journal of STEM Education*, *5*(1). https://doi.org/10.1186/s40594-018-0115-6

Reay, D. (2003). A risky business? Mature working-class women students and access to higher education. *Gender and Education*, *15*(3), 301–317. https://doi.org/10.1080/09540250303860

Reay, D. (2004a). Cultural capitalists and academic habitus: Classed and gendered labour in UK higher education. *Women's Studies International Forum*, *27*(1), 31–39. https://doi.org/10.1016/j.wsif.2003.12.006

Reay, D. (2004b). Education and Cultural Capital : The Implications of Changing Trends in Education Policies. *Cultural Trends*, *13*(2), 73–86. https://doi.org/10.1080/0954896042000267161

Reay, D. (2004c). Gendering Bourdieu's Concepts of Capitals? Emotional Capital, Women and Social Class. *The Sociological Review*, *52*(2_suppl), 57–74. https://doi.org/10.1111/j.1467-954x.2005.00524.x

Reay, D. (2004d). "It's all becoming a habitus": Beyond the habitual use of habitus in educational research. *British Journal of Sociology of Education*, *25*(4), 431–444. https://doi.org/10.1080/0142569042000236934

Reay, D. (2005). Beyond consciousness? The psychic landscape of social class. *Sociology*, *39*(5), 911–928. https://doi.org/10.1177/0038038505058372

Reay, D. (2013). Social mobility, a panacea for austere times: tales of emperors, frogs, and tadpoles. *Brithish Journal of Sociology of Education*, *34*(5–6), 660–677. https://www.jstor.org/stable/43818793

Reay, D., Ball, S. J., & David, M. (2002). “It’s taking me a long time but I’ll get there in the end”: Mature students on access courses and higher education choice. *British Educational Research Journal*, *28*(1), 5–19. https://doi.org/10.1080/01411920120109711

Reay, D., Crozier, G., & Clayton, J. (2009a). ‘ Fitting in ’ or ‘ standing out ’: working- class students in UK higher education. *British Educational Research Journal*, 1–18. https://doi.org/10.1080/01411920902878925

Reay, D., Crozier, G., & Clayton, J. (2009b). “Strangers in paradise”?: Working-class students in elite universities. *Sociology*, *43*(6), 1103–1121. https://doi.org/10.1177/0038038509345700

Reay, D., David, M., & Ball, S. J. (2001). Making a difference?: Institutional habituses and higher education choice. *Sociological Research Online*, *5*(4), 1–12. https://doi.org/10.5153/sro.548

Reay, D., Davies, J., David, M., & Ball, S. J. (2001). Choices of Degree or Degrees of Choice? Class, “Race” and the Higher Education Choice Process. *Sociology*, *35*(4), 855–874.

Reddy, T. (2006). Higher Education and Social Transformation in South Africa Since the Fall of Apartheid. *Cahiers de La Recherche Sur l’éducation et Les Savoirs*, *5*, 121–145. https://doi.org/10.4000/cres.1118

Reggiani, M., Gagnon, J. D., & Lunn, R. J. (2024). A holistic understanding of inclusion in STEM: Systemic challenges and support for women and LGBT+ academics and PhD students. *Science Education*, *February 2023*, 1637–1669. https://doi.org/10.1002/sce.21899

Reyes, H. L., & Duran, A. (2024). A Narrative Study Examining Latina Collegians’ Maternal Relationships and Their Influence on Educational

Trajectories. *Journal of Latinos and Education*, *23*(1), 149–162. https://doi.org/10.1080/15348431.2022.2114907

Riley, D. (2008). Engineering and social justice. *Synthesis Lectures on Engineers, Technology, and Society*, *3*(1), 1–152.

Riley, D., Pawley, A. L., Tucker, J., Catalano, G. D., Riley, D., Pawley, A. L., Tucker, J., & Catalano, G. D. (2017). *Feminisms in Engineering Education : Transformative Possibilities Published by : The Johns Hopkins University Press Stable URL : http://www.jstor.org/stable/20628172 Feminisms in Engineering Education : Transformative Possibilities*. *21*(2), 21–40.

Ríos-Jara, H. (2025). No to the Fake Reform Strategies and Outcomes of Student Protests on Chile's Higher Education Reform. *Politics & Policy*, *53*(1). https://doi.org/https://doi.org/10.1111/polp.70003

Rivera, L. A. (2011). Ivies, extracurriculars, and exclusion: Elite employers' use of educational credentials. *Research in Social Stratification and Mobility*, *29*(1), 71–90. https://doi.org/10.1016/j.rssm.2010.12.001

Roberts, K., Dowell, A., & Nie, J. B. (2019). Attempting rigour and replicability in thematic analysis of qualitative research data; A case study of codebook development. *BMC Medical Research Methodology*, *19*(1), 1–8. https://doi.org/10.1186/s12874-019-0707-y

Roberts, R. E. (2020). Qualitative interview questions: Guidance for novice researchers. *Qualitative Report*, *25*(9), 3185–3203. https://doi.org/10.46743/2160-3715/2020.4640

Rodrigues, R. B., & Seniuk Cicek, J. (2024). A scoping literature review of sociotechnical thinking in engineering education. *European Journal of Engineering Education*, *49*(5), 807–833. https://doi.org/10.1080/03043797.2024.2346344

Roksa, J., & Kinsley, P. (2019). The Role of Family Support in Facilitating Academic Success of Low-Income Students. *Research in Higher*

Education, *60*(4), 415–436. https://doi.org/10.1007/s11162-018-9517-z

Rosenzvaig-Hernandez, M. (2024). Unmaking the market: exploring the Chilean challenges to de-privatise the educational system. *Globalisation, Societies and Education*, *22*(5), 856–874. https://doi.org/10.1080/14767724.2022.2119123

Roulston, K., Demarrais, K., & Lewis, J. B. (2003). Learning to Interview in the Social Sciences. *Qualitative Inquiry*, *9*(4), 643–668. https://doi.org/10.1177/1077800403252736

Rubin, M. (2012). Social class differences in social integration among students in higher education: A meta-analysis and recommendations for future research. *Journal of Diversity in Higher Education*, *5*(1), 22–38. https://doi.org/10.1037/a0026162

Rubio, E. (2012). Capital social y exclusión. Una mirada desde los profesionales de la intervención social. *Miscelanea Comillas*, *70*(136), 37–62.

Rutakumwa, R., Mugisha, J. O., Bernays, S., Kabunga, E., Tumwekwase, G., Mbonye, M., & Seeley, J. (2020). Conducting in-depth interviews with and without voice recorders: a comparative analysis. *Qualitative Research*, *20*(5), 565–581. https://doi.org/10.1177/1468794119884806

Sackey, S. M., Ancha, V. R., Chinyama, M. P., Awono Onana, C., Danwe, R., Megahed, M. M., Delpouve, B., Chama, S., Mahomed, N., Kayibanda, V., Kabeya Mukeba, L. Y., & Müller, A. (2014). Collaborative meta-profile development to harmonise mechanical engineering education in Africa. *Tuning Journal for Higher Education*, *2*(1), 161. https://doi.org/10.18543/tjhe-2(1)-2014pp161-178

Salas, V., & Gaymer, M. (2017). Política pública de gratuidad en educación superior en Chile: ¿qué falta? In L. N. T. Juan Cándido Gómez Gallego, María Concepción Pérez Cárceles (Ed.), *Investigaciones de Economía de*

la Educación (pp. 75–100).

Salazar-Fernandez, J. P., Sepúlveda, M., & Munoz-Gama, J. (2019). Influence of Student Diversity on Educational Trajectories in Engineering High-Failure Rate Courses that Lead to Late Dropout. *IEEE Global Engineering Education Conference (EDUCON)*, 607–616.

Salazar Monroy, P., Oliveros Ruiz, M. A., Valdez Salas, B., & Coronado Ortega, M. A. (2019). Movilidad social en los graduados de Ingeniería de la Universidad Politécnica de Baja California. *Revista de Estudios y Experiencias En Educación*, *18*(38), 87–111. https://doi.org/10.21703/rexe.20191838salazar6

Sallaz, J. J., & Zavisca, J. (2007). Bourdieu in American sociology, 1980-2004. *Annual Review of Sociology*, *33*, 21–41. https://doi.org/10.1146/annurev.soc.33.040406.131627

Samuelson, C., & Litzler, E. (2016). CommunityCulturalWealth: AnAssets-BasedApproach to Persistence of Engineering Students ofColor CateC.Samuelsona. *Journal of Engineering Education*, *105*(1), 93–117. https://doi.org/DOI 10.1002/jee.20110

Sanborn, H., & Thyne, C. L. (2013). Learning democracy: Education and the fall of authoritarian regimes. *British Journal of Political Science*, *44*(4), 773–797. https://doi.org/10.1017/S0007123413000082

Santelices, M., Catalán, X., & Horn, C. L. (2018). *Equidad en la Educación Superior. Diseño y resultados de programas de acceso en universidades selectivas*. Ediciones Universidad Catolica de Chile.

Santelices, Maria Verónica, Catalán, X., Horn, C., & Venegas, A. (2018). High School Ranking in University Admissions at a National Level: Theory of Action and Early Results from Chile. *Higher Education Policy*, *31*(2), 159–179. https://doi.org/10.1057/s41307-017-0048-6

Santelices, María Verónica, Horn, C., & Catalan, X. (2019). The Quest for

Equity in Chile's Higher Education. Decades of Continued Efforts. In *ペインクリニック学会治療指針２*. Lexington Books.

Sapiro, G. (2015). Habitus: History of a Concept. *International Encyclopedia of the Social & Behavioral Sciences: Second Edition*, *December 2015*, 484–489. https://doi.org/10.1016/B978-0-08-097086-8.03085-3

Sayer, A. (2009). Reflexivity and the habitus. In M. S. Archer (Ed.), *Conversations About Reflexivity* (pp. 108–122). Taylor & Francis Group. Created. https://doi.org/10.4324/9780203867556-13

Scandone, B. (2017). Social class, ethnicity, and the process of 'fitting in.' In R. Waller, N. Ingram, & M. R. M. Ward (Eds.), *Higher Education and Social Inequalities: University Admissions, Experiences, and Outcomes* (pp. 116–135). https://doi.org/10.4324/9781315449722

Schmid, E., Garrels, V., & Skåland, B. (2024). The continuum of rapport: Ethical tensions in qualitative interviews with vulnerable participants. *Qualitative Research*. https://doi.org/10.1177/14687941231224600

Schmitt, M. (2021). Women Engineers on Their Way to Leadership: The Role of Social Support Within Engineering Work Cultures. *Engineering Studies*, *13*(1), 30–52. https://doi.org/10.1080/19378629.2021.1882471

Schneider, J., Lucena, J., & Leydens, J. A. (2009). Engineering to Help: The Value of Critique in Engineering Science. *IEEE Technology and Society Magazine*, *28*(4), 43–48.

Schroedler, T. (2017). *The value of foreign language learning: A study on linguistic capital and the economic value of language skills*. Springer.

Searle, J. (1995). *The Construction of Social Reality*. The Free Press. https://doi.org/10.1086/230850

Secules, S., Gupta, A., Elby, A., & Tanu, E. (2018). Supporting the Narrative Agency of a Marginalized Engineering Student. *Journal of Engineering*

Education, *107*(2), 186–218. https://doi.org/10.1002/jee.20201

Seitz, S. (2016). Pixilated partnerships, overcoming obstacles in qualitative interviews via Skype: a research note. *Qualitative Research*, *16*(2), 229–235. https://doi.org/10.1177/1468794115577011

Serna, E., & Serna, A. (2013). ¿Está en crisis la ingeniería en el mundo? Una revisión a la literatura. *Revista Facultad de Ingeniería Universidad de Antioquia*, *66*, 199–208.

Seron, C., Silbey, S., Cech, E., & Rubineau, B. (2018). "I am Not a Feminist, but..": Hegemony of a Meritocratic Ideology and the Limits of Critique Among Women in Engineering. *Work and Occupations*, *45*(2), 131–167. https://doi.org/10.1177/0730888418759774

Seron, C., Silbey, S. S., Cech, E., & Rubineau, B. (2015). Persistence Is Cultural: Professional Socialization and the Reproduction of Sex Segregation. *Work and Occupations*, *43*(2), 178–214. https://doi.org/10.1177/0730888415618728

Shahri, N. (2023). Rapport in research interviews: An interdiscursive perspective. *System*, *119*(October), 103165. https://doi.org/10.1016/j.system.2023.103165

Shukla, A. K. (2024). *Enhancing Communication Skills for Engineering Students*. *6*(5), 1–4.

Siann, G., & Callaghan, M. (2001). Choices and barriers: Factors influencing women's choice of higher education in science, engineering and technology. *Journal of Further and Higher Education*, *25*(1), 85–95. https://doi.org/10.1080/03098770020030524

Sieben, S., & Lechner, C. M. (2019). Measuring cultural capital through the number of books in the household. *Measurement Instruments for the Social Sciences*, *1*(1), 1–7. https://doi.org/10.1186/s42409-018-0006-0

Siisiäinen, M. (2000). The Two Meanings of Social Capital. *Sociological Forum*, *15*(1), 1–12. https://www.jstor.org/stable/3070334

Simpson, A., Knox, P., & Yang, J. (2023). Children s engineering identities-in-practice An exploration of child adult.pdf. *Journal of Engineering Education*, *112*(4), 1056–1078.

Sims, D., Zingela, Z., Mokhachane, M., Botha, G., Mawela, D., Singaram, V., Baatjes, K., Green-Thompson, L., & Begg, K. (2025). Medical education, reflections and perspectives from South Africa: a review. *BMC Medical Education*, *25*(1). https://doi.org/10.1186/s12909-025-06910-8

Singer, A., Montgomery, G., & Schmoll, S. (2020). How to foster the formation of STEM identity: studying diversity in an authentic learning environment. *International Journal of STEM Education*, *7*(1). https://doi.org/10.1186/s40594-020-00254-z

Slay, H. S., & Smith, D. A. (2011). Professional identity construction: Using narrative to understand the negotiation of professional and stigmatized cultural identities. *Human Relations*, *64*(1), 85–107. https://doi.org/10.1177/0018726710384290

Smith, C., Wao, H., Kersaint, G., Campbell-Montalvo, R., Gray-Ray, P., Puccia, E., Martin, J. P., Lee, R., Skvoretz, J., & MacDonald, G. (2021). Social Capital From Professional Engineering Organizations and the Persistence of Women and Underrepresented Minority Undergraduates. *Frontiers in Sociology*, *6*(May), 1–13. https://doi.org/10.3389/fsoc.2021.671856

Smith, Edwin. (2003). Ethos , Habitus and Situation for Learning : An Ecology. *Journal of Sociology of Education*, *24*(4), 463–470. https://doi.org/10.1080/0142569032000109378

Smith, Emma. (2011). Women into science and engineering? Gendered participation in higher education STEM subjects. *British Educational Research Journal*, *37*(6), 993–1014.

https://doi.org/10.1080/01411926.2010.515019

Smith, J., & Lucena, J. (2016). Invisible innovators: how low-income, first-generation students use their funds of knowledge to belong in engineering. *Engineering Studies*, *8*(1), 1–26. https://doi.org/10.1080/19378629.2016.1155593

Snellman, K., Silva, J. M., Frederick, C. B., & Putnam, R. D. (2015). The Engagement Gap: Social Mobility and Extracurricular Participation among American Youth. *Annals of the American Academy of Political and Social Science*, *657*(1), 194–207. https://doi.org/10.1177/0002716214548398

Soto Hernández, V. J. (2016). Estudiantes de primera generación en Chile: Una aproximación cualitativa a la experiencia universitaria. *Revista Complutense de Educacion*, *27*(3), 1157–1173. https://doi.org/10.5209/rev_RCED.2016.v27.n3.47562

Soto, J. D., Calle, M. G., Oliveros, I., Ripoll, L., Lopez, L., & Rueda-Delgado, D. (2024). Improving Students' Oral Communication Skills in Electrical Engineering. *2024 IEEE Technology and Engineering Management Society, TEMSCON LATAM 2024*. https://doi.org/10.1109/TEMSCONLATAM61834.2024.10717823

South Africa. Department of Education (DoE). (1997). *Education white paper 3: a programme for the transformation of higher education*. Department of Education. https://doi.org/https://www.gov.za/sites/default/files/gcis_document/201409/18207gen11960.pdf

Spaaij, R. (2012). Building social and cultural capital among young people in disadvantaged communities: lessons from a Brazilian sport-based intervention program. *Sport, Education and Society*, *17*(1), 77–95. https://doi.org/10.1080/13573322.2011.607913

Spooner, M. H. (2002). Medicine becoming a " female " profession in UK.

CMAJ, *167*(4), 385.

Stanton-Salazar, R. D. (2011). A social capital framework for the study of institutional agents and their role in the empowerment of low-status students and youth. *Youth and Society*, *43*(3), 1066–1109. https://doi.org/10.1177/0044118X10382877

Starman, A. B. (2013). The case study as a type of qualitative research. *Journal of Contemporary Education Studies*, *1*(March 2013), 28–43.

Stokke, K., & Törnquist, O. (2013). Democratization in the Global South. The Importance of Transformative Politics. In K. Stokke & O. Törnquist (Eds.), *Democratization in the Global South*. Palgrave Macmillan UK. https://doi.org/10.1057/9780230370043_4

Strutz, M. L., & Ohland, M. W. (2012). Low-SES first-generation student's decision to pursue engineering. *ASEE Annual Conference and Exposition, Conference Proceedings*. https://doi.org/10.18260/1-2--21664

Suwinyattichaiporn, T., & Johnson, Z. D. (2022). The Impact of Family and Friends Social Support on Latino/a First-Generation College Students' Perceived Stress, Depression, and Social Isolation. *Journal of Hispanic Higher Education*, *21*(3), 297–314. https://doi.org/10.1177/1538192720964922

Swartz, D. (1997). *Culture and Power: The Sociology of Pierre Bourdieu*. The University of Chicago Press. https://doi.org/10.2307/2654908

Sweetman, P. (2003). Twenty-first century dis-ease? Habitual reflexivity or the reflexive habitus. *Sociological Review*, *51*(4), 528–549. https://doi.org/10.1111/j.1467-954X.2003.00434.x

Tahir, S., Danyal, M., Ali, A., & Sani, A. (2025). Vol 10, Issue 1, 2025 AUG. *Health Science Australia*, *10*(1), 1–4.

Tan, C. Y. (2020). *Family cultural capital and student achievement: Theoretical*

insights from PISA (Issue December). Springer. https://doi.org/10.1007/978-981-15-4491-0

Tarabini, A., Curran, M., & Fontdevila, C. (2017). Institutional habitus in context: implementation, development and impacts in two compulsory secondary schools in Barcelona. *British Journal of Sociology of Education*, *38*(8), 1177–1189. https://doi.org/10.1080/01425692.2016.1251306

Taylor, S. J., Bogdan, R., & DeVault, M. L. (2016). *Introduction to Qualitative Research Methods. A Guideboook and Resource* (4th ed.). Wiley. http://library1.nida.ac.th/termpaper6/sd/2554/19755.pdf

Temple, B., & Young, A. (2004). Qualitative Research and Translation Dilemmas. *Qualitative Research*, *4*(2), 161–178. https://doi.org/10.1177/1468794104044430

Tepe, K., Verchier, Y., & Kokou, Y. (2024). *The challenges of massification in higher education in developing countries*. https://hal.science/hal-04465666

Tett, L. (2004). Mature working-class students in an 'elite' university: Discourses of risk, choice and exclusion. *Studies in the Education of Adults*, *36*(2), 252–264. https://doi.org/10.1080/02660830.2004.11661500

Thomas, L. (2002). Student retention in higher education : the role of institutional habitus. *J.Education Policy*, *17*(4), 423–442. https://doi.org/10.1080/02680930210140257

Thomsen, J. P., Munk, M. D., Eiberg-Madsen, M., & Hansen, G. I. (2013). The educational strategies of Danish university students from professional and working-class backgrounds. *Comparative Education Review*, *57*(3 SUPPL), 457–480. https://doi.org/10.1086/670806

Thomson, P. (2016). *Educational leadership and pierre bourdieu*. Routledge.

Thorpe, H. (2009). Bourdieu, feminism and female physical culture: Gender reflexivity and the habitus-field complex. *Sociology of Sport Journal*, *26*(4),

491–516. https://doi.org/10.1123/ssj.26.4.491

Tinto, V. (1993). Leaving college: Rethinking the causes and cures of student attrition. *University of Chicago*.

Tinto, V. (2015). Through the Eyes of Students. *Journal of College Student Retention: Research, Theory and Practice*, 1–16. https://doi.org/10.1177/1521025115621917

Tinto, V. (1987). The Principles of Effective Retention. *Fall Conference of the Maryland College Personnel Association*, 1–15.

Tondeur, J., Sinnaeve, I., Van Houtte, M., & Van Braak, J. (2011). Ict as cultural capital: The relationship between socioeconomic status and the computer-use profile of young people. *New Media and Society*, *13*(1), 151–168. https://doi.org/10.1177/1461444810369245

Tonso, K. L. (2006). Student engineers and engineer identity: Campus engineer identities as figured world. *Cultural Studies of Science Education*, *1*(2), 273–307. https://doi.org/10.1007/s11422-005-9009-2

Torche, F. (2011). Is a college degree still the great equalizer? Intergenerational mobility across levels of schooling in the United States. *American Journal of Sociology*, *117*(3), 763–807. https://doi.org/10.1086/661904

Toroka, M. I., & Kafanabo, E. (2024). Assessing the Relevance of Technical Education Curricula to Current Industrial Skill Demands in Tanzania: A Case Study of Civil, Electrical, and Biomedical Engineering Curriculum. *Papers in Education and Development*, *42*(1), 215–234. https://doi.org/10.56279/ped.v42i1.11

Torres, R. (2022). Neoliberalism and the Impact of Student Demonstrations in Chile: Pushing the Bounds of the Post-Pinochet Education Project? *Latin American Perspectives*, *49*(3), 146–161. https://doi.org/10.1177/0094582X221082985

Tramonte, L., & Willms, J. D. (2010). Cultural capital and its effects on education outcomes. *Economics of Education Review*, *29*(2), 200–213. https://doi.org/10.1016/j.econedurev.2009.06.003

Trede, F., Macklin, R., & Bridges, D. (2012). Professional identity development: A review of the higher education literature. *Studies in Higher Education*, *37*(3), 365–384. https://doi.org/10.1080/03075079.2010.521237

Trevelyan, J. (2010). Reconstructing engineering from practice. *Engineering Studies*, *2*(3), 175–195. https://doi.org/10.1080/19378629.2010.520135

Turnbull, S. M., Locke, K., Vanholsbeeck, F., & O'Neale, D. R. J. (2019). Bourdieu, networks, and movements: Using the concepts of habitus, field and capital to understand a network analysis of gender differences in undergraduate physics. *PLoS ONE*, *14*(9), 1–28. https://doi.org/10.1371/journal.pone.0222357

Uccelli, P., E.Phillips, Barr, D., Meneses, A., & C. Dobbs. (2015). Beyond Vocabulary Exploring Cross-Disciplinary Academic-Language Proficiency and its association with reading comprehension. *Reading Research Quarterly*, *50*(3), 337–356.

UNESCO. (2024). World Education Statistics. In *World Education Statistics 2024*.

Upadhya, C. (2016). Engineering equality? Education and im/mobility in coastal Andhra Pradesh, India. *Contemporary South Asia*, *24*(3), 242–256. https://doi.org/10.1080/09584935.2016.1203863

Upadhyay, U. D., & Lipkovich, H. (2020). Using online technologies to improve diversity and inclusion in cognitive interviews with young people. *BMC Medical Research Methodology*, *20*(1), 1–10. https://doi.org/10.1186/s12874-020-01024-9

Valbuena, L. F. R. (2018). Industrial engineering education field in Colombia. *Proceedings of the International Conference on Industrial Engineering and*

Operations Management, *2018*(JUL), 2849–2861.

Van de Werfhorst, H. G. (2009). Credential inflation and educational strategies: A comparison of the United States and the Netherlands. *Research in Social Stratification and Mobility*, *27*(4), 269–284. https://doi.org/10.1016/j.rssm.2009.10.001

Van De Werfhorst, H. G., & Kraaykamp, G. (2001). Four field-related educational resources and their impact on labor, consumption, and sociopolitical orientation. *Sociology of Education*, *74*(4), 296–317. https://doi.org/10.2307/2673137

van der berg, S. (2007). Apartheid's enduring legacy: Inequalities in education. *Journal of African Economies*, *16*(5), 849–880. https://doi.org/10.1093/jae/ejm017

Van Rensburg, B. J. (2010). Managing the expectations – reality mismatch through aspirations , access and achievement : Engineering a first year undergraduate student ' s habitus. *13th Pacific Rim First Year in Higher Education Conference,'Aspiration, Access, Achievement.'*

Venegas-Ramos, L., & Sánchez Lara, R. (2024). Inclusión de las Diversidades en Educación Superior: Alcances y Desafíos desde la Justicia Educativa. *Revista Latinoamericana de Educación Inclusiva*, *18*(1), 175–194. https://doi.org/10.4067/s0718-73782024000100175

Verdin, D., Smith, J., & Lucena, J. (2024). First-generation college students funds of knowledge support the development of an engineering role identity. *Journal of Engineering Education*, *113*, 383–406.

Verwiebe, R., & Hagemann, S. (2024). Bourdieu revisited: new forms of digital capital–emergence, reproduction, inequality of distribution. *Information Communication and Society*, *4462*, 1–23. https://doi.org/10.1080/1369118X.2024.2358170

Villalobos, C., Quaresma, M. L., Bonilla, A., Kuzmanic, D., & Valenzuela, J. P.

(2023). Cultural tastes and practices of students from elite universities and careers in Chile. *Psicoperspectivas*, *22*(2), 1–16. https://doi.org/10.5027/psicoperspectivas-vol22-issue2-fulltext-2853

Villalobos Saldivia, I. (2023). Movimientos estudiantiles: resistencia al sistema neoliberal en la educación chilena. *Revista Sul-Americana de Psicologia*, *11*(1), 107–125. https://doi.org/10.29344/2318650x.1.3379

Villanueva, I., & Nadelson, L. (2017). Are we preparing our students to become engineers of the future or the past? *International Journal of Engineering Education*, *33*(2), 639–652.

Vincent, L., & Hlatshwayo, M. (2018). Ties that bind: The ambiguous role played by social capital in black working class first-generation South African students' negotiation of university life. *South African Journal of Higher Education*, *32*(3). https://doi.org/10.20853/32-3-2538

Volpe, E., Polmear, M., Simmons, D. R., & Weisenfeld, D. (2023). Exploring the Role of Social Capital in Civil Engineering Students' Leadership Development. *Journal of Civil Engineering Education*, *149*(3). https://doi.org/10.1061/jceecd.eieng-1870

Wacquant, L. (2006). Chapter 16 : Pierre Bourdieu. In R. Stones (Ed.), *Key Contemporary Thinkers* (Vol. 2, pp. 215–229). Macmillan. http://www.ncbi.nlm.nih.gov/pubmed/19648931

Wajcman, J. (2009). Feminist theories of technology. *Cambridge Journal of Economics*, *34*(1), 143–152. https://doi.org/10.1093/cje/ben057

Walker, M. E. (2000). Movement and Metaphor : Towards an Embodied Theory of Music Cognition and Hermeneutics. *Bulletin of the Council for Research in Music Education*, *145*(145), 27–42. http://www.jstor.org/stable/40319020

Walker, M., & Mathebula, M. (2020). Low-income rural youth migrating to urban universities in South Africa: opportunities and inequalities. *Compare*, *50*(8), 1193–1209. https://doi.org/10.1080/03057925.2019.1587705

Walker, M., McLean, M., Mathebula, M., & Mukwambo, P. (2022). Low-Income Students, Human Development and Higher Education in South Africa. In *Muse.Jhu.Edu*. African Minds. https://muse.jhu.edu/pub/362/oa_monograph/chapter/3201496/pdf

Walpole, M. B. (2003). Socioeconomic Status and College: How SES Affects College Experiences and Outcomes. In *Review of Higher Education* (Vol. 27, Issue 1, pp. 45–73). Johns Hopkins University Press. https://doi.org/10.1353/rhe.2003.0044

Walther, M. (2014). Bourdieu's Theory of Practice as Theoretical Framework. In *Repatriation to France and Germany A Comparative Study Based on Bourdieu's Theory of Practice*. Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-05700-8_2

Waterhouse, G., Ridley, A., Bull, R., Satchell, L., & Wilcock, R. (2023). Applied Cognitive Psychology - 2023 - Waterhouse - Rapport-building in multiple interviews of children.pdf. *Applied Cognitive Psychology*, *37*, 1210–1222.

Watson, J. (2013). Profitable portfolios: Capital that counts in higher education. *British Journal of Sociology of Education*, *34*(3), 412–430. https://doi.org/10.1080/01425692.2012.710005

Watt, H. M. G., Richardson, P. W., Klusmann, U., Kunter, M., Beyer, B., Trautwein, U., & Baumert, J. (2012). Motivations for choosing teaching as a career: An international comparison using the FIT-Choice scale. *Teaching and Teacher Education*, *28*(6), 791–805. https://doi.org/10.1016/j.tate.2012.03.003

Welde, K. De, & Laursen, S. (2011). The glass obstacle course: Informal and formal barriers for women Ph. D. students in STEM fields. *International Journal of Gender, Science and Technology*, *3*, 571–595. http://genderandset.open.ac.uk/index.php/genderandset/article/viewArticle/205

Wilcox, P., Winn, S., & Fyvie-Gauld, M. (2005). “It was nothing to do with the university, it was just the people”: The role of social support in the first-year experience of higher education. *Studies in Higher Education*, *30*(6), 707–722. https://doi.org/10.1080/03075070500340036

Wilson, M., Matsumoto, D., Avendano Vasquez, A. N., Garcia Garcla, J. M., & Helmy, M. (2022). Social Judgments of Rapport in Investigative Interviews Across Cultures. *Cross-Cultural Research*, *56*(5), 496–526. https://doi.org/10.1177/10693971221119944

Winkle-Wagner, R. (2010). Foundations of educational inequality: cultural capital and social reproduction. *ASHE Higher Education Report*, *36*(1), 1–144. https://doi.org/10.1002/aehe.3601

Wolff, K., Dalton, A., Blaine, D., Viljoen, C., & Basson, A. (2022). Engineering Education in the Global North and South: A Comparative Thematic Analysis. *2022 IEEE IFEES World Engineering Education Forum - Global Engineering Deans Council, WEEF-GEDC 2022 - Conference Proceedings*, 1–6. https://doi.org/10.1109/WEEF-GEDC54384.2022.9996204

Wolniak, G. C., Seifert, T. A., Reed, E. J., & Pascarella, E. T. (2008). College majors and social mobility. *Research in Social Stratification and Mobility*, *26*(2), 123–139. https://doi.org/10.1016/j.rssm.2008.02.002

Woodrooffe, D. D. (2011). When visions of the rainbow nation are not enough: Effect of post-apartheid higher education reform on social cohesion in South Africa. *Peabody Journal of Education*, *86*(2), 171–182. https://doi.org/10.1080/0161956X.2011.561184

Wright, D. (2006). Cultural capital and the literary field. *Cultural Trends*, *15*(2–3), 123–139. https://doi.org/10.1080/09548960600712934

Xu, P., & Jiang, J. (2020). Individual capital structure and health behaviors among chinese middle-aged and older adults: A cross-sectional analysis

using bourdieu's theory of capitals. *International Journal of Environmental Research and Public Health*, *17*(20), 1–17. https://doi.org/10.3390/ijerph17207369

Xu, W. (2023). International Higher Education and the Pursuit of 'Chinese' Capitals: African Students and Families' Strategies of Social (Re)Production. *British Journal of Educational Studies*, *71*(3), 307–323. https://doi.org/10.1080/00071005.2022.2103095

Yüksek, D. (2016). Highbrow Cultural Consumption and The Perception of Social Prestige in Europe. *Dumlupınar Üniversitesi Sosyal Bilimler Enstitüsü*, *47*, 122–147.

Zörner, W., Mahomed, N., Zulu, A., Bader, T., Tenthani, C., Cuamba, B., & Chingosho, H. (2020). Meta-profile and competencies for harmonisation of higher education in sector-specific technology areas: A case study of Renewable Energy in Southern Africa. *Tuning Journal for Higher Education*, *8*(1), 75–97. https://doi.org/10.18543/TJHE-8(1)-2020PP75-97