# Doctoral Students' Perceptions of their Socialization Processes and Outcomes of Success in Nationally Accredited Engineering and Technology Programs in Chilean Universities

by

Ivet Parra Gaete

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved October 2022 by the
Graduate Supervisory Committee:

Gustavo Fischman, Co-Chair
Jeongeun Kim, Co-Chair
Sergio Celis

ARIZONA STATE UNIVERSITY

May 2023

# ABSTRACT

This qualitative study explores the socialization processes of doctoral students in engineering and technology Ph.D. accredited programs at Chilean universities and how these experiences may impact their success outcomes, particularly advancement, time to degree, completion, and preparedness for postgraduation success. I employed semi-structured interviews to learn from 23 current doctoral students representing ten unique doctoral programs at eight higher education institutions (HEIs). Findings showed increasing student diversity among programs. In addition, students' socialization showed to be affected by individual and institutional, and program-related factors, which resulted in distinctive student experiences. These processes were also shaped by the larger context of national policies related to programs such as funding, accreditation, and the job market. This study also identified trends in the relationships between students and program faculty, staff, and peers at different times of the doctoral training, which also created common and distinctive socialization dynamics. Findings illustrated how students' socialization experiences facilitated their advancement throughout the program toward completion, meeting expected degree completion times and enhancing their preparedness for postgraduation success. This dissertation includes implications for practice and future research opportunities.

# DEDICATION

To my dearest daughter Sofia Rafaella Trivino and husband, Sebastian Trivino.

En memoria de mis queridísimos y siempre recordados tata Luis Gaete, tía Clara Parra, madrina Edith Espinoza, y primo Ricardo Castro a quienes no pude acompañar en su último adiós y cuyas vidas y amor trascienden distancias, espacios, y tiempo.

ACKNOWLEDGMENTS

Thank God for allowing me to live this experience and bringing me to this special moment. For the unconditional love, health, and abundance provided over the years, even during a pandemic. To my dear parents, Estrellita and Alejandro, who were my first teachers, and who have never doubted me. To my mother-in-law Maria Teresa for her love and understanding. To my siblings Lily, Alejandra, and Luis Alejandro. To my extended family in Chile, Gaete Cárdenas and Parra Montero, especially to my grandmother Laura Cárdenas, aunt Eliana Parra, and the Flores Schmied family. My dearest friends, Tania Carvajal, Lorena Paredes, Laura Carrasco, Henriette San Martín, Patricia Millaquén, and Adriana Yañez, who have always been there for me. To Carolina Rebolledo, Alex Uribe, Andrés Aburto, and Nancy Díaz for their friendship, encouragement, and selfless gestures of kindness before and during this adventure. My mentors, Dr. Pablo Espinoza Concha, Prof. Cristina Oporto, Prof. Patricia Araya, and Dinah Lee Arnett, thank you for believing, inspiring, and supporting me at every step.

To my advisor and mentor, Dr. Jeongeun Kim, who has been my role model, always demonstrating her care and letting me learn from her brilliance, dedication to scholarship, passion for teaching, and kind heart. I do not have enough words to express my immense gratitude. Dr. Gustavo Fischman, for all his support since I applied to the program and for all the advice to become a better scholar. To Dr. Sergio Celis for helping me to develop as a scholar, the encouragement, help, and sharing opportunities. I am honored to call myself a colleague of yours. To Dr. Maria Teresa Tatto, my first advisor and mentors Dr. Mildred Boveda, Dr. Meseret Hailu, and Dr. Keon McGuire. Through them, I appreciate many Mary Lou Fulton Teachers College professors for caring,

helping, and teaching me so much in and outside the classroom. To my dear friends and doctoral peers, Dr. Esther Pretti do Lago, Dr. Areej Mawasi, and Dr. Kristi Glassmayer for caring deeply for my soul, and Dr. Garine Palandjan, Dr. Takeshi Terada and soon-to-be doctors Cathy Cullicot, Ivonne Lujano, Marina Basu, and Mariia Vitrukh for their friendship, compassion, care, sense of humor, prayers, support, and for being my inspiration over the years. To the many Chilean ASU students who became our family in Arizona. To my friends from the Fulbright International Students Association (FISA), ASU International Student Club, and the Chilean Cultural Center of Arizona.

My special gratitude to the 28 current students in doctoral programs in engineering and technology disciplines in Chilean universities who participated in this study. I extend my appreciation to these students' doctoral program directors, coordinators, and secretaries from Universidad de Antofagasta, Universidad de Concepción, Universidad Adolfo Ibañez, Universidad de La Serena, Pontificia Universidad Católica de Chile, Universidad de Santiago de Chile, Universidad de Talca, and Universidad Técnica Federico Santa María.

Finally, I acknowledge the Chilean government through Becas Chile and ASU Mary Lou Fulton Teachers College for financing my doctoral education in the United States. I also recognize the ASU Graduate and Professional Association (GPSA) support through the Graduate Research Support Program and the Educational Policy and Evaluation Doctoral Program (EPE) committee that granted me the Research Grant Award that financed important components of the dissertation research.

TABLE OF CONTENTS

Page

CHAPTER Page

CHAPTER Page

CHAPTER Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

LIST OF ACRONYMS

| | |
|---|---|
| ANID | Chilean National Agency for Research and Development (Agencia Nacional de Investigación y Desarrollo) former CONICYT. |
| CNA | National Accreditation Commission (Comisión Nacional de Acreditación). |
| CONICYT | National Commission for Science and Technology (Comisión Nacional de Investigación Científica y Tecnológica). |
| LOCE | Constitutional Organic Law of Education (Ley Orgánica Constitucional de Enseñanza). |
| MECESUP | Quality and Equity Improvement in Higher Education (Mejoramiento de la Calidad y la Equidad en la Educación Superior). |
| MinCiencia | Ministry of Science, Technology, Knowledge, and Innovation (Ministerio de Ciencia, Tecnología, Conocimiento e Innovación). |
| MINEDUC | Ministry of Education (Ministerio de Educación). |
| SIES | Education Information Service (Servicio de Información de Educación Superior). |
| IP | Professional Institute. |
| CFT | Center for Technical Training. |
| BPR | President Scholarship Program (Programa de Becas Presidente de la República). |

# CHAPTER 1

# INTRODUCTION

This study emerged after reflecting on the rapid increase of doctoral programs in Chilean universities and student enrollment in the last 40 years. Between 1982 and 2021, the number of programs grew from 16 to 266. Meanwhile, enrollment increased from less than 150 to over 6,000 students in about 4 decades (SIES, 2020a). During this period, Chile underwent intense political and social transformations, which profoundly affected the national educational policy, shifting the expectations for higher education (HE), including doctoral education (see a complete description of the national social and political context at the end of this chapter).

Before the 1981 reforms, Chilean HE was formed only by universities geared toward training first-degree graduates, funded primarily by the national government. Since then and influenced by global goals for higher education to support society advancement and sustainability, especially those in emerging economies like Chile, HE has become associated with supporting national economic development, increasing the number of Ph.D. holders (advanced human capital) to produce more research and innovation and solving complex social problems that require multidisciplinary approaches (CONICYT, 2013a; CTCI, 2022).

## Enrollment versus Graduation

As enrollment in doctoral programs in Chile increased dramatically in recent decades, so did the number of doctoral degrees conferred nationally[1]. However, the total

[1] The growth occurred while the Chilean national government implemented aggressive policies for training scholars abroad.

number of degree conferrals remains low when compared to enrollments. This mismatch suggests that while policies aiming to increase the number of Ph.D. holders over time have been effective, they might not meet the expected retention and completion rates. Table 1 shows the increase in Ph.D. graduates since 2010 (with slight declines in 2013 and 2020) and the total number of graduates during this decade representing 13% of total enrollments in doctoral programs (*n*=7,317/ 56,415).

**Table 1**

*Enrollments and Completions of Students in Doctoral Programs in Chilean Universities between 2010-2020*

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Enrollments** | 4,055 | 4,052 | 4,471 | 4,653 | 4,925 | 5,172 | 5,545 | 5,540 | 5,930 | 6,048 | 6,024 | 56,415 |
| **Completions** | 395 | 492 | 603 | 602 | 650 | 685 | 704 | 725 | 822 | 871 | 768 | 7,317 |
| **%** | **9.7** | **12.1** | **13.5** | **12.9** | **13.2** | **13.2** | **12.7** | **13.1** | **13.9** | **14.4** | **12.7** | **13.0** |

Source: prepared by the author based on the Education Information Service (SIES), Ministry of Education (MINEDUC) Enrollment databases 2007-2020 (SIES, 2020a) and Completion historical database 2007 2020 (SIES, 2020b).

Engineering and technology (E&T), social sciences, and sciences are the three main fields concentrating the highest enrollment in doctoral degrees nationally (SIES, 2021c). These three areas also show increased enrollment, but low graduation rates. The tension between high enrollment and low degree attainment is most aggravated in engineering and technology (E&T) doctoral programs. Table 2 shows that doctoral completion in E&T fields is the lowest compared to the other two areas with the most enrollments.

**Table 2**

*Enrollments and Completions of Students per Area with Highest Enrollments of Doctoral Programs in Chilean Universities between 2016-2020*

| Field | | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|---|
| **Engineering & Technology** | Enrollments | 985 | 815 | 1,098 | 1,198 | 1,277 | 5,373 |
| | Completions | 95 | 131 | 123 | 143 | 134 | 626 |
| | **%** | **9.6** | **16.1** | **11.2** | **11.9** | **10.5** | **11.7** |
| **Social Sciences** | Enrollments | 1,047 | 1,009 | 1,189 | 1,214 | 1,084 | 5,543 |
| | Completions | 120 | 153 | 183 | 162 | 159 | 777 |
| | **%** | **11.5** | **15.2** | **15.4** | **13.3** | **14.7** | **14.0** |
| **Sciences** | Enrollments | 1,821 | 2,138 | 1,932 | 2,006 | 1,821 | 9,718 |
| | Completions | 281 | 231 | 274 | 324 | 267 | 1,377 |
| | **%** | **15.4** | **10.8** | **14.2** | **16.2** | **14.7** | **14.2** |

Source: prepared by the author based on the historical enrollment database 2007-2022 (SIES, 2022a) and completions historical database (SIES, 2020b).

In addition to low degree attainment, doctoral programs in the E&T fields in Chilean universities present longer times to completion in comparison to social sciences and sciences fields. Although comprehensive national data about the intended duration of all doctoral programs are unavailable, the Ministry of Education and the National Accreditation Commission (CNA) reported that most doctoral programs last eight semesters . However, as shown in Table 3, the actual duration of degree completion average is higher. Table 3 shows that between 2010 and 2020, doctoral graduates took 12.25 semesters on average to complete their degree regardless of the field. Over the same period (see Table 3), E&T students took less time than the average (12.04 semesters) but still took two more semesters than expected to complete their degree (SIES, 2021a). Finally, Table 3 illustrates the variations in time to completion across disciplines.

**Table 3**

*Average Time to Graduation of Students in Doctoral Programs in Chilean Universities by Field between 2010-2020*

| Field | Average of Semesters |
|---|---|
| **Agricultural Sciences** | 11.93 |
| **Sciences** | 12.01 |
| **Engineering and Technology** | 12.04 |
| **Social Sciences** | 12.09 |
| **Medical and Health Sciences** | 12.41 |
| **Humanities** | 13.04 |
| **Average** | **12.25** |

Source: prepared by the author based on the Education Information Service (SIES), Ministry of Education (MINEDUC) databases (SIES, 2021a) *Data from Law, Architecture, Administration, and Commerce doctoral degrees were not complete or available. Disaggregated Education data were added to calculate the Social Sciences totals.

## Problem Statement

In Chilean universities, high enrollment, low graduation rates in doctoral programs in the E&T fields, and long training times raise important questions regarding possible issues during the training process. These concerns include, but are not limited to, the admissions process, program flexibility, and institutional support as part of the diversity among programs already suggested by prior scholarship (Baeza, 2018; Celis & Véliz, 2020). All these factors may contribute to disappointing Ph.D. graduation rates.

Low conferrals are not just an issue in Chilean E&T fields but across research fields at the national level and in other higher education systems such as the United States, South Africa, and Germany (Crede & Borrego, 2014; DHET, 2019; Herman, 2011; Jaksztat et al., 2021; Terrell et al., 2012). Similar concerns about the Chilean case permeate doctoral education in other Latin American countries, such as Argentina, Brazil, Colombia, and Mexico (De la Fare et al., 2021; Wainerman & Matovich, 2016). Global

policy trends are contributing to an increase in higher education institutions and programs and the establishment of accreditation systems. However, some of these policies may concentrate more on outcomes than on doctoral pedagogy and processes (Nind & Lewthwaite, 2018). This latter policy approach could contribute to the low completion rates observed. Similarly, higher education systems internationally have followed common patterns to evaluate their doctoral programs' graduation rates rather than analyzing these rates in terms of students' experiences (De la Fare et al., 2021). Students may better understand, along with other factors, the reasons for completing the degree, time to competition, and withdrawing from the program (Sverdlik et al., 2018).

For example, multiple studies indicate that delaying graduation often leads to noncompletion rates (Kim & Otts, 2010; Van de Schoot et al., 2013). The withdrawal and delay to completion present severe consequences for diverse stakeholders, including national governments, managers, institutions, and students (Torka, 2020). In the case of countries like Chile, where the national government grants most funds for doctoral education (MinCiencia, 2019), delays in graduation and withdrawal, leading to low graduation rates, may result in financial loss and political and economic pressures to generate additional public funding. Other effects of low numbers of degree conferrals include adverse consequences for programs and higher education institutions. One example of this negative impact is damaging the institution's reputation and reducing its ability to recruit promising students or attract funding (Torka, 2020). These are not trivial concerns, as doctoral programs are usually expensive for institutions, having direct tuition payments and grant support funds barely compensated (Barr & McClellan, 2018).

Torka (2020) added that delay and withdrawal can also result in programs losing a significant number of institutional resources and coursework capacities and distress to faculty and advisors, who are overloaded and discouraged by students' delays and departures (Horta et al., 2019).

The effects of low degree conferral rates can also harm doctoral students on a personal level. For example, additional years can affect students' self-esteem, employability, and career progress (Lovitts & Nelson, 2000). Additionally, Doran et al. (2016) have suggested that delayed graduation can increase students' debt. The possibility of incurring personal debt can become a financial stressor for doctoral students in Chile, where the national government funds nearly 65% of doctoral students for a maximum of eight semesters (MinCiencia, 2019). The lack of public funds to cover additional semesters may increase the number of doctoral students who turn to private loans and personal or family reserve funds to pay for their studies, bringing financial constraints that can affect their academic progress and completion (Torka, 2020).

As reviewed, low doctoral degree conferral rates have many harmful consequences. Despite these undesirable effects, there is limited research on students' experiences and possible factors influencing the gap between enrollments and degree attainment in doctoral education at Chilean higher education institutions (HEIs), particularly in E&T. In this sense, available studies on doctoral education in Chile have predominantly focused on understanding these recent developments and changes in terms of public policy (Baeza, 2017, 2018; Devés & Marshall, 2008; Espinoza & González, 2009; Muñoz-García & Bernasconi, 2020). The scholarship also includes evaluations of

specific national programs such as Becas Chile and the CONICYT National Scholarship Program (CONICYT, 2013a) and empirical studies analyzing public policy and institutional behavior (Celis & Véliz, 2017, 2020; Chiappa & Muñoz García, 2015, Núñez-Valdés & González Campos, 2019). In particular, the latter studies are relevant to this research, as they have pioneered scholarship on doctoral students' experiences and argued their perceptions' relevance as ways to understand diverse phenomena, such as the impact of national policy on HE, universities as organizations, doctoral programs in terms of internationalization (Celis & Véliz, 2017, 2020), and students' educational trajectories (Chiappa & Muñoz García, 2015). Thus, examining students' experiences in the Chilean context is essential to understand the multiple and intricate factors that may play a role in this group of doctoral students' outcomes.

Moreover, research completed in other HE systems in other world regions confirms direct connections between doctoral students' experiences and success outcomes, influencing their satisfaction and persistence in their academic program (Leijen et al., 2016). Understanding parallel connections in doctoral students' experiences in E&T in the Chilean system is fundamental to facilitating the discussion about degree completion in this national setting. Students' perceptions of their doctoral programs and interactions with diverse actors of the specific program community may offer unique perspectives to a more comprehensive understanding of their training.

Several studies, mainly in the United States and increasingly in doctoral education systems in other countries, have previously examined doctoral students' experiences in their programs by employing the lens of socialization applied specifically to study

graduate and doctoral student populations. Socialization theoretical perspective has been a predominant lens of inquiry for scholars studying doctoral training in the United States (Austin & McDaniels, 2006; Gardner, 2008a). This study adopted socialization concepts of doctoral students, particularly those that have studied socialization within the program and departmental environments and have employed the concept to comprehend doctoral students' development. For example, Golde's (1998) definition of socialization is particularly useful for studying this student population's experiences from a program perspective. Socialization, in this sense, can be understood as a process through which a doctoral student becomes a member of an academic (i.e., department) and disciplinary community of scholars.

Socialization was utilized to examine specific features of programs' structures that frame the various interactions of students with other members of the academic and disciplinary community, such as aspects related to admission requirements, available support, information sharing, and program climate. Similarly, the socialization concept allowed for an improved understanding of the implications of national policy and institutional contexts in student experiences. Socialization, at the same time, can be instrumental in understanding the salient dynamics of students' relationships with faculty, staff, and peers. In other words, by looking at the programs' structures and interactions of students and other individuals within the program, the socialization concept seems instrumental to acknowledging the distinctive experiences of this group of doctoral students in their Ph.D. journeys and the unique features of E&T doctoral education in Chile.

Examining the interactions of the students with the features of the program's structures, faculty, staff, and peers through the socialization lens is beneficial to discuss factors related to the program that affect this group of doctoral students' outcomes, such as completion, time to degree, advancement, and preparedness for postgraduation success. The focus on these program elements and actors is substantiated by preceding empirical research indicating that program structures and relationships with supervisors, staff, and peers may influence students' outcomes (Mello et al., 2015; Sverdlik et al., 2018; Zhou & Okahana, 2019). Finally, I employed Gardner's (2009a) specific phases of socialization and development of students to organize the examination of their experiences over time.

The concept of socialization served to discern distinctive attributes of Chilean doctoral students in E&T and the factors that set their socialization apart from that of doctoral candidates in other educational systems. This dissertation may contribute to the theory of doctoral students' socialization in two important ways: firstly, it emphasizes that students' individual and personal background characteristics are unique to their social and cultural environment, significantly influencing their experiences. Secondly, it underscores the need to adopt a program-oriented perspective to socialization that incorporates institutional and program-related factors and broader contextual factors such as the job market, funding for programs and students, and international pressures that shape doctoral programs and can affect students' experiences directly or indirectly. From this perspective, these two factors must be, in turn, situated within the specific policies influencing the role of the discipline for national and institutional purposes (e.g., national

plans of development or innovation, institutional or program funding). By incorporating these key features into the socialization process, various higher education systems can effectively utilize the concept to explore students' experiences from a program perspective more nuancedly. Based on the described elements, the purpose of this study was to explore processes of socialization that occur throughout the three phases (admission, integration, and candidacy) of the doctoral students' experience in E&T programs at Chilean accredited programs and how students' experiences through these processes may impact students' outcomes of success, particularly advancement, time to degree completion, and preparedness, for postgraduation success.

## Research Questions

To address the study's purpose, I sought to answer the following research questions (RQs):

**RQ1.** What socialization processes do current doctoral students in E&T at Chilean accredited programs experience in their interactions with faculty, staff, and peers within the specific features of the programs?

**RQ2.** How do students experience these socialization processes at different times in their programs (i.e., admission, integration, and candidacy)?

**RQ3.** How do students perceive socialization's impact on their advancement, time to degree, completion, and preparedness for postgraduation success?

## Significance of Study

This research was unique as I examined Ph.D. students' socialization experiences from a program perspective. I aimed to expand the understanding of doctoral training in

E&T at Chilean universities. I also examined the potential impact of these experiences on doctoral education outcomes in this national context. Through the program perspective on doctoral students' socialization and its possible influence on their success outcomes, more knowledge is gained about the Ph.D. training of these students. In turn, a better comprehension of the Ph.D. training in these disciplinary and national boundaries is helpful to learn more about the existing void between enrollment and degree completion rates in Chilean E&T-accredited Ph.D. programs. The conceptual framework was used to examine students' experiences in specific areas of interactions (administrative staff, faculty members, and peers) and throughout dynamic phases of their doctoral development from admission to graduation (admission, integration, and candidacy). At the same time, this study's theoretical underpinnings helped to explore the perceived factors for advancing toward degree completion, time to graduation, and preparedness for postgraduation success. Exploring contextual nuances of these students' socialization was key to understanding the tension between high enrollments and low conferrals of degrees and informing further research on the influences of related elements on doctoral students' persistence and success. This dissertation also contributes to the study of doctoral education in Chilean universities as an emergent topic in education research, analyzing recent phenomena in the national higher education system. Additionally, this study may help inform other studies on global and regional developments and national and international HE policies, specifically regarding doctoral education.

By employing doctoral students' development phases and socialization concepts, I aimed to develop an emerging body of knowledge about doctoral students' training

process in Latin American countries (Barkhuizen, 2021; Diaz-Bazo, 2021; González, 2021; Labraña et al., 2021) as complementary to theoretical perspectives centered on organizational changes, student outcomes, and policy analysis. By closely examining the Chilean case, I sought to evaluate holistically the suitability of socialization in a very specific scenario to ascertain a more profound understanding of Global South higher education systems. Finally, I present implications for prospective and current students and programs leadership, administrative staff, and policymakers.

## Global and Regional Trends in Doctoral Education and Engineering and Technology

Doctoral education and the training of highly specialized professionals have become relevant globally. In this context, knowledge generation through research and innovation is identified as key to the advancement of nations and regions. Doctoral education in engineering and technology has become instrumental in innovation and sustainability. In this way, the number of Ph.D. graduates in such fields indicates a country's capacity to develop and find solutions to local and global challenges (OECD, 2021b; Schneegans et al., 2021).

Following the global trend, countries in emerging economies, such as Latin America, have invested large amounts of public resources and implemented policies to promote research and Ph.D. training since the 2000s. Such policies specifically aimed to advance research and innovations in the country's priority areas like engineering, technology, and natural sciences (Gacel-Ávila et al., 2017). The results of such national efforts included an increased number of Ph.D. degree holders in the region. It is possible

to observe how conferrals doubled between 2000 and 2010 in Brazil, Mexico, Argentina, Cuba, Chile, Colombia, Costa Rica, Ecuador, Uruguay (Barro, 2015), and Venezuela (Brunner & Villalobos, 2014) particularly in natural sciences and E&T. At the same time, national governments like Chile have invested in strengthening the infrastructure of higher education, supporting the development of national doctoral programs, and assessing their quality through national accreditation agencies.

Educational policies in several Latin American countries allow for specialized training among professionals internationally and nationally. In this way, governments have implemented aggressive strategies to send students abroad to study specialized priority areas, such as natural sciences and engineering. These policies include Science without Borders (SwB) in Brazil, the Proyecta 100,000 in Mexico, and Becas Chile in the context of this country. The training of specialists abroad could have implications for domestic Ph.D. programs. These implications include a more limited and competitive job market for graduates, pressures to improve programs' quality through accreditation, and the need to expand enrollment to other student populations, such as international students from other Latin American countries. Additionally, the increase of Ph.D. graduates overseas returning to Chile may have affected domestic Ph.D. programs by enhancing international networks, mobility of students and faculty, and promoting cross-cultural understanding.

The recent developments in doctoral education in the region need to be situated in the larger context of Latin America in the most recent years' socio-political environment and the incidence of COVID-19 starting in 2020. The Latin American region has faced

the rise of social and political conflicts in several countries (e.g., Colombia, Brazil, and Nicaragua), as indicated by Rovelli and De la Fare (2021). These authors also highlighted that these issues have, in turn, amplified the political fragmentation among national governments and existing trends of privatization and commodification in several national higher education systems of the region. Furthermore, the pandemic exacerbated the inequalities and unresolved issues, such as health and development, in Latin American countries, impacting HE (Didou-Aupetit, 2020).

The COVID-19 global pandemic also affected doctoral education in Chile. The suspension of in-person university activities began in March 2020 and lasted for several weeks until temporary solutions, including virtual classes, were implemented to continue teaching and learning. From July 2020, a few universities gradually resumed in-person academic activities while enforcing mandatory preventive measures. Throughout 2021, universities continued to implement prevention and control measures to curb the spread of COVID-19. In some instances, in-person activities were again suspended due to disease outbreaks or the emergence of new virus variants.

## Development of Doctoral Education in Chile and Sociopolitical Context

As a starting point for discussing the changes in doctoral education in Chile over the last 4 decades, I provide some historical context that framed the beginning of doctoral education in Chile as a formal system. Between 1968 and 1982, only a few doctoral programs operated in Chile, and individuals with doctoral degrees were mainly trained overseas. The first doctoral programs in Chile focused on the natural sciences and the

humanities (Baeza, 2017; Devés & Marshall, 2008) and were created within a public-funded national higher education system.

In 1973, the Pinochet military dictatorship brought, among other transformations, the end of a long-standing tradition of institutional autonomy for universities that prepared the national higher education system for changes introduced later by the constitutional reform in 1981. The 1981 reform incentivized private investors to create new higher education institutions, leading to the rapid proliferation of private institutions. Privatization allowed for enrollment to increase both at the undergraduate and graduate levels. The 1981 reform also pushed the HE system towards a market orientation by shifting the burden of HE costs from the national government to the students and their families and pressuring HEIs to diversify their funding sources. In addition, the 1981 reform promoted diversification among HE institutions at the technical and doctoral levels. In addition to universities, the regulation introduced a pre-undergraduate group focused on training individuals in technical skills through professional institutes (Institutos Profesionales, IPs) and centers for technical training (Centros de Formación Técnica, CFTs).

Engineering and technology doctoral education programs were introduced between 1983 and 1989, diversifying the offer of doctoral programs at the time (Devés & Marshall, 2008). Before then, most of the doctoral programs in Chile (80%) remained in the natural sciences, the humanities, and social sciences. Throughout the 1980s, the Chilean government also promoted diversification among doctoral programs, mainly through implementing public programs. Such initiatives were the President Scholarship

Program (BPR) in 1981 and the National Plan of Scientific and Technology Development in 1988, which incentivized students to access doctoral training in national institutions.

By 1990, democracy was restored in Chile after 17 years under Pinochet's authoritarian regime. Despite the hopes that the popularly elected government led by the center-left coalition (Concertación) would implement changes to regulate the market-oriented higher education system, this did not occur. Legislators approved Law 18.962 (also referred to as the Constitutional Organic Law of Education, LOCE) right before the presidential inauguration and transition to democratic government. LOCE impeded the incoming government from substantially modifying the 1981 reform. In this way, LOCE endorsed continuing a predominantly free-market economy framework for higher education throughout the 1990s.

During the 1990s, enrollments in doctoral programs continued to grow (SIES, 2020a). By the end of the 1990s, the growth in the supply of doctoral programs in Chile was accompanied by strong pressures from government agencies for accountability and performativity, a trend also observed in other Latin American countries (De la Fare et al., 2021; Labraña et al., 2021; Rovelli & De la Fare, 2021). The pressures manifested in implementing the first competitive fund to support higher education in Chile, which was introduced in 1999 and sponsored by the World Bank. In its first stage (1999-2005), this competitive fund, the Quality and Equity Improvement in Higher Education (MECESUP), aimed to fund graduate programs primarily in the arts, humanities, social sciences, and education. Simultaneously, the MECESUP fund improved academic

infrastructure and incorporated personnel in programs from the priority fields. These developments occur under the subsequent Concertación governments.

The second stage of MECESUP (1999- 2005) improved the infrastructure and research capacity of 40 doctoral programs and financed the creation of 24 doctoral programs (Espinoza & González, 2009; Reich, 2012). MECESUP also funded various attempts to introduce mechanisms to assure higher education quality during its second stage. These attempts resulted in implementing the National Accreditation Commission (CNA) approved by Law No. 20,129 in 2006 (Establece Un Sistema Nacional de Aseguramiento de La Calidad de La Educación Superior, 2006). During the same year, the Institutional Improvement Plan (PMI, Plan de Mejoramiento Institucional), another performance-based funding mechanism, was introduced. PMI was created to allocate limited public funds to universities based on their results and impact (Fernández Darraz, 2015; Reich Albertz et al., 2011). The HE and doctoral education developments followed a similar policy framework throughout the 2000s (Espinoza & González, 2009). Contributing to the expansion of doctoral education, a scholarship program was introduced in 2001 to fund doctoral training of Chileans in other countries (mainly Germany, France, and the United States) in fields not yet developed in Chile (CONICYT, 2013b). In 2008, the same program delved into a unified scholarship system with additional funding to support the graduate studies of Chileans in the country (Becas CONICYT) and the training of Chileans internationally (Becas Chile).

After 2010, the CONICYT and Becas Chile scholarship programs continued, sponsoring an exponential growth in the number of enrollments and graduates while the

rationale of public efforts became focused on strengthening local doctoral programs to produce more research and innovation, solving complex social problems that require multidisciplinary approaches and becoming a scientific hub in the Latin America region (CONICYT, 2013b; CTCI, 2022). Despite the dramatic growth in enrollments and degree conferrals at the doctoral level since the 1990s, social dissatisfaction with the national education system surfaced. Despite the apparent achievements, the general education structure remained highly stratified by social class (Gutiérrez, 2012; Matear, 2006; Torche, 2005), contributing to the country's profound social inequalities (OECD, 2020). The discontentment was finally manifested through secondary student-led protests in 2006 in the Santiago metropolitan area, which was soon replicated in different regions. The LGE was presented as a new institutional framework for education in Chile. Also, the legislation was repealed, LOCE and was inspired by principles such as universality and long-life education, gratuity, quality of education, equity, autonomy, diversity, responsibility, participation, flexibility, transparency, integration and inclusion, sustainability, human dignity, an integral education (Law 20.370). However, the student movement grew to incorporate secondary and university students. During the following years, students continued to push against the educational policy that was still regulated by a free market economy.

In 2011, a new wave of student manifestations took place. One of the students' demands referred to the CAE loan system established in 2006, which generated large amounts of debt among students (Olavarría Gambi & Allende González, 2013) and became one of the central concerns of the 2011 student protests (Bellei et al., 2014).

Students also protested profiteering and the concentration of enrollments in the private sector (Delisle & Bernasconi, 2018). They demanded more resources for public universities and greater access to HE, especially for lower-income families (Bellei et al., 2014). Although social demonstrations decreased in intensity in the following years, they have not stopped. Other members of Chilean society supported the student movement and became relevant public actors and agents of policy change (Leon Reyes, 2018). Social movements played an important role in Chilean lawmakers' approval of a tuition-free policy in 2016[2] (Delisle & Bernasconi, 2018).

Delisle and Bernasconi (2018) also indicated that the 2016 policy benefited 50% of the most impoverished undergraduate students in paying for college. In 2018, the government also introduced the so-called "Great Reform" (Law, 21.091). This reform provided a formal structure for HE. The new design included establishing the Higher Education Secretary, the Higher Education Superintendence of Higher Education, and the Educational Quality Assurance System. In addition, the reform assures tuition-free schooling for students in the lower 60% of the family income distribution (Delisle & Bernasconi, 2018; *Ley 21.091. Sobre Educación Superior*, 2018). More recently, in 2019, a new event marked the social agenda in Chile, known as the social outburst (Estallido Social in Spanish), with still-developing effects on the HE system. The social outburst was a series of massive demonstrations and severe riots that began in the capital (Santiago) and soon spread throughout the nation, with a greater impact in the main cities. Civil protests continued in 2020 and 2021 and were motivated by the rise in

[2] Tuition-free is translated into Spanish as Gratuidad, in Spanish.

subway fares, increased corruption, increased cost of living, education privatization, and inequality.

Social movements led to a national plebiscite in Chile in October 2020 to determine whether a new constitution should be drafted to modify the one established in 1981. Most voters agreed to draft a new constitution (78%), while 79% later opted for a Constitutional Convention formed by a group of representatives voted through a national election in May 2021. The vote on the acceptance or rejection of the text occurred in September 2022. Finally, Gabriel Boric won the presidential election in December 2021. Boric became the youngest man as president and was one of the former leaders of student protests in 2011 for public HE. Boric became the first leftist president since the 1970s. The social movements of the 2010s and changes in policy towards a stronger role of the state in education led to unknown consequences for doctoral education in Chile and represented a unique case of study.

## Doctoral Education as Part of the Chilean Higher Education System

Doctoral education in Chile is part of the country's larger national HE system that consists of 221 institutions distributed amongst universities, professional institutes (IPs), and centers for technical training (CFT) (SIES, 2021b). While the first university in Chile was founded in 1842, IPs and CFTs were established much later. IPs and CFTs focus on providing vocational and technical training. Since the 1981 reform, HE institutions in Chile may be public or private. IPs and CFTs may operate for profit, while universities may not (Arango et al., 2016). Only universities are allowed to offer doctoral programs in Chile. By 2021, the national HE system registered 266 unique doctoral programs from all

disciplines (283 if counted by program and institution) (CNA, 2021). The national accreditation agency, in the same year, accredited 80% of those programs ($n$ = 213/266), while the remaining percentage of programs did not meet the quality standards in the process (CNA, 2021). At the same time, less than half of accredited programs were offered by public institutions (39%; $n$ = 89/229).

Doctoral education quality in Chilean universities is currently determined and measured by the National Accreditation Commission (CNA). According to this organization, Ph.D. training is oriented toward producing disciplinary research (CNA, 2016). According to the CNA, most doctoral curricula in Chile today begin with 1 or 2 years of required courses, after which students present their qualification exams and defend their dissertation proposal, leading to the dissertation work. Most programs officially last 4 to 5 years (CNA, 2021). Also, the majority are in-person and full-time academic programs. From the total number of doctoral students enrolled in 2021 in Chile ($n$ = 6,729), 90% ($n$ = 6,025) registered in daytime on-campus programs, while 7% ($n$ = 494) attended evening programs on campus. Also, 0.7% ($n$ = 48) attended hybrid format programs, while 1.8% ($n$ = 120) attended fully online programs. Only 0.6% ($n$ = 42) of students reported enrolling in programs in other instructional formats (SIES, 2021b). In this sense, the Chilean doctoral education model differs from other countries. Chile has not fully developed practice-based doctorates, professional doctorates fully, and full online doctorates to attract diverse student populations, such as in countries like Australia, China, and Iceland (Wildy et al., 2015), Norway (Lee, 2018) and other European countries (Kehm, 2020). In these countries, Ph.D. candidates are usually hired

as research or teaching assistants (e.g., Switzerland) or are expected to progress essentially by themselves as part of an unstructured process, such as in some Scandinavian countries (Naidoo, 2015; Skakni, 2018a, 2018b).

From a funding perspective, doctoral students in Chile are primarily funded by public resources. For example, around 65% of graduates under 70 years old residing in Chile indicated that their students' funds came from the national government through ANID and public institutions, 15% were funded by non-Chilean institutions through scholarships, and 5% by teaching and research assistantships (MinCiencia, 2019; MINEDUC, 2014). The ANID (former CONICYT) scholarships are limited to eight semesters (48 months), with the possibility of applying for a 6-month extension (MINEDUC, 2014).

After graduation from doctoral training, doctoral degree holders from all disciplines in Chilean HEIs are mostly hired by HEIs in Chile. For example, according to the 2019 national survey among 2,445 doctoral degree holders in E&T living in Chile, 84% of individuals were employed at a higher education institution. On the other hand, seven percent were employed in the industry. The rest of the graduates found employment in public administration (4%) and non-profit private institutions (4%). A smaller percentage of graduates secured jobs in different education positions (1%), while another 3% found employment in other sectors (MinCiencia, 2019).

## E&T Doctoral Programs in Chilean Universities

The doctoral programs in E&T offered by Chilean HEIs possess unique features. This section provides an overview of student enrollment, accreditation percentages

compared to other fields, and gender distribution. In addition, I briefly describe the overall employment patterns in the national context. These features provide a situated context in which students experience socialization.

Enrollments in E&T fields represented 20% of the total enrollments in doctoral education across fields ($n$ = 6,875) in 2022, after natural sciences (31%) and before social sciences (15%) (SIES, 2022a). The high enrollments also mirror the increasing provision of programs in E&T since the 1981 reform allowed the establishment of private HEIs. Consequently, doctoral programs were also offered by private institutions. Between 1983-1989, several doctoral programs in E&T were introduced, diversifying the provision of doctoral education that, until then, was concentrated in the natural sciences, the humanities, and social sciences (Devés & Marshall, 2008). Later in the decade, public funds were directed to support local E&T doctoral programs, primarily in public institutions.

From 213 unique accredited doctoral programs across fields, the E&T groups are the third majority of accredited programs (15%). These are surpassed by programs in the natural sciences (37%) and the social sciences (21%). The remaining programs are in the humanities (10%), agricultural sciences (8%), medical and health sciences (6%), or multidisciplinary programs (4%) (CNA, 2021).

Regarding gender, most students registered in doctoral programs in E&T in all Chilean universities are men. The total number of students enrolled in doctoral programs in E&T in all Chilean universities was 1,447 in 2021, while the number of women in the same year reached 481 (33.24%). E&T programs registered a similar proportion of

women between 2013 and 2021. Of the 9,824 students registered during this period, women represented only 33.27% (3,268) (CNED, 2022). Results from the 2019 national survey of doctoral degree holders per area indicated that fewer women graduated with a Ph.D. in E&T (10%) compared to men (19%), while E&T presented a wider gender gap across fields (MinCiencia, 2021).

Links between E&T doctoral programs and students during their training in Chile and the industry are still in the initial stage (Celis & Véliz, 2017). Similarly, the participation of doctoral graduates in E&T fields after degree conferral in the private sector remains scarce (Celis & Véliz, 2017; MINEDUC, 2014; Olavarría, 2012). A 2019 survey distributed nationally to Ph.D. graduates residing in Chile revealed that only 7% of graduates in the engineering and technology field found jobs in the industry. Most of these graduates (84%) found employment in higher education, while 4% secured jobs in public administration and 4% in non-profit private institutions. A smaller percentage of graduates (1%) landed jobs in different education positions, while another 3% found employment in other sectors (MinCiencia, 2019). These percentages match prior reports (Gonzalez & Jiménez, 2014; MINECON, 2014). The job prospects for Ph.D. graduates in Chile are restricted due to several factors. One of the primary reasons is the insufficient investment made by the Chilean industry in innovation, research, and development (MinCiencia, 2020; MINECON, 2017). Also, the national government subsidizes most research generated within the country through multiple competitive funds, further limiting job opportunities for Ph.D. graduates (MinCiencia, 2019). National government involvement in science policy influences universities in various ways. One such way has

been hiring regulations for faculty at HEIs. Hiring faculty trained in prestigious universities abroad has increased potential productivity and improved the chances of securing research grants and program accreditation (Celis & Kim, 2018; Celis & Véliz, 2017). This has contributed to the hiring trend of foreign-trained Ph.D. holders in Chilean HEIs. The number of foreign faculty hired in Chilean HEIs has increased by 97.3% between 2012 and 2022 (SIES, 2022b).

Contributing to this hiring trend, the Chilean government has implemented an aggressive policy to fund advanced studies abroad of nationally trained professionals over the past 15 years. Before the scholarship program was implemented in 2007, only 40 individuals completed their doctoral degrees at international universities. However, this number steadily grew over the following years, reaching 389 Ph.D. graduates in 2016. This represented 45% of the total number of Ph.D. graduates domestically and internationally (ANID, 2022). Graduates are legally obligated to return to the country to fulfill the policy goal of contributing to research and innovation in priority fields, such as E&T. Thus, universities have become the main employer of these graduates. As a result, the job market has become highly competitive for Ph.D. graduates who obtain degrees in Chilean institutions. Despite the systematic policy efforts, the national scientific community – although it has grown – remains small compared to other countries such as the United States, Germany, and Sweden (OECD, 2021a).

## Structure of the Dissertation

This dissertation comprises five chapters. In the first chapter, I introduced the underlying research problem, purpose, and guiding questions. In addition, I presented the

global, regional, and national context in which this study was developed. In Chapter 2, I present literature relevant to the study and outline the theories framing this dissertation. Next, in Chapter 3, I describe the methodological strategy and research design, while in Chapter 4, I present the results of this study. Finally, in Chapter 5, I discuss the findings in dialogue with extant literature and conclude by presenting final remarks as well as implications for practice, theory, and future research.

# CHAPTER 2

# LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

## Literature Review

This section begins by presenting the relevant scholarship on socialization in engineering and technology (E&T) as well as describing and synthesizing the main developments in doctoral students' socialization theories. Next, I present an analysis of the scholarship concerning the most relevant factors influencing doctoral students' experiences and success outcomes, primarily concerning advancement in the degree, time to degree, completion, and preparedness for postgraduation success. Finally, this chapter ends with a presentation of this dissertation's conceptual underpinnings, which were instrumental to learning about E&T doctoral students' experiences in Chilean universities.

For this dissertation, I drew heavily on international literature, particularly research conducted in the United States, to establish the conceptual basis for using socialization concepts. This approach was chosen for two main reasons. Firstly, there is a scarcity of studies that focus on doctoral students' socialization processes as well as those that apply a comparable theoretical framing to examine HE phenomena in Latin America. Furthermore, the vast body of literature on doctoral students' socialization in the U.S. context provided ample material for me to draw upon and synthesize into a strong theoretical framework for this dissertation. Nevertheless, to apply these concepts effectively in the Chilean case, it was imperative for me as a researcher to recognize and consider the distinct characteristics of Chilean higher education during data analysis. The idiosyncrasies of Chilean higher education, including its historical, cultural, political, and

socio-economic context, demanded a nuanced approach beyond replicating the theoretical framework employed to study other educational systems.

**Developments on Doctoral Students' Socialization**

To understand doctoral students' socialization, I begin this section with a discussion of socialization theory developed primarily in the United States in the late 1950s. Despite not being exhaustive, this literature review offers important pointers to situate this study in the context of specialized scholarship about doctoral students' socialization processes. Relying on Merton (1957) and Bloom (1963), Bragg (1976) formally defined socialization initially as "the process by which individuals acquire the values, attitudes, norms, knowledge, and skills needed to perform their roles acceptably in the group or groups in which they are, or seek to be, members" (p. 6). In Bragg's view, successful professional socialization is conducive to forming the individual's professional identity.

It is possible to identify three distinct elements in Bragg's definition of socialization. First, socialization is a continuous process in which the expected outcome is learning specific roles. Second, this learning process requires the individual's motivation to achieve a goal, which also involves practice. Third, Braggs' socialization view implies a social cycle that consists of interactions between individuals and groups of individuals. His model also emphasizes that during socialization, an individual is directly influenced by frequent interactions with significant others, which often exert more power and control within the new group (Brim & Wheeler, 1966).

Another commonly cited contribution was offered by Gilligan (1978). Specifically, Gilligan argued that personal characteristics, such as gender, play a significant role in this socialization process. Gilligan's argument contributes to a better understanding of how graduate students are socialized into new communities in the United States. An important contribution to understanding how graduate students are socialized can be found in Wenworth's (1980) work, which critiques the idea of socialization as a deterministic process and emphasizes the ability of individuals to act as agents within a complex system.

Later, Weidman et al. (2001) proposed an update to Bragg's model. This revised model portrayed graduate students' socialization as learning and adapting to a community, with the degree program the most important aspect, above personal and professional community influences. As a learning process, socialization involves active participation and influence from individuals within one's community and program. This process includes developing a sense of rapport and commitment to the community in a developmental manner. As Tierney (1997) asserted, socialization cannot be reduced to a simple, linear process. Rather, it is a dynamic and interpretive continuum that is influenced by a multitude of interrelated variables. These variables interact with one another to shape a person's social development over time. Therefore, socialization is a complex and ongoing process characterized by fluidity and variability. In conclusion, from the models of Bragg (1976) to Weidman et al. (2001), it is possible to identify how scholarship acknowledged the bigger role of disciplines, institutions, and programs in shaping socialization and a more active role of the individual going through that process.

In this way, ideas about doctoral students' socialization shifted toward being less of a merely rational and sequential process than prior models.

Antony (2002) observed socialization as a critical process wherein students may not readily accept certain values and norms by the institutional and program environments. Instead, individuals have the potential to acquire expertise and understanding of a subject within that framework without necessarily adopting all aspects of it. This highlights the capacity for individuals to engage critically with established practices and to challenge and refine them in ways that may better align with their own values and goals. Moving forward in time, conceptual models of socialization between 2000 and 2010 in the United States also showed a critical interest in examining underrepresented groups in doctoral education in the United States, like women and students of color, and the intersections of the socialization process in relation to the discipline department and institutional contexts (Antony, 2002; Antony & Taylor, 2004; Ellis, 2001).

Much like Gardner (2008a), other critical approaches to doctoral students' socialization have improved the understanding of individual students' social identities and illuminated issues related to institutional and disciplinary structures of inequities, such as racism and sexism (Acker & Haque, 2015; Barker, 2011; Felder et al., 2014; Portnoi et al., 2015; Ramirez, 2017). These inequity structures have been identified as influential in doctoral socialization and shaping students' satisfaction with their training –that is, with their Ph.D. program overall – and degree completion (Griffin et al., 2020; Williams et al., 2018).

One commonality among the later perspectives on the socialization of doctoral students is the developmental nature of this process in stages or phases. Gardner (2008a), for example, suggested that the term "phase" was much more suitable than the "stage" used in other prior models (e.g., Weidman et al., 2001). Phases, according to Gardner, better communicate the idea that socialization is a fluid and dynamic process. Thus, Gardner (2009a) identified three main phases in doctoral students' socialization process: admission, integration, and candidacy. These phases are further discussed in the conceptual framework section of this dissertation.

From the 1950s, when socialization was first described, to the early 2000s, when it was once again revised in HE scholarship, as well as to the present times, the concept of socialization remains relevant. It continues to be employed in empirical research to examine current issues in doctoral student experiences. For example, scholars have explored how different socialization processes foster the development of doctoral students' agency (e.g., Portnoi et al., 2015), increase their interactions with faculty and peers (Jeong et al., 2019), and how these interactions are influenced by diverse university settings (Wofford & Blaney, 2021). Utilizing socialization, researchers have also examined the transition of students into the professional role as scholars (Gardner & Doore, 2020), independent researchers (Gardner, 2008a), and faculty members (Austin & McDaniels, 2006). Lastly, scholars have also relied on socialization scholarship to study diverse student populations, such as international students in the United States (Véliz, 2020), junior researchers in new academic research environments (Hakala, 2009), and underrepresented students (Azizova, 2016). Socialization has also been instrumental in

research on issues of power and inequality in doctoral education (Gopaul, 2019) as well as organizational and institutional logic to doctoral education (Mars et al., 2014; Zheng, 2019). Socialization frameworks have also been employed to identify challenges and practices for improving doctoral student education and professional development in specific fields (Danso & Aalgaard, 2019).

**Socialization of Doctoral Students in E&T**

As mentioned above, around 2000, scholars developed theoretical approaches to situate more doctoral students' socialization within a specific discipline's values and traditions (Austin, 2002a, 2002b; Gardner, 2008a; Golde, 1998; 2005). Gardner (2009a) argued that doctoral students' experiences could not be understood as a monolithic phenomenon as students' experiences vary within and among different disciplines. Gardner also asserted that fields differ in valuing certain educational outcomes over others, their traditions on the relationships between teaching and research, and patterns of interaction within the academic circle. Moreover, the values and practices of each field and discipline are enacted differently depending on the academic community, creating a unique departmental environment and culture (Gardner, 2009a; 2009b).

Disciplines also differ in the organization of how students work and interact. For example, STEM fields are often highly dependable on teamwork and work in laboratories, while doctoral students in the humanities tend to work more individually (Gardner, 2009a; Golde, 1998). The work in labs also facilitates certain relational dynamics. For example, while working closely together in a laboratory, students may experience opportunities for team building. Often, these may also be spaces of isolation

and hostility for racial and gender minority students (P. Felder & Barker, 2013; Wofford & Blaney, 2021). These findings align with prior studies that suggest that laboratory-based research may generate very little interaction among students (Gardner, 2009a), which can generate isolation among Ph.D. students when the program culture does not support peer interaction. Also, empirical research has shown that students in science and engineering rely heavily on supervisors during doctoral training to develop knowledge and skills and to transition to their professional role. Additionally, typically only one faculty member serves as an advisor and research supervisor for STEM students working in research laboratories (Graham, 2013), limiting those Ph.D. students' experiences with other faculty members, as the same supervisor often becomes the students' dissertation chair, being the only facilitator of degree completion (B. Burt, 2014).

An emerging theme in socialization scholarship in STEM fields relates to the gendered experiences of women. STEM academic programs historically have recruited and graduated more men in countries such as the United States (Wofford & Blaney, 2021) and have developed male-driven discipline cultures (Sallee, 2011b). According to these authors, in these cultures, women have established certain negative beliefs about themselves and their performance in the field and experiences. For example, Ruud et al. (2018) documented that female doctoral students in STEM fields might be less satisfied than their male counterparts in relation to their advising experiences and career preparation during their training. Tao and Gloria (2019) also suggested that women in STEM may think more negatively about their abilities to succeed in doctoral training, also known as the impostor phenomenon. Tao and Gloria (2019) specifically showed that

higher levels of impostorism in women were connected with more pessimistic views of completing a STEM-related Ph.D. program, lower beliefs about their ability to be successful in each research domain (i.e., self-efficacy), and negative perceptions of the doctoral environment.

**Outcomes of Success**

To explore the experiences of doctoral students in STEM fields in Chile, I also aimed to understand the connections that students perceive between their socialization and success outcomes, which I assessed as relevant in the context of doctoral education development in Chile. These outcomes were as follows: degree advancement, time to degree completion, and preparedness for postgraduation success. To achieve this goal, I present an analysis of scholarship regarding the most significant factors that influence doctoral students' experiences and outcomes of success.

Doctoral students' success outcomes broadly refer to students' achievements during their studies that are beneficial to degree completion and professional practice. I drew from international literature, primarily from the United States, to explore these factors due to the growth of the scholarship in doctoral education as a research field in the United States. In contrast, scholarship on doctoral outcomes in the Latin American context remains an emerging research topic due to the recent increase in programs and enrollment in the last decade. This dissertation engaged with and helped to fill that gap in the scholarship. Next, I describe two main group factors highlighted in scholarship associated with advancement, time to degree, and preparedness for postgraduation success. These were (a) student-related and (b) program/institutional factors.

### *Individual-Related Factors*

Individual-related factors refer to the internal and psychological processes of Ph.D. students that may influence academic work. Examples of these factors include, but are not limited to, motivation and self-esteem, scholarly identity, personal and social lives, living conditions, and agency (Sverdlik et al., 2018). For example, scholars have indicated that individual characteristics of doctoral students can affect the likelihood of completion and drop-out (Kyvik & Olsen, 2014). Such individual characteristics include Ph.D. students' previous experience, abilities, and motivation for conducting research; various factors related to private life; and demographic attributes such as social background, sex, age, and nationality.

**Motivation.** Motivation is often cited as a prominent predictor of the advancement and persistence of doctoral students across fields in U.S. doctoral education (e.g., O'Meara et al., 2013; Onwuegbuzie et al., 2014). O'Meara et al. (2013) conducted an exploratory qualitative study using an emotional competence framework to explore the relationships between advisor and advisee (10 doctoral students and 11 faculty supervisors) of the anthropology department in a research-extensive institution in the United States. For them, motivation was one of graduate students' most prevalent aspects of personal competence. This finding was relevant to persistence in the program, as motivated students are generally more likely to be satisfied and invested in their doctoral work (Abraham, 2000). Similarly, Onwuegbuzie et al. (2014) conducted a mixed-methods study that identified, among other findings, examples of intrinsic and extrinsic motivation among eight women doctoral students in education fields at two state

universities in the United States. According to Onwuegbuzie et al., self-consciousness is one example of intrinsic motivation, while support from family can be understood as extrinsic motivation, which played key roles not only as reasons to pursue their doctoral studies, but also to be able to continue, overcome difficulties, and complete their degree.

Motivation is also important in improving students' acquisition of research skills and managing emotional distress during independent scholarly work. (Devos et al., 2017) illustrated this point. Interview data from 21 Belgian doctoral students showed that motivation was the primary reason for gaining a sense of progress in their research. This inner determination was useful in motivating students to continue working despite difficulties. Research has also indicated that motivation implies high levels of personal interest in the goal they are pursuing during their Ph.D. studies (Brailsford, 2010; Lin, 2012; Uqdah et al., 2009) and clarity of purpose (O'Meara et al., 2013; Guerin et al., 2015; Skakni, 2018b). Motivation also can be influenced by personal characteristics like students' age (Cao, 2012) and family support (Onwuegbuzie et al., 2014).

**Personal and Social Lives.** Research in the last 2 decades associates doctoral training with high-stress levels for students for various reasons, including a shift in the organization of research (e.g., increased workloads) and accelerated developments (e.g., Petersen et al., 2012). Due to the extensive demands of doctoral training and to understand the possible consequences on outcomes, scholars have examined issues involving students’ health, well-being, and social lives in different world regions (Brown & Watson, 2010; Levecque et al., 2017), which can, in turn, affect students’ performance and outcomes.

For example, Levecque et al. (2017) demonstrated that a lack of social support and work-life conflict negatively impacted doctoral students' well-being and increased their likelihood of developing mental illnesses and not completing their degrees. By conducting a quantitative study, Levecque et al. analyzed the experiences of 3,659 Belgian doctoral students across several universities and disciplines. According to their results, 51% of the respondents reported mental health issues (e.g., depression, anxiety), 40% reported three or more, and 32% reported at least four, with work-family conflict being the most significant factor associated with psychological distress or depression. Besides the obvious concern for the students' well-being and the impact on their outcomes, Levecque et al. highlighted three additional reasons why mental health can represent an issue for doctoral education policy. First, mental health problems may affect the quality and quantity of individuals' research output. Second, it may pose a considerable cost to research institutions and teams. Third, it impacts both the supply and entrance to the research industry.

High-stress levels among doctoral students have also been studied in another national setting. For example, (Castelló, Pardo, et al., 2017) examined survey responses of 724 social sciences doctoral students from 56 universities in Spain. Results showed that one-third of the sample (primarily young women) expressed their intention to drop out of their Ph.D. program related to distress. The most frequent reasons for participants' intention to drop out were difficulties balancing work, personal life, and doctoral studies, generating mental tension. Another common reason for dropping out was problems with socialization (e.g., experiencing less integration into academic, professional, and social

life in their departments and difficulties in their relationship with their supervisors), which also affected students' well-being.

**Writing Competences Development.** When analyzing the various facets affecting students' outcomes and experiences, salient scholarship examines how Ph.D. students' writing skills progress. Developing such skills has shown to be an important part of the Ph.D. student experience, and it is often associated with positive student outcomes, such as degree completion, achievement, and well-being (Sverdlik et al., 2018). Also, writing as a doctoral task has been identified as a relevant activity influencing students' perceptions of themselves within their scholarly communities, namely, their academic identity (Aitchison et al., 2012).

Research, besides emphasizing positive experiences, also highlights problematic experiences during Ph.D. training across fields related to developing writing abilities. These experiences can bring students high-stress levels (Sala-Bubaré & Castelló, 2017) and negative emotions like confusion and frustration (e.g., Aitchison et al., 2012). These perceptions, in turn, can affect their overall relations and performance during their Ph.D. training. Research has also centered on the perceptions of students regarding their writing skills. Drawing from Lonka (2014) and Torrance et al. (1994), (Castelló, McAlpine, et al., 2017) described that perceptions in this context refer to mental representations of how writers define or characterize writing and their practices and habits around writing activities during their doctoral training. Castelló, McAlpine, et al. also suggested that international studies on perceptions about writing at the doctoral level can be grouped into maladaptive and adaptative perceptions of writing. While adaptative group

perceptions and activities help advance the researcher's writing goals, maladaptive perceptions limit the potential for individuals to act in ways that advance their writing goals. According to Castelló et al. (2017), maladaptive perceptions include writing blocks, procrastination, perfectionism, and the conception of writing as an innate ability (Boice, 1993; Lonka et al., 2014; Rose, 1980). Those students with maladaptive perceptions might experience not only greater anxiety and stress and worse relations with the community, but also feel less able to complete their thesis and are more likely to consider dropping out of their doctoral studies.

Finally, it is possible to observe recent scholarship surrounding writing skills during doctoral training in the context of Latin American countries, like Argentina and Ecuador (Álvarez & Colombo, 2021b; Colombo & Rodas, 2021). These studies have been explicitly tied to capacity building of such skills rather than linked to outcomes. Also, these studies suggest increasing scholarly interest in the experiences of students.

**Student Agency.** Based on extensive literature in the social sciences, (O'Meara et al., 2011) defined a graduate student's agency as assuming strategic perspectives or taking strategic actions toward goals that matter to him/her. This factor influences students' experiences, trajectories, and outcomes, particularly time to degree and Ph.D. completion (Barnes & Randall, 2012; McAlpine & Amundsen, 2018; O'Meara et al., 2014; Rigler et al., 2021). Student agency in doctoral education involves the perspectives students assume and their actions to pursue goals that matter to them (Campbell & O'Meara, 2014; O'Meara et al., 2013). Scholarship has documented a considerable variation concerning the degree to which Ph.D. students, as emerging researchers,

perceived and acted as agents (O'Meara et al., 2014). Studies have also demonstrated that variation in researcher agency during the degree can positively and negatively affect students' experiences and outcomes (McAlpine & Amundsen, 2018). Regarding the positive effects, student agency refers to their ability to take ownership of their Ph.D., or how students can effectively manage possible difficulties with supervision (González-Ocampo & Castelló, 2018). Scholarship has also explored the effects of student agency related to the active participation of doctoral students in their scholarly community. For example,  qualitatively examined 669 doctoral students in a Finnish university. Students who reported agency were associated with fewer feelings of exhaustion and anxiety, more interest in their training, and fewer thoughts of withdrawing from their Ph.D. programs. The results also implied that students' capacity to work with others to respond better to complex research problems (i.e., relational agency) tended to reduce disengagement, negative emotions, and the risk of withdrawing their Ph.D. training while potentially promoting student satisfaction with their Ph.D. experience. Similarly, McAlpine and Amundsen (2018) suggested that differences among students regarding agency were likely to generate divergent levels of satisfaction, completion, and career success.

In contrast to the high level of student participation, insufficient agency often leads students to a poor understanding of career options, among other factors, which can contribute to negative emotions among doctoral students (Thiry et al., 2015). Although the relevance of scholarship on the agency is shown in these studies, this is an emerging examination in doctoral education. Developed doctoral student agency may aid the

persistence and completion of the doctoral program, engagement with the scholarly community, and dissemination of graduate research (Rigler et al., 2021).

Scholarship has also addressed the influence of departments and programs on students' agency. O'Meara et al. (2014) surveyed and interviewed 884 STEM doctoral students at two universities in the United States specifically to learn how departments impacted students' agency in career advancement. The authors identified five ways in which departments (i.e., actors, structure, and cultural norms) supported students to enable their agency toward career advancement. These key elements revolved around encouraging and legitimizing multiple career paths; providing structured opportunities for students to practice skills and experience different work environments; providing resources, financial support, and information; facilitating networking; and offering mentoring and guidance.

Similarly, scholarship asserts that doctoral students' agency is encouraged or hindered by programs allowing their students to make decisions like choosing their advisors. For example, Barnes et al. (2012) surveyed 870 students at a large U.S. research university and focused on supervisor and advisee relationships, where they found differences across fields. For example, STEM students had more opportunities to choose their supervisor than in the other disciplines, where supervisors were mostly assigned. Also, the results suggest that being actively involved in supervisor selection led to more positive advising experiences and relationships and higher satisfaction levels.

### *Institutional and Program Related Factors*

In addition to individual-related factors affecting the outcomes studied in this dissertation, another group of factors is one related to institutions and programs. Despite extensive scholarship on many other doctoral students' outcomes, this section revises scholarship specifically applicable to degree advancement, time to degree completion, and preparedness for postgraduation success. Herein, I highlight supervising structures, supervisor and student relationships, program structure, and funding opportunities.

**Supervisor-Student Relationship.** Scholarship has consistently shown that the relationship between supervisor and student can be one influential factor in their persistence, advancement, time to candidacy, and degree completion. This relationship's importance is also supported by prior foundational studies (e.g., Bair & Haworth, 2005). More recently, Gube et al. (2017) suggested matching supervisors' discipline expertise and students' research topics (education fields). According to the authors, this alignment enables students to benefit from their supervisors' expertise in developing an "insider" understanding of their doctoral research. These experiences, therefore, helped Australian students gain a sense of advancing their research and may increase their chances of completing their degree. Early studies on these interactions suggest that student involvement in supervisor selection in a doctoral program intertwines with student progress, completion, and satisfaction with their experience with clearly understood expectations (Ives & Rowley, 2005).

Similarly, Pyhältö et al. (2015) identified another important factor affecting Finnish doctoral students' satisfaction with their training and ability to persist in their

doctoral studies. The authors suggested that alignment between the student and their advisor on the priority of supervisory activities, including supervision in the research process, coaching project management, and basic prerequisites for supervision, leads to higher satisfaction with doctoral education. Successful supervision was characterized by several basic elements in this study, such as the commitment and availability of the supervisor and regular updates for students about their progress in their doctoral studies. These factors ensured that students received the necessary support to progress their research and contribute to their overall satisfaction with the doctoral training. In summary, Pyhältö et al. (2015) highlighted the significance of effective mentorship and supervision in facilitating the successful completion of doctoral programs and helping students achieve their academic and career goals.

In addition, U.S.-grounded research has suggested that supervisors influence how students begin to comprehend the discipline and the roles and responsibilities of scholars, their socialization into their academic career, the selection of dissertation topic, the quality of the dissertation, and subsequent job placement. In this way, supervisory relationships are one of the main interactions and are key to the socialization of Ph.D. students into their roles as students and professional scholars (Gardner, 2010). Scholars have also examined the role of supervisors' awareness of students' skills and motivation issues in their personal lives, which are often the main factors for students to leave their doctoral training. For example, (Gardner, 2009b) interviewed 60 doctoral students and 34 faculty members from U.S. doctoral programs. Gardner found that faculty perceived that students primarily decided to drop out because of their limited skills or motivation (74%),

followed by issues and problems in students' personal lives that interfered with their doctoral training (e.g., mental illness; 15%). In contrast, students reported that personal problems (e.g., marriage, childcare issues; 34%) were the main cause for leaving their studies, followed by departmental challenges (e.g., poor supervision; 30%) and lack of motivation (21%). Gardner (2009b) called attention to the fact that faculty members, in this case, are often unaware of their potential role in student choices to persist or cease their studies. Relationships with supervisor(s) may also affect doctoral students' emotions (Corcelles et al., 2019; Cotterall, 2013; McAlpine & McKinnon, 2013). While doctoral students often tend to suppress their emotions (Herman, 2010), the emotional aspects during the training and the research practice involved in developing a scholarly identity are closely related to being a successful doctoral student (Thomson & Walker, 2010). For example, relationships with the supervisor can be either negative or positive. Corcelles et al. (2019) employed an open-ended online survey of 1,173 doctoral students from different disciplines from 56 Spanish universities to prove this point. Students acknowledged positive relationships between students and their supervisors (e.g., the supervisor's election, changes in management, assistance and guidance received, and quality of communication) with the supervisor as well as the negative aspects (e.g., lack of positive appraisal of students' writing skills). Part-time students and students with scholarships more often mentioned these negative experiences with supervisors.

Experiences with supervisors have similarities across disciplines and national systems. For example, through a longitudinal narrative inquiry, Cotterall (2013) studied the lived experiences of six international doctoral candidates studying in Australia. Most

participants positively evaluated their supervisors primarily by acknowledging students' efficiency and providing support, feedback, a friendly manner, and confidence to begin writing. Despite the favorable aspects, participants also described the harmful behaviors of supervisors that strongly affected their emotions. For example, the lack of guidance students needed from coursework to candidature was found to be an issue, as was the difference in students' and supervisors' expectations.

McAlpine and McKinnon (2013), on the other hand, highlighted mostly positive aspects of student and advisor relationships. They surveyed 16 doctoral students in social sciences from two universities in the United Kingdom for a longitudinal qualitative study in which respondents generally found their supervisory relationships satisfactory (e.g., they felt reassured, proud, encouraged, reinvigorated, and confirmed). In another example, Bair and Haworth (2005) and Barnes and Randall (2012) in the United States also suggested that experiencing support from their supervisor fostered both doctoral satisfaction and degree completion. Moreover, McAlpine and McKinnon (2013), in UK-based research, indicated that sometimes interactions between doctoral students and supervisors favored a shift in the student from negative to positive situations. Examples of these changes include occasional support supervisors offered during students' emotionally draining situations. Finally, although supervisors' relationships with Ph.D. students have been well-researched, scholars suggest this area strongly differs depending on supervisors' and students' backgrounds, preferences, and motivations between individuals (McAlpine et al., 2020). Thus, studies in this area should address these variables clearly to increase the understanding of how relationships between students and

advisors may improve Ph.D. students' experiences and favor satisfaction and degree completion.

**Program Structuration.** Research reveals that structured doctoral programs can help students progress in their training. Most structured programs often present preplanned steps associated with timeframes, well-defined routes, and resources for students toward degree completion. As an example, Skopek et al. (2022) observed more detailed definitions of academic courses, classes, and seminars at certain points in the program and found that deadlines contribute to degree completion. Maintaining a clear structure seems more critical during the dissertation as, in this phase, students tend to work more isolated and independently (Gardner, 2009a; Weidman et al., 2001). This can also be linked to experiences gained by programs over the years and the maturity reached by the program. For example, doctoral programs in Norway have developed a system incorporating more regulations into the dissertation process to completion rates and time-to-degree (Kyvik & Olsen, 2014). In the Norwegian case, the time available and the formal requirements for the thesis were reduced and became more flexible. One example of such flexibility was shifting from traditional doctoral dissertations to article-based theses as a degree completion requirement. Other aspects of the program structure that seemed to benefit their time-to-degree and completion were more regulations on the supervising system (McAlpine & McKinnon, 2013).

**Funding Opportunities.** Funding opportunities offered by doctoral programs or institutions can directly or indirectly be related to students' outcomes, including their advancement, times to graduate, and completion (McAlpine et al., 2020; Sverdlik et al.,

2018). Regarding degree completion, Ampaw and Jaeger (2012) conducted a longitudinal explanatory research study over 5 years to examine the experiences of 2,068 doctoral students across various fields in a land-grant institution in the southeastern United States. The questionnaire results revealed that while financial aid was crucial, the type of financial support students received was even more critical, impacting students differently at various stages of their Ph.D. program. In addition, the study found that research assistantships, in contrast to other forms of financial support, were more effective in improving completion rates than other forms of financial assistance. In alignment with Ampaw and Jaeger's (2012) results, Van de Schoot et al. (2013) surveyed 565 respondents in the Netherlands and indicated that the type of financial support might sometimes increase students' time to complete their degrees and hinder students' advancement. For example, certain funding sources lack an accountability system (e.g., audits, inspections, and performance evaluations) or may require frequent updates. Skopek et al. (2022) indicated that the length of funding provided is also relevant, especially for those students in the last phase of their studies. To this respect, Frasier (2013) also noted that financial support for dissertation writing is crucial, as it allows students ample time to complete the task and reduces the stress caused by financial constraints. inadequate funding may force students to take on additional on-campus jobs, such as research or teaching assistantships, which may detract from their ability to complete their dissertations on time, as Castelló et al. (2017) observed. On the contrary, students with financial constraints at the time of the dissertation may also need to accept employment outside the university, which may result in departing or extending their time

in the program (Skopek et al., 2022). In addition, other authors argue that funding conditions are often connected to other elements, such as publishing during their doctoral training Ph.D. and a personal time strategy (Horta et al., 2019) that, in combination, affect the time students take to complete their degree Ph.D. Greater access to funding, in turn, has been found to correspond with higher levels of students' overall satisfaction with their doctoral experience and lower noncompletion (Leijen et al., 2016). Funding appears as one very relevant predictor of longer times to completion in various doctoral education systems and at different periods of their studies (Ampaw & Jaeger, 2012; Barnes & Randell, 2012; Horta et al., 2019; Van de Schoot et al., 2013; Sverdlik et al., 2018).

## Conceptual Framework

I aimed to gain insight into the socialization experiences of doctoral students within Chilean higher education institutions (HEIs). To achieve this goal, I utilized a socialization framework that adopted a program approach to research. This framework allowed me to examine the experiences of students from various disciplines within the broader field of engineering and technology (E&T).

As prior studies exploring doctoral education in Latin America using socialization frameworks were unavailable, I utilized conceptualizations primarily developed in the context of U.S. doctoral education (Austin & McDaniels, 2006; Gardner, 2008a), which were then adapted to fit the program and discipline scope of this study. I also drew on Golde's work (1998, 2005) to further inform my research.

It is important to recognize that the Chilean doctoral education system presents several unique differences that must be considered as limitations when employing this conceptual model. One consideration is the low percentage of Ph.D. graduates relative to the national population in Chilean HEIs compared to other OECD countries. In 2019, Chile registered one of the lowest percentages (0.17%) of Ph.D. graduates, while the OECD average reached 1.16% (OECD, 2021b). In contrast, North American and European OECD countries such as Germany, Sweden, the United States, Luxembourg, Switzerland, and Slovenia had the highest percentages (OECD, 2021b). OECD data suggest that Chile's scientific community is relatively small compared to more advanced doctoral education systems. Other unique features of Chilean doctoral education include a limited job market, insufficient investment by the Chilean industry in innovation, research, and development (MinCiencia, 2020; MINECON, 2017), a gradual and emerging relationship between doctoral programs and industry, low participation of doctoral graduates in the industrial sector, differences in program development, and years of accreditation. Finally, there are intersections of institutional, departmental, and program cultures. These cultures are embodied by local academic communities and reflect the values and norms of the E&T disciplines. Additionally, these cultures strongly influence interactive and interpersonal processes, which shape socialization within these contexts.

Despite the singular qualities of the Chilean system, the framework is suitable to this dissertation for multiple reasons. First, it allowed me to focus the examination on a similar program progression structure. Thus, in this sequence, students apply to the

doctoral program and then enter and spend the first 2 years on coursework to subsequently present qualifying exams and develop a dissertation. Second, the framework allowed me to analyze the interaction between students and faculty, peers, and program staff, as the organization of programs in Chile presents a similar type of constituents. Third, this framing was useful to better understand important program-related factors in students' socialization, like levels of professionalization, program climate, advising, and support systems. This dissertation suggests that individual characteristics do not solely determine doctoral students' socialization and academic success, but these processes are also influenced significantly by institutional and programmatic structures that, in turn, respond to contextual factors of a broader nature.

My decision to adopt this conceptual map was informed by several additional aspects. Firstly, the increasing numbers of Chilean Ph.D. graduates from U.S. institutions over the past decade have fostered a community of social sciences and education scholars who build on similar theoretical approaches while evaluating their applicability to the specific context of Chile as a Global South country. In addition, national policies in Chile related to R&D have focused on increasing international collaborations and the internationalization of universities. This collective research often draws from global predominant theoretical perspectives.

Drawing on Golde's studies (1998, 2005) and considering the program and discipline scope to her research, I offer a broad definition of doctoral students' socialization. Specifically, I describe socialization as the process by which students become members of a community formed by a particular doctoral program that operates

within an academic unit (department) and a specific group of E&T disciplines. However, I used the verb "become" instead of "adjust" to acknowledge the ability of students as active participants in their socialization process. As Antony (2002) noted, socialization involves "active social engagement in which one individual directly influences the perceptions, behavior, and skill acquisition of another individual" (p. 361). In this sense, socialization is not just a passive process of adjustment but an active process of engagement and influence between individuals.

Golde's (1998, 2005) understanding of doctoral student socialization suits this dissertation as it is conceived as a process where the department also expresses the discipline's values and regulations. This means that individuals interact with each other under explicit and implicit rules and traditions embodied by the experts in the program (i.e., faculty members), often part of one or few departments. This consideration was important for focusing this dissertation on the E&T discipline. To this point, literature has already informed that the socialization of doctoral students is susceptible to differences in training among fields. Under this prism, socialization in E&T shares some commonalities that do not show in other areas of study.

This conceptual perspective also explores multiple areas of doctoral socialization. These areas also illuminate program dimensions that scholars have identified as relevant to explain success outcomes like advancement, time to degree, and preparedness for postgraduation success. One of these areas refers to program-related factors affecting the student process. These factors include the program's resources, support available, information sharing, participation in scholarly activities, and program climate. Another

area of socialization refers to the relationships between the student and the program staff (i.e., director, coordinator, and secretary) and student and faculty members, including supervisors and instructors. Finally, another area of socialization illustrates the interaction between students and other students of the same or different cohorts in the same program (peers).

Besides exploring program-related factors of socialization and interactions between the student and other members of the programming community, this conceptual framework proposes an analysis of the different times of the doctoral training. As such, I recognized socialization as a longitudinal process (Braxton & Baird, 2001; Gardner, 2009a; Weidman et al., 2001). To do so, I incorporated Gardner's (2009a) concept of phases during the Ph.D. training as the conceptual framework. The phases are referred to henceforth as admission, integration, and candidacy.

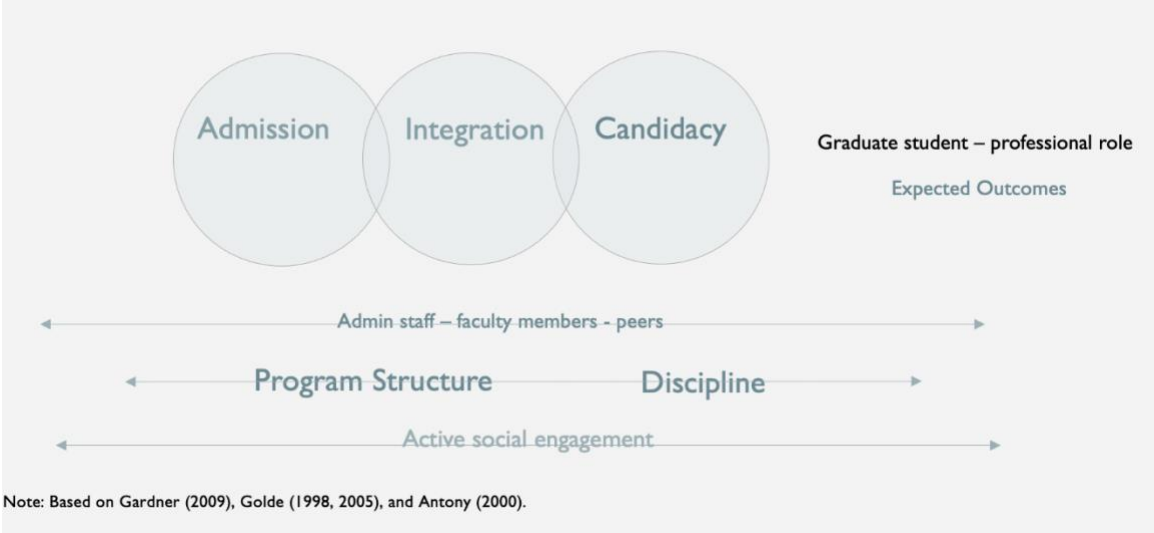
The admission phase comprehends the time between the application to the doctoral program and the period when coursework begins. In contrast, the integration phase follows the admission, mainly concentrating on the time students dedicate to coursework. After dealing with the structures and tasks of the coursework phase, students move into the final phase of their doctoral experience (Gardner, 2009a). The candidacy phase marks the period after students have passed the examinations, defended their dissertation proposal, and reached candidacy status. During this phase, students in this group work primarily on their dissertations.

Phases have been included as a central part of this study's conceptual framework for two reasons. For one, phases allow for examining the developmental nature of

students' Ph.D. journeys chronologically from the application until graduation. For another reason, the phase component supplements the analysis of the relational dynamics of students and program-related factors as well as between the student and faculty, staff, and peers, at specific times of their training. Finally, the three-phase conceptualization bounds the analysis by centering on the student experience in a particular Ph.D. program context. Finally, this dissertation's conceptual basis includes advancement, time-to-degree, and preparedness for postgraduation success as the main outcomes to be measured during their training.

**Figure 1**

*Conceptual Framework Doctoral Student Experience Using Socialization Elements*




Note: Based on Gardner (2009), Golde (1998, 2005), and Antony (2000).

# CHAPTER 3

# METHODOLOGY

In this chapter, I describe the research methods employed to answer three research questions: (a) What socialization processes do current doctoral students in E&T at Chilean accredited programs experience in their interactions with faculty, staff, and peers within the specific features of the programs? (b) How do students experience these socialization processes at different times in their programs (i.e., admission, integration, and candidacy)? and (c) How do students perceive socialization's impact on their advancement, time-to-degree, completion, and preparedness for post-graduation success? To do this, this chapter offers a detailed, specific account of qualitative research methods that enable readers to understand how data are analyzed to be presented as results (Smagorinsky, 2008).

I begin this chapter by reflecting on my identities and positionality in this research to offer background context on how these views shaped this study. Then, I describe the overall research design and discuss the guiding epistemological and ontological underpinnings and characterize the study settings, participants, and recruitment strategy. Next, I describe the data collection methods, instruments, and analysis process. I end this chapter by discussing considerations for this inquiry's trustworthiness.

## Researcher's Positionality Statement

Herein, I briefly reflect on a few dimensions of my identities and their relevance for conceptually framing and developing this research. This exercise can also be useful for readers to understand the decisions on selecting the method design, the instruments,

recruitment strategies, and the analysis process. First, this study was developed while pursuing my doctorate as a Chilean in the United States. Since I started, my research interest has been in HE, particularly the processes of internationalization and student mobility. From that perspective, I became more familiar with the literature that connected public policies on doctoral education's future and the internationalization of national universities. At that point, I was attracted to learn more about possible parallels between my Ph.D. journey and those of the participants as they unfold in a more global HE that has set common priorities regarding quality education, accountability, and internationalization. Before initiating my doctoral studies, my professional experience as a practitioner in Chilean HE also influenced this study's conceptual framework. For one, I was interested in how doctoral programs were or were not supporting their students, especially those from underrepresented fields. Also, I wanted to better understand programs, priorities, strengths, and limitations.

While meeting the participants, I deeply empathized with several experiences that resounded with mine in some ways, while others were highly contextual. I felt especially connected to situations of doctoral students who, like me, came from a working-class family; had privileged educational opportunities; or identified as a woman, a mother, or an international student and how these identities have shaped my Ph.D. experience. The reflection on these intersections also influenced how I analyzed literature more critically and the interview questions and structure. My training and research on international students and HE policy has informed me of the multiple efforts at the national HE systems and at the institutional levels to respond to the new demands of doctoral

education in Chile and the struggle programs and institutions face to finance them at the same time they support students, especially those in the margins. Bearing these ideas in mind, I came to interview participants. I was not surprised to find that although students perceived their success as the result of personal and external factors, they also acknowledged that the program played a crucial role in facilitating or hindering their success. Finally, my interpretation of the data has been strongly guided by my educational trajectories in HE in the social sciences. Hence, I understand E&T programs and the socialization of students in these fields from those perspectives.

## Overview of Research Design

I employed a generic qualitative research design to address this study's research questions. Generic or basic qualitative research serves to understand the meanings of a social phenomenon through the lens of participants (Merriam & Tisdell, 2015). To this end, this study explored students' socialization experiences and perceptions. I neither intended to present generalizable results nor explore the meaning of socialization to students, which would be more associated with a phenomenological study design. This qualitative research design served this study in several ways. First, it supported this study's exploratory nature. Specifically, I examined perceptions of doctoral students' socialization processes and possible relations to student success outcomes in the Chilean context, where doctoral education has recently expanded. This research aimed to understand the gap between high enrollments and low conferrals in E&T by focusing on students' perspectives on their training and efforts to complete their degrees. As a result, a qualitative research design offered an empirical foundation for exploring the peculiarities

of individual and relational experiences of students with a program and field focus that have yet to be studied in this national context. Thus, I expected the results from this study to inform theories and future research on the training of doctoral students in the national context. The qualitative design provided immediate access to participants' perceptions while experiencing socialization during their doctoral education journeys. This aspect enriched the conversation with details about the process. The qualitative approach also gave students a voice to describe their experiences as they perceive them and in their own words. Finally, this methodology facilitated a more open discussion with participants so that they could provide as many details as possible about their experiences prompted by the interview protocol.

A constructivist epistemology guided the qualitative approach to this inquiry. Constructivism conceives research as the product of the dialogue and a "co-construction" between the participant and researcher influenced by their understandings and engagements with the world (Crotty, 1998). Through the conversation, the participant and researcher make sense of students' experiences guided by open-ended questions and responses. In contrast, the constructivist perspective does not envision research as a discovery (Crotty, 1998). In the study context, the constructivist approach guided the instrument's questions, data analysis, and presentation of the results.

## Study Settings and Recruitment of Participants

I employed the National Accreditation Commission (CNA) website's advanced search tool to determine the study settings. The selection was based on the search terms: *technology*, *science/technology*, and *science/health/technology*. The search resulted in 44

doctoral programs in E&T operating in Chile. From that total, I selected 27 (61.4%) CNA nationally accredited programs (see Appendix A). Therefore, the study excluded 18 programs that were not accredited or were in the process of accreditation at the time of the study.

Considering the programs' CNA accreditation status as inclusion criteria for recruiting students was relevant for several reasons. First, the CNA accreditation criterion allowed me to access students from programs in E&T that were both in operation and met national standards of educational quality set by CNA and shared common goals regarding student outcomes, including retention rates and time-to-degree. On the other hand, accreditation as a criterion allowed me to exclude new programs or programs under the national educational quality benchmark.

The goal for CNA for accrediting doctoral programs is to certify their quality by evaluating how well they fulfill the institutional declared purposes, outcomes, and standards established by the corresponding scientific or disciplinary community (CNA, 2022). The evaluators assign a score (number of years from a 0 to 10 scale) to represent the program's quality. According to the CNA, more years of accreditation signal the higher quality of the program (CNA, 2022). The accreditation years for the selected programs ranged between 2 and 9 years. Accreditation years are determined based on (a) a self-evaluation report; (b) a completed form with the program's indicators of student success and faculty productivity such as retention, time-to-degree, faculty member and student publications; and (c) peer visits and evaluation report on their findings (CNA, 2022). CNA accreditation as a selection criterion to recruit participants for this study

acknowledges the current national policy context in which programs develop. CNA certification currently permits institutions and programs to apply for competitive public funding. As most programs are funded by the state (MinCiencia, 2019), public financing has become vital for the sustainability of doctoral education in Chile. In terms of the students, only those enrolled in CNA-accredited doctoral programs are eligible to apply for public competitive scholarship funds that fully finance their studies (maximum of 4 years). The CNA-accredited status enables students and program faculty members to access public funds to support their research (CNA, 2022).

For this study, I recruited students from CNA-accredited doctoral programs in E&T from Chilean HEIs for the 2021 academic year. As a selection criterion, the E&T represented disciplines that, in the Chilean context, gathered the third highest enrollment in doctoral education and a low number of conferrals. In addition, the selection of E&T programs bounded to a group of participants who shared standard disciplinary foundations and work traditions. In addition, the one-discipline approach facilitated learning about the differences in students' experiences based on a specific time in their program rather than differences across disciplines. In addition, examining students' experiences only in E&T allowed me to understand better how these experiences were influenced by their day-to-day interactions with the structure of the program, faculty, and peers within similar academic and disciplinary communities. Through the responses to a background questionnaire, I learned about participants' unique personal and socioeconomic context, educational trajectory, and time in their program to understand them as a group and contextualize their perceptions.

## Participants' Background

The final analysis includes 23 current students from 10 E&T nationally accredited doctoral programs in eight universities registered for the 2021 academic year. In addition, participants also represented eight unique doctoral programs in the expertise areas of engineering and technology (E&T) according to the CNA classification. In reality, all programs are in the engineering area: minerals, computational engineering, industrial engineering and operations, environmental engineering, mechanical engineering, biological and medical engineering, materials, engineering systems, and informatics engineering. Responses to the background questionnaire also indicated that 13 participants were working on their dissertation, five were taking courses, and the other five were working on their qualification exams. Finally, none reported having to discontinue their studies during their Ph.D. training.

Participants were also diverse in terms of nationality. While 15 were originally from Chile, eight participants came from other countries. Further, seven were from other Latin American countries, and only one was from a different continent. Gender representation among participants was balanced. While 12 participants identified as men, 11 identified as women. This study must represent women as they are less represented in doctoral studies across fields. Between 2010 and 2019, the percentual average of women who enrolled in their first years in doctoral programs, regardless of the field, ranged between 40% and 46% compared to men (ANID, 2020). For the E&T fields in Chile, this percentage dropped. Also, of most participants, 16 were between the ages of 26 and 34 years old, 10 were between 26 and 29, and six were between 30 and 34. Only five

participants were older than 35 years old. Also, most participants were single (19), while most of the total (18) did not have children at the moment of the interview. As a proxy for participants' distribution in terms of socioeconomic background, participants self-assessed their origin and family socioeconomics. Responses indicated a concentration in upper-middle, middle, and working-class families. Nine participants reported coming from working-class families, while seven were from the middle and upper-middle classes. To capture their professional and academic trajectories before their Ph.D., I asked participants to identify their immediate professional and educational experiences before their Ph.D. To this question, 12 responded that before entering their Ph.D., they were fully dedicated to studying, while seven were only working. Four participants were studying and working simultaneously before the Ph.D. Six participants were in another Ph.D., while 10 were working on their bachelor's or master's degrees. Seven participants worked before starting their Ph.D. and were employed on research projects at a university or search center. Figure 2 depicts, in detail, the participants' background. Figure 2 also introduces the participants using pseudonyms and indicates their personal information and characteristics relevant to this study.

## Figure 1

*Summary of Participants' Background*

| PSEUD | GENDER | AGE | SES | MARSTA | CHILDREN | PREV. OCC. | DEGREE | RESEARCH | YEAR | AREA | INT. STAT. | MILESTONE | INST. TYPE | INST. LOCAT. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Enrique | M | 35-39 | M | S | Y | S&W | M | No | 2021 | Minerals | I | E | Pub | REG |
| Tania | F | 22-25 | W | S | N | S | B | No | 2021 | Minerals | D | C | Pub | REG |
| Rafaella | F | 26-29 | M | M | N | S&W | B | Yes | 2018 | Minerals | D | D | Pub | REG |
| Alejandro | M | 30-34 | UM | S | Y | S | M | No | 2017* | Computational | D | D | Priv | REG |
| Lorena | F | 35-39 | W | M | Y | S | PhD | Yes | 2018 | Industrial and Operations | I | D | Priv | CAP |
| Juan | M | 30-34 | W | S | N | W | N/A | Yes | 2018 | Environmental | D | D | Pub | REG |
| Santiago | M | 26-29 | W | S | N | W | N/A | Yes | 2020 | Mechanical | I | E | Priv | CAP |
| Lily | F | 26-29 | UM | S | N | S | PhD | No | 2020 | Mechanical | D | D | Priv | CAP |
| Sofía | F | 35-39 | UM | S | N | S | M | No | 2020 | Environmental | I | C | Pub | REG |
| Isabel | F | 30-34 | W | S | N | S | PhD | No | 2017* | Mechanical | I | D | Pub | REG |
| Diego | M | 26-29 | UM | S | N | S | B | No | 2019 | Biological and Medical | D | D | Priv | CAP |
| Nicolás | M | 26-29 | M | S | N | S&W | B | No | 2019 | Environmental | D | D | Pub | REG |
| Astrid | F | 26-29 | M | S | N | S | PhD | No | 2019 | Materials | I | D | Pub | REG |
| Alejandra | F | 26-29 | M | S | N | W | N/A | No | 2019 | Materials | I | D | Pub | CAP |
| Catalina | F | 26-29 | W | S | N | S | B | No | 2020 | Materials | D | E | Pub | CAP |
| Pedro | M | 30-34 | W | S | N | W | N/A | No | 2019 | Materials | D | C | Pub | CAP |
| Emma | F | 30-34 | M | S | N | W | N/A | No | 2021 | Engineering Systems | D | D | Pub | REG |
| Laura | F | 35-39 | W | M | Y | W | N/A | Yes | 2020 | Environmental | D | D | Pub | REG |
| Sebastian | M | 40-49 | M | M | Y | S | M | No | 2018 | Informatics | D | D | Priv | REG |
| Rodrigo | M | 30-34 | UM | S | N | S | PhD | No | 2019 | Informatics | D | E | Priv | REG |
| Lucas | M | 26-29 | W | S | N | W | N/A | Yes | 2020 | Informatics | I | E | Priv | REG |
| Marcos | M | 22-25 | UM | S | N | S&W | M | Yes | 2021 | Mechanical | D | C | Priv | CAP |
| Guillermo | M | 26-29 | UM | S | N | S | PhD | No | 2021 | Mechanical Engineering | D | C | Priv | CAP |

PSEUD Pseudonym

GENDER Gender
- M Male
- F Female

AGE Age

SES Socioeconomic Status
- UM Upper Middle
- M Middle
- W Working

MARSTA Marital status
- S Single
- M Married

CHILDREN Have children
- Y Yes
- N No

PREV. OCC. Occupation prior to Ph.D.
- S&W Were studying and working
- S Were only studying
- W Were only working

DEGREE Degree were studying before entering this PhD and were not working
- B Bachelors'
- M Masters'
- PhD Other PhD
- N/A Not applicable

RESEARCH Were working on research right before entering the Ph.D.

YEAR Year of entry to the Program
- 2017* 2017 or before

AREA Engineering area of the Program

INT. STAT.
- D Domestic students or Chilean students
- I International

MILESTONE Academic milestone on which students are currently working
- C Coursework
- E Qualification Exam or Proposal
- D Dissertation

INST. TYPE
- PUB Public
- PRIV Private

INST. LOCAT.
- REG Another Region
- CAP CAP region or Región Metropolitana de Santiago

## Programs' Background

Participants studied in 10 doctoral programs in eight different institutions distributed in four university profiles based on (a) university type (state control) and (b) location. According to these features, participants were distributed evenly per university type: 13 were public universities versus 10 private institutions, 14 were regional institutions, and nine were in the capital. Also, all selected programs offered in-person instruction. Most had to adjust to partial or total virtual settings because of institutional, national, and institutional measures due to the COVID-19 pandemic between March 2020 and 2022.

Application requirements across these programs in E&T were similar. They also admitted students directly with undergraduate or master's degrees as stipulated in the national accreditation standards (CNA, 2016). However, programs differed in other application requirements, such as the scores assigned to candidates' previous research and teaching experience and English and Spanish language requirements. There was no information available to determine whether all programs represented required students to confirm the sponsorship of a faculty advisor at that phase.

Regarding funding, although most programs were nationally accredited by the CNA at the time, students were granted admission. Few programs were in their first year of operation and thus were not yet accredited. Only students admitted to accredited programs could apply for public funds provided by the Chilean National Agency for Research and Development (ANID, former CONICYT). These funds covered students' tuition, fees, and stipend for a maximum of 48 months, with the possibility of a one-time

extension for a maximum of 6 months. As students who entered recently established programs were not yet accredited, they were offered internal scholarships by the institution during the first year and until accredited by the CNA.

The programs' curricula also presented general similarities. For example, most programs concentrate on mandatory courses in the first 2 years. However, some programs also allowed students to transfer credits from previous graduate courses in the same field. Thus, not all students would spend the same time in the classroom. The Ph.D. curricula for participants were strongly focused on developing their research expertise (knowledge and skills obtained by practice) in the discipline. Programs do not include formal teaching training through their courses, although some departments and universities offer elective courses.

The programs' differences among academic programs include resources (workshops, tutoring) and supplemental funds available for student research and support attendance at national and international conferences. However, data were not conclusive to indicate what programs had more resources to offer these doctoral students. Regarding resources, students also indicated that some E&T doctoral programs collaborated with other doctoral programs in the country from different institutions in offering common opportunities for students (e.g., courses and lectures). However, data were limited in this respect and did not provide a clearer picture of why these partnerships were formed.

As per recruitment, some programs recruited doctoral students from their own institutions (at the undergraduate and master's levels). The program's faculty members were more closely involved in recruiting these students in such cases. During the application phase, program directors and faculty members actively assisted students in

applying, prepared interviews with the admission committee, and connected them to other students.

## Interview Instrument

This study employed a semi-structured interview as the primary data collection method. Before the interview, participants received an individual email with instructions to electronically sign their informed consent to being interviewed and audio recorded. The consent form was added to the background questionnaire described in the previous section.

Qualitative individual interviews were suitable for this study for multiple reasons. First, perceptions are easily captured with a different methodological instrument. In this study, the interview was beneficial to engage in a one-on-one dialogue with participants to prompt insights on their experiences regarding their doctoral journey. Second, individual interviews offered me sufficient time to discuss their unique experiences without interacting with other participants, as normally occurs in focus groups. As a result, personal interviews offered lengthier times for detailed descriptions and reflections. Despite its benefits, individual interviews introduced several limitations that need to be considered. Creswell and Creswell (2017) argued that the main constraints include the unknown influence of the researcher’s presence, as this may affect participants' comfort and openness when speaking about their personal experiences. Another constraint relates to the researcher's reactions to participants' responses. Lastly, a prevalent limitation of individual interviewing is the participant's ability to be articulate and perceptive.

Semi-structured individual interviews were the most suited interview format for this research. First, this type of interview offered reasonable control over the content and order of the questions, which gave a general structure and a starting point to prompt participants to talk about their experiences. Second, this interview format offered more flexibility than a definite organization and permitted me to continue exploring new aspects and viewpoints that participants considered relevant. I incorporated supplemental questions on topics participants brought up that were not in the original protocol version, serving the study's exploratory nature. In agreement with the constructivist view, semi-structured interviews allow for knowledge production rather than following a fixed interview guide (Brinkmann, 2018).

Inspired by the techniques to craft a quality qualitative interview protocol (Austin & McDaniels, 2006; Gardner, 2008a), this study created open and prompted questions that primarily aimed to facilitate the conversation and encourage participants to offer detailed descriptions of events and their relationships with the program community. Participants provided examples and explanations of diverse socialization aspects. In addition, questions were organized to describe participants' experiences chronologically at different training points. I employed this study’s conceptual framework to create the questions and prompts and to organize questions by times in the training and areas of students’ interaction with the program community and structure. The questions reflected (a) the phases of doctoral student development: admission, integration, and candidacy. Within each phase, I also asked participants about their relationships within (b) the areas of student interactions. These areas involved students’ relationships with program elements, faculty, and peers. This mental map was useful to frame these interactions

(areas) within a chronological order (phases) to explore how they shaped students in the individual and relational process of assuming their roles as doctoral students and how they prepared these students for their professional roles after graduation (socialization). Program structure questions aimed to retrieve data about available support, information sharing, participation in scholarly activities, and program climate, among other unique aspects of students' degree programs. Interview questions were also intended to illuminate experiences between students and the program faculty members, including advisors and instructors who integrated the program community. Finally, interview questions were directed to discuss students' relationships with other students of the same or different cohorts of the same program (peers).

I purposefully organized the interview questions by phase and area to explore connections between students' socialization experiences and outcomes. Figure 3 exemplifies the constructs that were incorporated into the interview questions. See Appendix D for the complete list of the constructs, references contributing to their selection and understanding, how they were defined for this study, and how they were incorporated and organized in the interview questions and sections. Refer to Appendix E for the interview protocol in English.

**Figure 2**

*Interview Section Constructs and Definitions*

| Section in Interview | Construct | Construct Definition |
|---|---|---|
| | **Student-Program Structure Relationships** | |
| Socialization of students during the application process until before attending courses | Support | Any form of help students perceived from the program or institutions, staff, faculty, or peers. |
| | Program climate | Students perceive different aspects as the program/ department's patterns of norms, values, practices, beliefs, and assumptions that guide the behavior of individuals and their interactions. |
| | Challenge(s) | Any form of difficulty students perceived to encounter during this period. |
| | Level of knowledge | In what ways students perceived they knew about different aspects of their program. |
| | Program climate | Different aspects students perceive as the program/ department's culture or patterns of norms, values, practices, beliefs, and assumptions that guide the behavior of individuals and their interactions. |
| | Support systems | Forms in which students perceive the program, institutions, staff, faculty, or peers helping. |
| | Sense of belonging | How students perceive themselves as accepted, included, and identified as a member of the Program community. |
| | **Student-Faculty Relationships** | |
| Socialization of students during course taking period, qualification exams, and dissertation | Relationship with the advisor(s) | Perceptions of the different interactions with the advisor(s) over time. |
| | Support from advisor to academic progress and complete program | Ways in which students perceived their advisor(s) assisted them in making academic progress and completing the program. |
| | Support from advisor(s) to increase the sense of belonging to program/ department/field or scholarly communities | Ways in which students perceived their advisor(s) were facilitating their sense of belonging to program/ department/field or scholarly communities. |
| | Relationships with other faculty in the program | Interactions with other faculty and the nature of the interaction. |
| | **Relationships with peers** | |
| Socialization with peers during Ph.D. training | Interaction with peers | Interactions with other fellow students in the same program, over time. |
| | **Outcomes** | |
| Socialization experiences and advancement during the program | Academic advancement | The program's academic milestones (completion of required courses, qualification exams, proposal defense, and dissertation) were achieved within the program's given time to completion. |
| Socialization and preparedness success post-graduation | Preparedness post-graduation | Ways in which students perceive they are prepared to take on professional career |

## Interview Language and Pilot

The interview protocol was first elaborated in English to request approval from the Institutional Review Board (IRB) but was conducted in Spanish. The protocol was also reviewed by three fluent Spanish speakers with expertise HE who contributed to adjusting the interview guide's language, content, and organization. Next, I piloted the revised version of the interview protocol among five doctoral students of E&T in Chilean universities whose data were not included in the posterior analysis. The pilot interviews produced 4 hours and 17 minutes of audio interview data. The pilot specifically allowed simplifying the language to clarify the questions and assured questions were as open as possible, nonredundant, direct, and easy to answer. I expected participants to feel more comfortable with the questions and interviews so they could describe their experiences more freely. Finally, based on the pilot, I eliminated unnecessary or overly specific questions, merged others to have fewer questions to avoid respondent fatigue, and provided enough time for participants to elaborate on their answers. Fewer questions increased the chance of follow-up on the issues participants brought up.

## Virtual Interviewing

Each interview lasted approximately between 60 and 90 minutes. The 23 interviews generated 26 hours and 29 minutes of audio interview data. I conducted interviews via Zoom, a cloud-based videoconferencing service that enabled recording the audio from the meetings. Online interviews benefited this study by offering easier access to participants worldwide. The data collection process occurred during the COVID-19 pandemic when travel restrictions to enter and exit Chile were in place. Also, most universities in the country were closed or had not fully returned to face-to-face

instruction or in-person activities. Under these circumstances, online interviewing was the most convenient means of communication. Before the interview, I emailed participants a list of considerations based on (Seitz, 2016) checklist of recommendations for online interviewing. The suggestions included foreseeing a stable Internet connection, completing the interview in a quiet room with minimal distractions, slowing down and clarifying talk, and being open to repeating answers and questions (see Appendix E). I did not experience any major technical difficulties during the connection with participants. There were a marginal number of pauses and inaudible segments. Participants were willing to repeat their answers in those few cases, but these situations did not disrupt the conversation. Also, online interviewing did not substantially interfere with participants' ability to express themselves through body language or nonverbal cues. In some specific cases, and very briefly, participants drew their attention away from the conversation, probably because of multitasking or having several open tabs on the computer screen.

## Privacy and Confidentiality

Data collected via the background questionnaire and the consent signatures were stored on a personal laptop and accessed with a password. I removed participants' names from the data and assigned each interviewee a number to eliminate identifying information. Correspondingly, the numbers were also used to identify the interviews' audio files and to process the transcripts through an external service. Next, I removed personal or identifiable information from the transcripts. Finally, all steps were reviewed and approved by the IRB (see Appendix I) to ensure that participants in this study were treated ethically and that their rights and welfare were adequately protected. To share this

study's findings, each participant received a pseudonym. The pseudonym list was kept in a different file with restricted access.

## The Analytical Process

The data corpus for this study consisted of 23 verbatim interview transcripts in Spanish. While the results are presented in English, I completed the analysis in the original language. Employing the original language for the analysis is relevant in two ways. First, it acknowledges the sociocultural context in which the language is used as part of broader conditions that affect students' reactions and conceptualization of reality (Erickson, 2012; Saldana, 2021). As Chilean and Spanish-speaking individuals, most participants and I shared a sociocultural ground that influenced my interpretation of the data. I took notes for each interview, which were expanded shortly after the interviews and served exclusively as references but did not constitute the body of data for the analysis.

As a first step of the analytical process, I uploaded both interview transcripts and the respective background descriptions of each participant into the Dedoose platform to store and manage qualitative data (transcripts). Transcripts were carefully organized and labeled so that the data and participants were easily accessible, traceable, and verifiable. After organizing the transcript data, I read all the transcripts in detail to understand the data more comprehensively. I used my notes as reference and proceeded to a first coding to develop the first codes. Figure 4 shows the first round of the coding process and excerpts from transcripts.

**Figure 3**

*Codes Names, Descriptions, and Examples from Transcripts at the Initial Coding*

| Code Name | Description | Example |
|---|---|---|
| Challenge | Any form of difficulty students perceived to encounter during any time in their doctoral program. | Isabel: [From that period] I remember the smells. I remember the cold and... and, well, riding the Metro a lot [...] like pushing a lot, being pushed... After that month, I got a room near the university and I walked about ten minutes every day. The difficulty then was getting them [the property mangers] to rent you, because when you are a foreigner, for a landlord in Chile, you are a foreigner, you are not a doctoral student at [the name of a prestigious university], being supported, let's say, by the engineering Dean who is an extremely serious person. That, they don't understand. |
| Admission | Any event that occurs during the application process, registration, until the first day of classes. | |
| Arrival | Any event that occurs before, during, and after the first weeks of arrival from another place (city or internationally) | |
| Transition into institution | An event that occurs while changing or not from one university to another for the purpose of the doctorate. | Enrique: [The application process] It was very easy. Very easy actually, because it [the program] was in a place I already knew [...] I have a previous relationship, a previous interaction with the [Name of the university] through my master'. It was very difficult at the beginning, because they didn't know me, maybe I didn't know the program very well when I applied from [his origin country] for the master's degree, so I [for the doctorate application] tried to make a connection with the master' degree and the doctorate. |
| Transition into country | An event that occurs while changing from one country to another to pursue their doctoral studies. | |
| Interaction with the program structure | Any interaction of students with diverse characteristics constitutes the program as an organization. For this study, the program structure includes systems of support, information sharing, and opportunities, program climate. | |
| Admission | Any event that occurs during the application process, admission, until the first day of class. | |

After the first round of coding, I proceeded to a second coding cycle, in which I employed the different concepts of this study's conceptual framework as codes (e.g., phases, areas of interaction). The Ph.D. students' experience phases were useful in organizing events and ideas chronologically and identifying patterns over time. As a third

step in data analysis, I discussed the codes with my faculty experts, who provided feedback on the code descriptions and collaborated to identify themes across the data. I also invited two peer researchers in the field of education to read through two transcripts and codes to validate the accuracy of the coding process. Their feedback mainly regarded assessing and affirming the codes' names, suggesting more suitable and comprehensive descriptions, and agreeing on the accuracy of the interpretation of participants' opinions. Figure 5 depicts a summary of the analytic process.

**Figure 4**

*Model for Qualitative Data Analysis*

| Phase | Procedure | Product |
|---|---|---|
| Qualitative data collection | Conducted interviews through Zoom (online) | Interview transcripts |
| First coding round | Read each transcript individually and highlight relevant ideas, topics, people, and times. | First codes and general descriptions |
| Second coding round | Employed phases (admission, integration, and candidacy) to identify patterns over time, and reorganize the previous codes into broader ones into broader codes chronologically. | Reorganized set of codes (organized in broader codes by phases) |
| | At this point, I merged child codes into main codes and renamed others. | Identified transitions between phases. |
| Peer debriefing | At this stage, I discussed the codes with experienced researchers in higher education (committee members), and peer researchers. | Refined and validated set of codes. |
| Third coding round | In addition, I employed areas of interaction (program structure, faculty, and peers) to understand the relational dynamics within each phase. | Another set of codes (organized in broader codes by phase and areas) |
| | I merged codes into broader ones and renamed them accordingly. | |

## Trustworthiness

I implemented several measures to increase the study's trustworthiness. One of the measures was documenting the selection criteria for the study settings (universities) and recruiting the participants. Also, the instrument design was based on the existing literature that provided the suitability of constructs and definitions to examine the socialization of doctoral students. I relied on experts in the fields of education and engineering to review the interview protocol's content, structure, and language. The interview was also piloted among five Chilean doctoral students who were not incorporated in the final sample to contribute to the study's trustworthiness. Pilot

interviews were audio recorded and later transcribed in the original language by an external source to ensure data accuracy. Analysis was also conducted in the original language to avoid changes in the meaning of participants' stories, capture the richness and depth of individual narratives, and gain insight into their socialization experiences as doctoral students and their relations with their educational outcomes of success. To demonstrate rigor during data analysis, I described all the steps and provided examples to illustrate the different aspects of the coding process. To contribute to the study's rigor, I used peer debriefing to reduce, but not eliminate, my bias as the researcher during the data analysis phases. Finally, at the beginning of this chapter, I included a positionality statement as the researcher to reflect on a few aspects of my identities that created tensions shaping the data analysis, interpretation, presentation of the results, and discussion sections.

## Limitations

This study had multiple limitations that must be acknowledged. The limitations were in the selection criteria of the programs, recruitment of participants, and the research design. First, I selected students in 27 doctoral programs that were accredited, which represented 61.4% of the total 44 CNA nationally accredited programs. The characteristics and experiences of E&T doctoral students in accredited programs may differ significantly from those in non-accredited programs. Also, because of its exploratory nature, this research still represents an initial effort to examine the dynamics in the socialization processes students undergo during their doctoral training in these specific programs and field contexts. Thus, this study did not aim to generalize the results to all doctoral students in Chilean higher education institutions but provide rich

descriptions of student experiences. I also relied exclusively on interview data and did not include other methods (i.e., observation, survey, document analysis) that could have generated different data, analysis, and results. Similarly, I only included perceptions from a bounded group of current students and did not rely on perspectives from other HE actors to discuss students' socialization processes. In future research, including perspectives from students who withdrew from these programs or individuals who had already graduated could enhance, for example, the exploration of areas where institutional or program support was not sufficient.

I also disclosed the possibility of introducing self-selection bias in the study due to the specific criteria and sampling strategies. Regarding participants' selection criteria, they were only required to be enrolled in one of the programs selected for the 2021 academic year. Thus, the results needed to be analyzed considering that caveat. As for recruiting participants, I employed snowball sampling. In this recruiting technique, the same participants who have been interviewed recruited other participants among their acquaintances. I employed snowball sampling to increase participants' representation at every phase of their Ph.D. training. Considering the recruitment criteria and strategy, the findings are not intended to be generalizable to all doctoral students enrolled in a Chilean university, nor to all students from the represented disciplines. In contrast, this study offers a window to observe individual experiences that could result in patterns of students' socialization at the different phases and across programs. In Chapter 4, I present this study's findings.

# CHAPTER 4

# FINDINGS

In Chapter 4, I present qualitative data from 23 students from 10 unique engineering and technology (E&T) nationally accredited doctoral programs at eight Chilean universities. This dissertation addressed the following research questions (RQs):

**RQ1.** What socialization processes do current doctoral students in E&T at Chilean accredited programs experience in their interactions with faculty, staff, and peers within the specific features of the programs?

**RQ2.** How do students experience these socialization processes at different times in their programs (i.e., admission, integration, and candidacy)?

**RQ3.** How do students perceive socialization's impact on their advancement, time to degree, completion, and preparedness for post-graduation success?

I employed this dissertation's theoretical framework elements to report the findings, namely the phases (admission, integration, and candidacy) of the doctoral training to report the findings. In this section, I answer the first and second research questions by describing the main themes that characterized the socialization processes of students at each of the phases in detail. For the admission phase, the themes include (a) familiarity with the application process, (b) the relevance of administrative staff assistance during the application and registration phases, (c) the centrality of securing financial aid to guarantee students' doctoral training, (d) faculty as recruiters, (e) faculty sponsorship, (f) faculty support during and after application, and (g) peers at the admission phase. I continue presenting the following themes for the integration phase: (h) Program-led activities and collaboration opportunities, and (i) organization of the work in laboratories.

I continue by responding to the third research question of the study by highlighting the perceived connections between students' socialization experiences and the success outcomes on which this study has focused (i.e., advancement, time to degree completion, and preparedness for post-graduation success).

## Socialization at the Admission Phase

This phase of the doctoral journey begins when students apply to the program and end before they begin classes. Participants discussed a variety of aspects of the program's operation and organization. I continue presenting students' interactions with faculty and peers from the same or different cohorts.

First, participants highlighted aspects that primarily shaped their experiences during the first part of their journey related primarily to the program's structure. By structure, I refer to inherent aspects of organizational hierarchy, culture, and proceedings. Students highlighted three aspects of the program's structure relevant to their socialization: (a) familiarity with the application process, (b) the relevance of administrative staff assistance during the application and registration phases, and (c) the centrality of securing financial aid to guarantee students' doctoral training.

### Familiarity with the Doctoral Program

The first part of the application involved submitting required documents through the university or the program's virtual sites. Most participants agreed that the websites contained general information that was most accessible. Students who had previously studied or worked at the same department or institution found this process easier to navigate than the rest of their peers. For example, Emma shared that although she was already working on her dissertation, she still remembered feeling very knowledgeable

about the program and institution. She said that the fact that she had studied in the same university and department made a difference in knowing what to expect from the doctoral program timeline, requirements, and faculty community. Emma admitted that although the application was intuitive, she observed other students in her cohort experiencing difficulties understanding the application and processes before starting classes. To this end, Emma referred to these aspects as follows:

> For me, it was quite easy because I was an undergraduate and master's student at this university, so I know the university system very well. [Besides] both master's and doctorate degrees are very similar. In that sense, it was easy because I knew I could contact either the program coordinator, my advisor, or the program director if there were any issues (...), so it was quite easy for me. I have realized that the process was more difficult for colleagues who completed their degrees at other universities.

Most participants did not remember encountering major challenges at the application, except for a few participants, such as Alejandra. In her case, Alejandra struggled to get the documents legitimized by the Chilean consulate in her home country because of limited operating public services due to the internal social crisis. Unlike Alejandra's situation, the application was uncomplicated for other international students like Enrique and Sofia, who also had completed their masters in Chile before entering the Ph.D. Sofia expressed that she felt comfortable completing the application form and going through that process. She admitted that her previous experience studying in Chile made the application for the Ph.D. simpler with the overall education system and the requirements. She described her experience in these terms:

> I applied for the program remotely, submitted all the documentation, and did not contact faculty members or the program coordinator. I only revised the requirements, submitted the application, and waited for the interview, which was

> also by Zoom. It was remote because I was in Brazil and they were in Chile (...), and everything was fine. Then the result came out. (Sofia)

Although she had not completed a previous academic degree in Chile, Lorena agreed with other international students, such as Enrique and Sofía, that her application was clearly defined. In Lorena's case, she contacted the program coordinator via email to clarify additional questions about the process, mostly about requirements that had to be evaluated for equivalency with Chilean education standards. Lorena also emphasized that program coordinators were reasonable in accepting documents as they were originally issued by her home institution, which accelerated document submission and ultimate approval.

> I submitted the transcripts in the original grading scale and didn't have to convert them to a 1 to 7 scale. In other words, I understand some universities request all those conversions. They even request documents directly through the Ministry of Foreign Affairs. We didn't, or at least I didn't, have to go through any of that… That is why I say the experience was quite comfortable in that sense. (Lorena)

In summary, most students did not find major challenges in the application process. However, in some cases, the information some programs provided through web pages was not detailed enough to be understandable for students from different institutions or educational systems.

**Communication between Students and Program Staff**

This theme specifically refers to the communication between students and the program director, the coordinators, and assistants during the admission phase and the type of assistance students receive. Communication in this context involves the general process of exchanging information from an organizational perspective. Herby, I identified

some common drives for communication, accessibility, responsiveness, and the quality of the communication and information received from the program staff.

In terms of communication purposes, participants explained that communications were to request additional information, clarify the proceedings, or ensure documents were received and processed. For example, students had questions about the equivalency of documents, financial support available, and deadlines. These types of communications took place primarily by email and phone and less frequently in person. Participants also stressed that online means of contact were preferred because of the restrictions for in-person activities implemented by universities since March 2020 and throughout 2021 due to COVID-19. Participants also suggested that most programs made an email available on the websites for their questions during the application. The program coordinator or the secretary were frequently responsible for answering students' questions. After receiving the acceptance letter, most students were not always certain about who they needed to contact for specific matters that could not be solved by the program coordinator or the secretary, who process payments, enrollment, and allocation of scholarships. Oftentimes, the program staff knew how to connect students with the right university office; in other cases, this assistance was not provided. For the second group of students, communication was indirect, complex, and prolonged, while information was sometimes segmented, inconsistent, and confusing, especially for students unacquainted with the organization of the program and university. Before classes started, the program staff was also key in offering orientation on preparing for classes and facilitating conversations with instructors.

At the same time, participants' responses implied that not all doctoral programs hired a program coordinator or assistant exclusively for the program. Several times, they attended to demands from an entire department and multiple programs, making communications ineffective and complicated. According to Astrid,

> The assistant served the entire department (....) She already collaborated with everyone in the department [usually multiple programs]. After the program had a new director, he hired an exclusive secretary. She helped with all the paperwork, the bureaucratic stuff (. …) Many times, she asked questions on our behalf or who the person we needed to contact.

Program coordinators also took an active role in solving emerging issues during this phase. Lorena described a situation where the program coordinator assisted and simplified the application.

> I never contacted the program director (...) I only communicated with the program coordinators via email. The [admission] requirements were not complicated at all. The coordinators were flexible, and I could upload my transcripts to the system as my university issued them [in the original grading system]. I didn't have to convert them into the one-to-seven grading scale [as it is in the Chilean educational system] (…) I did not have to go through all the bureaucracy of requesting conversion certificates from the Chilean Ministry of Foreign Affairs as other local universities require (. …) I didn't have to go through any of that.

Other students, like Tania, also discussed experiencing difficulties communicating with the program representatives while COVID-19 management measures were in place, making her feel frustrated and confused about who to consult about the application and the admission processes.

> When I got the acceptance letter from the graduate school, (...) I knew... I prepared a list of questions, like, how to transfer course credits from a previous degree. Were there any scholarships? And how did the registration process operate? And there was no answer, I asked the same question [through emails to the secretary] many times, and there was no answer (...) I was very angry, and I thought, "I hate this email as a means of communication because I can go there [in person] (…) the old way. Before the COVID thing hit, you used to go to the

> office, asked questions, and they gave you the answer (...), but this was like it was up in the air. (Tania)

Tania went to doctoral education directly from undergraduate studies, and she was the first generation in her family to attend college. Much of her knowledge of navigating the Ph.D. application process came from a close faculty member who mentored her through it. Like Tania, Lucas expressed concerns about a lack of responsiveness of the program staff at a critical time of the admission phase, but in a slightly different personal context. As an international student, Lucas also thought they needed to fully comprehend the requirements and deadlines to obtain a student visa to be able to travel to Chile from another country. After being admitted to the program, Lucas needed funding confirmation from the institution to present his visa documentation in his home country. The university funding was Lucas' only way to afford his studies, which coincided with the fact he was identified as having low socioeconomic origins. However, despite repeated attempts, Lucas failed to connect with the program representative to confirm the scholarship, which delayed the visa processing. Lucas described the situation in these terms:

> So, I had a month to do all the paperwork (. …) I told them [program staff person], "it's impossible (...) you don't know what it takes to get a visa (. …) You put some obstacles in our way." I understand it was their [the program's] process. Everyone handles the immigration aspects differently (. …) Finally, I submitted my documents to the Chilean consulate in [a foreign city]. Everything was in process (...), but then the COVID-19 pandemic hit. It delayed everything (...) I did not hear anything from them, and we were already in February to start classes in March; I was sending emails, (...) but no one answered. Nobody called me back. I made an international call to the [program contact phone number], and nobody replied. Then I found out, and I hardly knew anything about [Chilean universities], that they were on summer vacation.[3]

[3] Summer vacations for university students are usually from mid-December through February. During February, some university's academic units are closed.

A few participants mentioned contacting program directors before and during the application. According to these students, directors were accessible and willing to meet before candidates applied to the program. Although interview data were inconclusive to confirm that these meetings were a formal step in the application process, some students who contacted directors before starting their application suggested that these conversations influenced their decision to enter the program. Juan recalled having several conversations when the director insisted he should apply to the program. Other students reported that they communicated only with directors during the application process. For instance, Astrid remembered her first communications with her program director and how she was the one who received the actual documents and processed her application documents.

> It [the initial communication] was always with the director of the program (. …) The communication [was] via email. She [the director] reviewed the documents, and once they seemed adequate, she approved them so that I could physically send them [records]. [Then] she sent me the acceptance letter, and I applied to ANID's and the university's internal scholarships. (Astrid)

Later, when students received the admission letter from the program, some participants continued communicating with program directors. For example, Alejandra (26-29 years old) remembered contacting her program director to learn how to start her classes while she could not officially enroll. The director, in turn, provided Alejandra suggestions to navigate the situation, which facilitated her first interactions with the courses' instructors.

> [The director] gave me the email addresses of the professors and told me: "Look, this semester, you have to take these two courses. These are the emails of the two

> instructors so you can get in touch with them. Tell [the faculty members] that you are new to the program, tell them that you have some problems with your documentation [to register], that you are going to start a little late, and how you can proceed with their courses; this way, you don't fall behind. (Alejandra)

In conclusion, interview data suggest that program directors, coordinators, and secretaries were key in introducing students to their Ph.D. experience; helping them navigate the requirements; and learning about responsibilities, resources, organizational structure, and relationships, hence relevant for facilitating or hindering socialization at this phase. The findings showed that timely and personalized communication and support seemed more important for participants who were unfamiliar with the university, programs' proceedings, and organization. As part of this group, international students were more explicit in expressing the need for more clarity and effectiveness in communications to be able to understand the application and registration processes and flexibility to comply with all the application requirements (e.g., submitting documents from their home institutions) and find a solution to specific issues that emerged during this phase. On the other hand, Tania showcased the relevance of timely communication and assistance from the program representatives as critical for students who were newer to higher and doctoral education. Finally, communication flows between students and program representatives provided relevant details about the program and institutional culture and corresponding resources allocated for this purpose.

**Students in Financial Need**

Lucas was one of several participants who stressed that securing financial aid was a determining factor in guaranteeing access to doctoral education. Like him, other participants also described situations where funding issues challenged them during the

admission phase. Anecdotes surrounding students' financial strain reveal a distinctive feature among a particular group of participants. For example, Catalina (26-29 years old) explained that the only way she could access doctoral education was by being fully funded, which also impacted her family income. She also suggested that these experiences shaped the beginning of their Ph.D. journey and transition to the integration phase.

> I met all the academic requirements. However, the financing [the program] was complex (…). My family's socioeconomic status isn't high, no. For me, not working meant not contributing financially to my household, and, therefore, [entering the program] was a decision that was just complicated and that directly affected my family (…) I studied for six years (undergraduate degree). My parents supported me (…) Studying for four more years meant continuing to study and not continuing earning, let's say, the compensation for all the study. (Catalina)

Rafaella (26-29 years old) shared Catalina's family's economic constraints and depended on securing funding at this phase to start her doctoral studies. Rafaella recreated part of an informal conversation with a faculty member and mentor, who encouraged her to apply to the Ph.D. program. The following excerpt illustrates her response to the faculty member about how doctoral education was conditioned to obtaining the scholarship.

> I might enter the program, but only if I get the scholarship (....)] I paid for my engineering degree with a government scholarship, so I am not getting into debt for this". So, after this, we applied to Conicyt [ANID] and got the scholarship, and I entered the program. (Rafaella)

Marcos referred to what it meant to count on financial support from the program with these words:

> I was informed about the costs [before the application]. Anyway, I applied for the [ANID] scholarship, knowing that I would eventually enter in September; if I did not get it, I knew there were other internal financing opportunities at the university.

Similarly, to Marcos, Tania commented on the significance of counting on internal funding after realizing she had missed the ANID scholarship deadline. At the same time, she described how the program director was the one who advocated for her to obtain such financial support from the program.

> So, I spoke with the director of the program. He replied, "let me ask." After consulting, he informed me: "the members of the program committee council approved a tuition grant, so you will not have to pay anything. He also told me: "we need to make it official and get approval from the graduate college." So, I was thrilled because paying [the amount] is difficult. (Tania)

In conclusion, anecdotes surrounding students' financial needs revealed a distinctive feature of these participants: students who came from working-class families saw doctoral education as an investment and could not access doctoral education without financial support. Most participants in this study stated that the ANID fully subsidized their doctoral training. At the same time, just a few programs financed a smaller group of students through internal scholarships. Participants who did not obtain the ANID scholarship were also eligible for the program's internal funding. Participants from programs in their first year of operation did not count with accreditation. As a result, those students were funded by their program. Only one participant in this study depended on personal funds to cover the program costs.

**Faculty Members at the Admission Phase**

Students interacted with program faculty members in different roles during the admission phase. Below, I focus on three themes of faculty roles as recruiters, sponsors, and supporters throughout admission that illustrate various aspects of students' socialization during the admission phase.

### *Faculty as Recruiters*

Students reported that faculty members in the same department participated actively in student recruitment. Enrique (35-39 years old) described how the productive collaboration created during his master's with a faculty member helped him decide to return to Chile and apply to that specific doctoral program.

> I completed my master's degree in the same institution, and last year, in August, I returned to my home country. I had already built good relationships with my professors in the department. Back then, the faculty who guided my master's thesis and I worked on one project together, presented at a conference, and published an article. He called and asked me if I was interested in pursuing a doctorate in the same department. I applied to the program, and the acceptance notification came right away. The university already had my record as a master's graduate (...), so I applied for a scholarship offered by the same institution, an academic merit scholarship, and I got it. I received an email confirming the funds. Then, I started applying for a Chile visa, and I came. (Enrique)

### *Faculty Sponsorship*

A few participants mentioned that the admission requirements included contacting one faculty member in the same or similar scholarship interest area during the application. Usually, a faculty sponsor agrees to work with the student as an advisor while implicitly endorsing the applicant's educational and research trajectory suitability for doctoral training. Sponsorship usually means that students will work in the faculty sponsors' laboratory during the doctoral training. Eventually, faculty sponsors can also financially support student research.

Alternatively, most participants determined their advisors later in the program. Interview data suggest that participants who had faculty sponsorship during the application process or early in the program had commonly built a relationship in advance either from working on research together or by having them as course instructors or thesis

directors during their previous degrees. Guillermo (26-29 years old) counted on the sponsorship of a faculty member to apply to the program, who became his advisor after being admitted. This participant also explained how this faculty member assisted him throughout the application process.

> He was the person who had been helping me from inside the institution. I did not request additional help apart from that (. …) He was my undergraduate thesis chair (. …) [He helped me] giving me general guidelines, confirming what documents I needed to submit, and where I had to upload them (. …) I don't remember exactly, but it seems that (...) I didn't need more than approval from some professors inside. (Guillermo)

### *Faculty Support During and After Application*

Besides faculty sponsors, other faculty members were connected to the doctoral program as part of the department and supported and facilitated students' applications. In Catalina's case, her undergraduate thesis chair was also a member of the doctoral program to which she applied. In the student's opinion, this faculty member was instrumental in easing this process. First, the professor connected her with the program director to learn alternatives for internal funding in case she did not receive the ANID scholarship. He also wrote a letter of recommendation and encouraged and followed up with her during this process. Catalina also commented that by knowing professors in the program before starting, she felt more comfortable within the program community.

Like Catalina, Alejandro (30-34 years) also received support with the application process from faculty members. One of them specifically helped Alejandro understand the requirements of the Ph.D. program to which he was applying, first to tailor and improve his statement letter as one key application requirement to match the program requirements and increase the student's chances of getting admitted.

> This professor helped me write the application essays, like the personal statement. He also was like, "Look, Alejandro, what the program is looking for is (. …) He helped me to communicate better what I had to offer to the program as a scholar, and not only describe who I was and what I was going to do with a Ph.D. degree. He changed my way of thinking and introducing myself, and then… I was admitted. So, his tips indeed worked. (Alejandro)

Based on these experiences, students who established positive relationships with faculty members in the program before starting their training seemed to feel better prepared for the application. At the same time, students who interacted with these faculty members at the early stage felt more familiar with the program operation and community.

**Peers at the Admission Phase**

During the admission phase, some participants described their experiences interacting with fellow program students from the same or previous cohorts, henceforth peers. Several of these interactions started with the advice of program community members (e.g., director, coordinator, or faculty members). For example, following the program director's recommendation, Alejandro (30-34 years) met students from an earlier cohort at the application stage to learn about this process. Alejandro highlighted his colleague's role during the application and in facilitating his transition into the doctoral program by explaining registration procedures and deadlines and advising on coursework. Alejandro also referred to informal peer mentorship as a unique feature of his program culture.

> I have realized that it's common for students to become a mentor who guides them and helps with the paperwork. But that is not formal…; it's like something that just happens. It's like a professor says, "Hey, Alejandro, can you talk to Felipe and explain how this works?" It's very casual. (Alejandro)

Participants also mentioned support in everyday activities, including logistics and finances, to start the program from peers they already knew and with whom they had a

shared background. In the context of narrating moving from overseas to Chile, Lorena found support from another international student from the same country in the same program. To this end, Lorena said, “Fortunately, I met Antonio, who had already been accepted into the program and arrived 15 days before I did. He was already living here with some friends. “He let me stay there that first day.” After finding permanent accommodation, Lorena realized that the scholarship could only be released until she could pay the registration fee and officially register. Lorena said she moved to Chile during a social and economic crisis. Moving to Chile represented Lorena's access to more opportunities and stable conditions for her and her family. The trip to Chile was by bus and took 5 days. Lorena traveled by herself without her two children and husband to settle in. This period, therefore, was emotionally charged for the student, who was also dealing with serious financial difficulties. She described how a colleague (another doctoral student) supported her economically during the first weeks in Chile.

> The only way I could start receiving that scholarship was to be officially registered [at the university]. However, to pay the tuition, I needed to go into debt. A colleague, who had studied with me before, had income (...), and he lent me the money (...) without interest, which I greatly appreciated (...) I always tell him that I could enter the program because of him. Otherwise, I had no way to pay for tuition. (Lorena).

In Alejandro’s case, Felipe helped him directly to navigate the application and registration processes. In contrast, Antonio helped Lorena overcome specific obstacles with their relocation and incorporation into unfamiliar administrative systems.

### Students' Socialization at the Integration Phase

At the integration phase, participants stressed the centrality of (a) program-organized activities, (b) the organization of their research work by laboratories, and (c)

physical spaces for doctoral students as aspects of the program structure. They also discussed relationships with faculty members and peers during the integration phase.

**Program-led Activities and Collaboration Opportunities**

Participants described opportunities managed or facilitated by their programs. The activities usually aimed to incentivize connecting with faculty and peers for socials, sharing information, research opportunities, or networking purposes. Among social interactions, participants highlighted formal and informal activities such as welcoming events for first-year students, students' birthday celebrations, or weekly breakfast times. As examples of informational activities, participants described initial orientations and sessions during the national accreditation process. Emma described a welcome meeting open for all her program Ph.D. students: “The meeting lasted a whole morning, and we learned about many program aspects, so if you did not know about them, the meeting was a refresher.”

Students also discussed other types of informational activities. Nicolas, for example, referred to a program-led meeting with its accreditation process. Doctoral programs in Chile need to be accredited to earn direct and indirect public funds and to signal their value within the national market. Students specifically participate in two main instances during their program accreditation process. One is the program self-assessment. At this stage, students usually answer surveys and may participate in focus group interviews or meetings with the internal teams that write this self-assessment report. The second occurs when external peers visit the program to report based on observation and meetings on its quality. During this visit, peers meet privately with a group of students to

discuss aspects of the program. Nicolas referred to one of these instances. In his opinion, this was a good opportunity to learn more about the program.

> I am much more familiar with the program after the first semester, especially considering the program was accredited. As students, we were a very active part of that process. We learned from the program's goals to resolutions and training. So yeah, I now feel much more familiar [with the program]. (Nicolás)

Students also highlighted seminars as another activity coordinated by their program. Although seminars were required courses as part of the program curriculum, in other cases, participants also described them as instances open to external audiences. Students valued these spaces as opportunities during which they could present their research to other scholars. Often participants also perceived seminars as opportunities to meet other faculty members in and outside of their departments and students from other cohorts. Other participants mentioned extracurricular events like lectures by well-known guest speakers or small conferences organized by their respective programs. Additionally, several participants acknowledged classes that resulted from agreements among doctoral programs from different universities. In students' words, these experiences allowed them to learn about a similar doctoral program in other institutions and expand their professional network by interacting with other academics and students.

These activities seemed to contribute to students' socialization in several ways. For example, meetings like orientations and sessions in the accreditation context offered students a space to learn more about the operation, milestones, requirements, and expectations of doctoral studies. These meetings also reduced students' uncertainty about the Ph.D. program. Other activities, such as seminars, facilitated interactions between students and peers from all cohorts, faculty members, and the program staff. Finally,

activities such as lectures, conferences, and courses in other institutions allowed students to expand their network and knowledge about research in their area of interest, but also opened possibilities for collaborative work. In terms of resources, students also indicated some E&T doctoral programs collaborated with other doctoral programs in the country from different institutions in offering common opportunities for students (e.g., courses and lectures). However, data were limited in this respect and did not provide a clearer picture of why these partnerships were formed.

Finally, several students reported they did not participate in such instances, derived by measures to avoid the spread of the COVID-19 virus, such as university shutdowns and prohibitions to holding in-person group activities. However, data were inconclusive to provide a better understanding of its impact, except for a generalized sense of detachment from the program community and unawareness of many aspects of their training.

**Organization of the Work in Laboratories**

Participants reported that as classes began, they also started working with their advisor(s), usually as part of their laboratory. Research teams in a laboratory commonly work on a specific expertise area and gather doctoral students from the same or different programs and cohorts. Opinions about the work organization in laboratories and interactions diverged among participants. Some participants thought this work distribution might not always facilitate interactions with other faculty members or peers in the same cohort or program. This was Diego’s case, who indicated that the department had three laboratories focused on different research areas and that divided the doctoral program students. Diego added that this work distribution often hindered students'

interactions with members of other program-affiliated laboratories. Like Diego, Marcos worked in a laboratory led by two researchers, one of whom was his advisor. According to the participant, the two groups' interactions were rare and not conducive to collaboration or integration. He articulated his perspective as follows:

> I don’t think it's something that we don't like each other or that we hold any rivalry, but simply that the instances to share have not been created. Deep down, I still don't feel part of the laboratory; I feel more like I belong to the area where the professor works, but not as a laboratory team member. That still worries me a little because deep down, we all have a common area and goal, but we still haven't had the chance to get to know each other or collaborate on a simple project. (Marcos)

On the other hand, some participants thought working in a laboratory was beneficial. For students like Rafaella, laboratories were spaces where they felt included and established most of their interactions during their Ph.D. Rafaella noted, “I work in process research, and there are one, two... three other professors I see daily… I ask how I am doing; I tell them what I'm doing. I also ask them how they are doing.”

Comparable to Rafaella’s experience, Santiago commented that his laboratory colleagues were either in the same program or from different cohorts. According to Santiago, they represented the main source of timely information that helped him to navigate the Ph.D. He explained,

> I can always ask questions to the one working next to me closest or to whom is already one semester ahead of me. I work with other team members in the lab. As every cohort is represented in the lab, we all have access to information to help each other.

Enrique added that research laboratories were, for him, places where students could learn and collaborate with each other from students in other laboratories. For example, he explained that those laboratories were open to students who needed to share the

equipment installed in different laboratories. Enrique thought those were chances to learn about new equipment and analysis techniques and gain insight from others' expertise.

In addition to laboratories, several students mentioned other spaces implemented by their programs exclusively for doctoral students. Diego said that students from the program and the whole department could use this space. He also specifically commented on how this room was used before the pandemic measures: "Before the pandemic, we used to get together quite a lot there and were students from other doctorates who were also part of the department. There were many people there" (Diego).

According to participants, these spaces were relevant for accessing technology and materials, meeting their peers from different cohorts and programs, and experiencing a sense of belonging to the program, representing a distinctive aspect of their experiences as graduate students. However, the data were insufficient to understand the relational dynamic in these spaces better or to evaluate their impact on the socialization of these students in E&T.

In summary, work organization in laboratories appears to be one distinctive disciplinary feature across this study's doctoral programs and a relevant dimension to learn about these students' experiences. Interview data also proposed that work organization determines students' specific opportunities and access to resources and programs, certain cultural traditions, organizational climate, and interpersonal relationships. On the other hand, exclusive spaces for doctoral students can be seen as part of the support system and resources offered by programs and as opportunities to interact and learn with peers and faculty who are not typically included in their laboratories.

In many cases, for these participants, laboratories were the main environment in which they engaged with hands-on research and where they became acquainted with the specificities of their discipline. Laboratory work also seemed relevant to provide practical research experience, considering many participants mentioned they did not have much research experience before the Ph.D. training. At the same time, data suggest that most interactions with peers and advisors took place in their laboratory. However, the data collected offered little detail on the relational dynamics between students and advisors, staff, and peers in such spaces.

**Faculty Members in the Integration Phase**

During the integration phase, students mostly interacted with faculty members in classroom settings, where faculty members were the instructors. Interview data suggested that relationships between students and instructors varied from case to case and, in a few instances, evolved into mentorship experiences.

Data also showed advisors were involved in assisting students to navigate the Ph.D. training towards outcomes of success and coming into their professional roles in their discipline. Advisors mainly assisted students by supervising their progress, helping them to define priorities among academic tasks, strategizing to develop their research skills, and developing their research agenda. Data also suggested that the key role of advisors was to help students deal with difficulties that threatened students' persistence (e.g., health issues, the possibility of withdrawing from the doctoral program).

Regarding faculty, two participants who identified themselves as women were emphatic on the relevance of personal support from women faculty in their programs who, coincidently, became their advisors and role models as scholars. For example, when

discussing this topic, Lorena narrated that 3 month after she arrived in Chile, her spouse and two children under 10 years old joined her. The student remembered how vulnerable and traumatized she felt after leaving her home country under political and social crises. Under these specific circumstances, Lorena found personal support beyond her expectations in a female faculty member who later became her advisor.

> One of the teachers who taught me a class, also a mother with children of similar ages to mine, later became my tutor. She, without my requesting it, (...) gathered winter clothes for them. My family arrived in June, and the truth is that coming from a tropical country (...), the weather here was very bad, and even if you come prepared, (...) nothing you [had could have been helpful] to face winter. (...) The teacher was an overly kind person. I think she also knew that when you arrive with a twenty-kilo suitcase, you can't bring much (. ...) She personally took care of buying winter clothes for my children. (Lorena)

In a different situation, Rafaella shared a particular experience of harassment from one male faculty member based on her gender. She added that in those hostile interpersonal moments, having female scholars in the program seemed key in making her feel represented, encouraged, and supported to achieve a career in a traditionally male-dominated field. Rafaella added,

> Most of the faculty members in the program are men, but... the women professors we have, are very strong in their field and very well-positioned. For example, we have a teacher from [another country] who works with [topic]. She is becoming an eminent scholar in the field, and she is very [colloquial word for highly competent] in what she does. [In addition] my teacher, [name] who, even though is quite young, became the head of the [an undergraduate engineering program] and is climbing quite fast in positions within the department (...) [Finally], this other professor [name of another female faculty] (...) she focused a lot on [name of a topic], she used to organize, besides teaching the class, these talks with experts from companies, and conferences. (...) She was the one who organized practically all of that. We do need more women in the program.

Besides the impact of female faculty on women students during this phase, participants referred to the important role of advisors as prominent actors in supporting

students during this socialization phase. Some of the main ways participants discussed advisors' support at the integration phase included help in defining priorities and goals for the Ph.D., strategizing what elective courses to take, developing their research agenda, and helping students narrow their dissertation topics.

Participants also mentioned that advisors contributed to developing professional networks in the discipline. For example, when involving students in research projects or manuscript writing, other scholars from the same and other institutions participated. In other situations, advisors contacted personal and professional acquaintances to secure students' internships in other institutions. Finally, advisors sometimes even facilitate students' access to funding opportunities.

In conclusion, one participant illustrated the case where a female faculty member was key to facilitating female students' personal adjustment into a new country and environment by explicitly emphasizing their shared roles as mothers and academics. However, data were not conclusive to suggest how this factor impacted their socialization as graduate students. Rafaella's experience, on the other hand, spoke to how female faculty helped her to feel safe in the male-dominated field of E&T in Chilean universities.

**Interaction with Peers during the Integration Phase**

During the integration phase, interactions among students from the same or different cohorts of the Ph.D. program developed mainly in class and while working in the laboratory. Beyond these instances, peer interaction depended on students' personal interests. Participants discussed that one possible reason for the poor peer interaction in class was the nature of the online format universities were required to adopt, as in-person

activities were discouraged during the COVID-19 pandemic. Participants also said that sometimes lack of interaction in class resulted from instructors' inexperience with the virtual setting reinforced during COVID-19. Conversely, the pandemic was beneficial in the experience of most participants, as it facilitated interactions among students by using a messaging application like WhatsApp, which was very popular among participants. Eleven out of the 23 participants who started their Ph.D. training during the pandemic (2020-2021) agreed that they developed a sense of isolation from the rest of the programming community due to strict guidelines to reduce in-person activities. Finally, a couple of participants, including Sebastian and Lorena, confided in having limited interaction with peers due to generalized individualistic dispositions in the surrounding program culture, which was reflected in their peers' attitudes.

## Students' Socialization at the Candidacy Phase

### Deadlines and Requirements

Participants in the candidacy phase felt more disconnected from the rest of the program community. They had fewer interactions with the program leadership during the candidacy phase. Astrid illustrated these experiences as follows:

> When you are working on the dissertation and do not longer attend classes, in some way as you feel like an orphan child, you are not on top of things; you just ask and say hello to people; I am not even physically in the same space anymore because I work in the lab, so I don't see those people anymore, and I am not always aware of small changes happening on a day-to-day basis.

Furthermore, while working on her dissertation, Emma explained that although she perceived herself to be acquainted with the aspects of her Ph.D. compared to the previous years, she still expressed doubts about deadlines and deliverables of the dissertation process until graduation.

> I am already more familiar with [the program degree requirements], but it is because I'm already in the [dissertation] stage (...) I already completed the required courses and the electives and took the qualifying exam, so I'm writing right now. So, of course, I know [the overall process]. However, there are still things that are not very clear, like... I know I must present a paper, but I don't know if I must do it at some specific time. I must write dissertation reports, but there is no format, so I think maybe... Maybe it's not that I'm uninformed, but that this stage is more open (...). (Emma)

These two participants conveyed that as they started working mostly on their dissertation, the nature of individual work towards unique deadlines rendered them organically distant from the rest of the program community, mainly socials. Participants also suggested that the timeline towards graduation can become less clear while accountability instances to pace their progress are mostly unregulated.

**Key Role of Advisors and Dissertation Committee Members**

Participants reported less contact with faculty members during the candidacy phase, mainly because they commonly finish their course requirements by the end of year two. In contrast, participants indicated that they turned to their advisors and dissertation committee members in facilitating the Ph.D. completion, developing the research processes, and preparing the manuscript of their dissertation. One example of assistance included establishing an advising style centered on students. For example, Alejandro shared that his dissertation and delay in the program had been a stressful process. He confided he was intimidated by the possibility of disapproval from the committee members. As a result, he was reluctant to share these thoughts with them.

> *My problem was not communicating my doubts with them like I was terrified they would be overcritical. You could say it was a trauma from my former advisor. Instead, this type of relationship is different with my current committee members, I mean, they call on me if I'm late, but, for example, Professor Rodríguez, at our last meeting, she showed understanding with the many issues of being a father today, even more so in a pandemic. It is complicated. She also told me that she*

> *was expecting a baby while working on the dissertation, and it was hard to work in those conditions. So, they have been very understanding of y situation. If I had been working with other faculty members, I might have thrown the towel long ago. (Alejandro).*

In the same manner, Rafaella recognized the significant contribution of her advisor and committee members in helping her overcome various difficulties that affected her dissertation progress. She shared the following:

> Also, I told my advisor about my family issues was going through. He told me, "No, don't worry, the family comes first, focus on that, and little by little, you focus on what you have left of the time; you see the investigation. Because, or else it won't give you the time." Also, because of the COVID issue, we were late. He told me, "Don't worry. If we need to restructure the thesis, we will do it, no problem". If I need any signed paper, he does that at any time. Since I don't have financing, they have paid me for analyzes and have bought reagents with money from other projects of theirs, which would not correspond to them buying them from me, but they have done so. They tell me, "Don't worry, we'll buy what's missing, no problem." (Rafaella)

These examples and similar responses by participants suggest that the dissertation might not be simple, but is an unclear and disconcerting process for students. On the other hand, the dissertation process can also be very intense and might affect students both physically and mentally. Students' opinions also suggested that the advising approach by faculty members might have positive and contrary repercussions at this phase.

**Peers during Candidacy**

Participants did not socialize much with other students from the program during the candidacy phase. For example, many did not attend classes as frequently as in the previous phase. Also, several participants admitted that work on the dissertation typically required much time for independent work. The pandemic effects and resulting shutdown

of lab facilities also reduced the opportunities for students to enter and work in the labs and interact with colleagues.

## Socialization and Student Outcomes

This section answers this study's third research question. Thus, findings in this part specifically illustrate participants' perceptions about the connections of their socialization as doctoral students and specific educational outcomes of success. I highlight next the perceived factors that hindered or contributed to (a) leaving the program, (b) advancing and time-to-degree in the program, and (c) and their preparedness for postgraduation success.

### Thinking about Leaving the Program

Despite all participants reporting they had not paused their current doctoral studies in the background survey, several discussed in the posterior interview that they had evaluated the option to withdraw from their program at some point in their Ph.D. An unexpected finding in this study was that six of the 23 participants reported in the background survey that they were enrolled in another doctoral program before entering the current program. Of the six students, four were women and held the status of international students. However, participants did not discuss these experiences openly in the interview.

Next, these excerpts illustrate those situations where students thought about leaving their current program. For example, Diego mentioned that although the idea of withdrawing was recurrent, it became more serious when his advisor left the institution.

Below, Diego explained the main reason for considering dropping out and why he decided to stay.

> When my advisor left, I was left with nothing. Then, leaving the program was a good option. In the end, I decided to stay (...) I like researching or playing with the things we can access here (. …) The electroencephalogram is not something you can access in any job (...) The other reason was that I found a topic for the thesis proposal that seemed interesting and turned out to be a new project (. …) Also, I didn't want to lose the two years I had already completed. I had the scholarship, so I was not losing anything. (Diego)

While she was working on her dissertation during the interview, Lily, like Diego, confided that she had seriously evaluated the possibility of withdrawing from her program once she started to work on her dissertation. Lily was one of the students who dropped out of a Ph.D. before entering her current one. When consulted about why she considered leaving her current program, Lily explained that she was dealing with a diagnosed mental health issue that impeded her from working at the pace she felt was expected as a graduate student or enjoying her time in the Ph.D. program. In Lily's case, her advisor helped her reconsider her decision and strategize a plan until graduation. Lily explained,

> My advisor proposed a plan so I would not leave the program. There were contractual issues with the university [funding]. He also told me, "All right, do not worry about courses and the things that are the heaviest workload. Stay as a student and work only on the dissertation." He also gave me more freedom and not so much workload.

Alejandra also considered departing from her program during the qualifying exam process. Like Lily's situation, the decision to leave was, in her view, connected to high-stress levels that, in turn, produced recurring physiological reactions. As soon as she realized these responses increasingly affected her health and academics, Alejandra began

treatment with an expert. When consulted about the specific circumstances that triggered this health condition, she acknowledged some personal reasons combined with the demands of doctoral experience. Alejandra described the events in the following terms:

> I thought I shouldn't be here; I shouldn't be doing a Ph.D. Everything was wrong at that moment for me. I guess it was also the stress of the qualifying exam. You think that maybe you're not enough, that you're not going to do well, that you're not understanding (…) When you're studying, you're not performing, and those thoughts (…) The same stressful situation causes you not to sleep, and you don't concentrate.

Alejandra did not mention disclosing her health condition to anybody in the program. In exchange, she contacted the university's counseling services department, which, in Alejandra's opinion, became busier during the pandemic. Her institution also implemented virtual workshops about stress management and mental health.

Similarly, Rafaella also reflected on her experience dealing with stress and burnout:

> It was the stress of the situation of taking care of my grandmother and not being able to dedicate the time that the doctorate demanded. I felt that I was not fulfilling... I was also burned out because taking care of my grandmother involved commuting long distances. Then, the pandemic took away my internship, and I couldn't go abroad(..). Later, I started to submit articles for publication, which were rejected. It was rejection after rejection from editors. At that point, I broke down. (Rafaella)

In contrast to Alejandra, Rafaella shared these feelings and concerns with her faculty advisor, who, in her words, showed empathy. The conversation with her advisor also encouraged her to start seeing a psychotherapist, who provided specific strategies that helped her navigate the situation more assertively and persist in the program.

Isabel had Ph.D. studies before entering her current program. As an international student in Chile, she seriously considered withdrawing mainly because of the impediment

of maintaining her visa status as a student, as she needed additional time to complete her Ph.D. Isabel described how she approached her advisor and shared her decision to leave the programs and his response.

> I told my advisor: “I'm in a bad situation regarding migration, (...) My scholarship is ending, and I can't work in Chile, Besides, I'm paying fines that I should not have to pay. Because of the COVID- 19, my family in [her home country] lost their jobs, so I'm going to leave… to support them (...) if I can do something for them." He replied, "but aren’t you withdrawing from your doctorate, right? Because I'm your [scholarship] guarantor." I told him, “Don’t worry that I'm not an irresponsible person. I'm sorry you didn't realize that earlier". He said, "no, no, I'm just asking." And I told him, "No, don't worry, I'm going to continue working as always."

Isabel added that she felt disappointed in her advisor's response. She interpreted it as a lack of empathy and an inability to guide her through her options to persist in her Ph.D.

In addition to these opinions, all participants who had considered leaving the program were, at the time of the interview, determined to complete their program, even if the process took longer than expected. Participants mentioned two main reasons to stay in their program. Students who were delayed in their programs indicated that one reason to remain in the programs was the availability of additional funding from the Chilean government (ANID) for a 6-month extension. The second reason was to avoid debt due to not completing their Ph.D. ANID-funded students must legally repay the disbursed amount to the government if they do not finish the program.

In addition to the above experiences, interview data suggest that departing a Ph.D. is a complex decision resulting from a variety of reasons. Participants also suggested that family obligations (e.g., caregiving) may contribute to withdrawal from the program. The experiences also included relationships with their faculty advisors and support. Advisors' actions and interactions with students can also influence students to many degrees in their

decision to withdraw. Data also showed supportive responses from advisors, such as the cases of Lily and Rafaella, and unsupportive ones, like the situation presented by Isabel. Regardless of these dissimilar experiences of support, in all cases, students decided to persist. Finally, female participants, compared to their male peers, were more likely to discuss experiencing stress and not feeling enough to be successful in their programs as one factor contributing to their desire to depart their Ph.D.

**Advancement and Time-to-Degree**

Participants also discussed factors related to the program design that affected students' advancement and the ability to complete the degree in 4 years. For example, transferring course credits to Ph.D. from another graduate program was a factor that participants perceived as contributing to their advancement and timely graduation. For example, Enrique explained he transferred course credits from the master's degree in the same department. This student recognized that students in similar situations had a comparative advantage over their peers who did not get a master's degree and were not able to transfer course credit. At the same time, Enrique stated that because he already knew most of the faculty members in the Ph.D. and established positive relationships with them, he was able to focus on research rather than on courses, allowing him to move faster in the program**.**

> I'm doing well with the deadlines (...) I was able to transfer some course credits from the master's. Otherwise, I would have been taking classes and had to dedicate much time to the courses. Considering that I guess I'm doing well, I have already completed a section of the literature review of my dissertation proposal and preparing for my qualifying exams. (Enrique)

Like Enrique, Rodrigo's doctoral program was designed as an alternative academic path to his master's program within the same institution. Although Rodrigo evaluated the course credit transfer as beneficial to progress in the Ph.D., he discussed that he was still writing his master's thesis as he started the Ph.D. As such, the additional time dedicated to his master's thesis contributed to this delay in taking qualifying examinations.

Another common reflection among participants was about the program curriculum and the time allocated to courses and to producing a dissertation. Some participants agreed that their programs were not structured enough to offer sufficient time to work on a quality dissertation and, hence, complete the program on time. Catalina discussed her concern by explaining the following:

> I think [the courses] are necessary, but perhaps they could make the academic load heavier the first year. This way, we can have more time for the dissertation. I feel that there is very little time to produce a quality doctoral dissertation. Some compulsory courses are fine, but others must be more specific and valuable.

From a different perspective, Enrique showed concern about his program changing requirements that shortened times for graduation. In his opinion, this expectation did not align with the time students in E&T programs take to finish or consider unpredictable factors that make students delay their graduation.

> It's very difficult to complete a doctorate in four years. On average, we are talking about 5.1 years, so this is what students are facing. We need to figure out equipment availability and then perform the experiments. Besides, we must complete the internship, which is mandatory. (Enrique)

Besides program design-related factors that helped or hindered students from making progress and meeting expectations of graduating in 4 years, participants also stressed

their advisors were the key person(s) in supporting and facilitating (or not facilitating) their progress toward completion. For one, participants reflected on their advisor's support in meeting deadlines and academic progress. Alejandro, for instance, appreciated his advisor's flexibility. At times, he struggled and had already delayed his graduation. Alejandro also valued his advisor's understanding of the unique challenges of being a parent, especially during university lockdowns.

> When my advisor worked on her thesis, she was pregnant. It was the same in terms of parental responsibilities. So, it is like... they [the advisors] understand why I am late, but they helped me to keep persevering. They have been a very important support for me. If I had been with other teachers, maybe I would have thrown in the towel on the program long ago. (Alejandro)

Advisors also helped participants progress and graduate on time by assisting with planning and organizing their work and anticipating ways to overcome possible academic challenges.

> We discuss every step. For example, this semester, I had a class where you had to write a literature review with everything that meant making this. From the study of a thousand papers until reaching, let's say, 50 articles, and from those doing complete analysis. Since she knew about this module, she anticipated: "Look, in the second semester, you need to complete a literature review in this class, but that is a lot for just one semester, so start it before." So as soon as I started the Ph.D., I began reviewing the literature; when the class started, I already had something structured. So yes, that advice is very helpful for someone who does not know how to navigate the program thoroughly (…). (Emma)

Astrid added that, in her case, her two advisors have contributed to making academic progress by checking in with her frequently and asking her questions they already knew were key to moving forward in her program.

> [The advisors have helped] by ensuring I'm not missing any elective course. They advise me on which to take, suggest an instructor, or say, "I'm going to open this course so you can complete those credits." During the dissertation, they are constantly asking me how I'm doing. They always ask if I have the materials or

> need anything to perform the analyses. They even managed so I could have additional funds after my ANID scholarship ended. (Astrid)

Participants tended to perceive pandemic effects such as social distancing and full or partial limitations for in-person activities as one of the relevant hindering factors for advancement and timely graduation. Participants like Alejandra also highlighted that she could not access the university and laboratories for a long time due to university lockdowns as a measure to prevent the spread of the COVID-19 virus: "The pandemic made experiments start very late. I should have started experiments earlier, at least a semester before. So, I am a little behind in that aspect because I just started doing essays this semester."

Participants like Rafaella resented the pandemic effects, and the subsequent limited operation of universities prevented her from completing her internship at another institution. In this way, Rafaella experienced unexpected delays in her doctoral work, which impeded her from accessing research and professional opportunities. Rafaella indicated, "The pandemic took away my internship. I could not go abroad... it delayed work, experimental work."

Participants experienced other pandemic effects such as isolation from the program, faculty, and peers; discoordination regarding deadlines; and less availability of equipment and facilities. They also reflected on limited in-person events and adjustments to online communications. Enrique described how the pandemic slowed his research with the following words:

> We needed to comply with the room capacity requirements. For example, the day before yesterday, I was in another laboratory. There were only a couple of students while the rest remained outside, not to exceed the room capacity. We must also adhere to restrictions to using equipment, interacting with each other,

> and working in the offices (...) There were many students [per classroom], so things changed.

Despite the COVID-19 constraints observed by students to their academic progress, most participants simultaneously recognized some advantages. One of those benefits was access to the Internet and videoconferencing platforms, like Zoom, that allowed students in the coursework phase to continue with their classes and meet with instructors and advisors. These communications, according to participants, were conditioned by occasional technical issues during videoconferences; bad Internet connection or access to technology (mostly in the case of participants following classes abroad); instructors' inexperience with online teaching and learning; and, in some cases, very low engagement among students. Participants finally highlighted some programs that coordinated new ways of communication (e.g., WhatsApp or similar) to check on students' well-being and progress and provide the support participants evaluated as key to continuing moving in their programs.

In synthesis, participants' responses allowed me to identify three types of factors inciting students' advancement and meeting the expected time to graduate: (a) program-related factors, (b) advisors, and (c) circumstantial reasons. In the favoring factors, participants discussed transferring course credits to Ph.D. from another graduate program and positive relationships with faculty members in the program. A second type of factors involved the relationship between students and advisors.

**Preparedness for Success after Graduation**

Participants' discussion of their perceptions of preparedness for success mostly centered on the courses they have taken relevant to research, research work, and teaching

opportunities they have accessed and created over their years in the program. In this sense, all students strongly concurred that they had become agents in identifying and engaging additional opportunities as part of their doctoral training. Regardless of their efforts, participants also recognized the primary role of their advisors in facilitating some of these opportunities. Advisors, according to participants, mainly communicated the importance of student engagement in such activities and facilitated access to such experiences. Finally, participants identified some research and teaching opportunities arranged by their programs as experiences that made them feel equipped for the workforce.

### *Building Teaching Skills*

Participants' responses suggested that teaching experience was not a formal requirement to obtain their Ph.D. degree. Several students acknowledged the significance of training on instruction for their future academic careers. Despite its pertinency, data hint that programs do not formally provide training as part of the mandatory curriculum, at the same time underlying the disparity of extracurricular opportunities among participants for teaching training during their Ph.D. studies. Also, participants who referred to such opportunities indicated they searched for teaching practice or were offered experience by their faculty advisor.

Emma has spent several years in the program and provided an overall opinion about teaching preparation as part of her Ph.D. training. She observed that despite the high-value teaching quality should have in training, especially considering most graduates will continue an academic career, the Ph.D. curriculum offered minimum possibilities. Emma also criticized instructors’ pedagogical and evaluation methods,

which seemed obsolete. In the student's opinion, these teaching practices were concerning as they were supposed to set an example for students learning how to teach.

> I think that the doctorate lacks a couple of mandatory courses about teaching or the competency-based model implemented in all universities in Chile. I also think we need more courses on pedagogy, educational resources, and making a good rubric—something basic, like designing a rubric and evaluating instruments. (Emma)

Rodrigo pictured himself working in the industry after graduating without leaving academia altogether. He acknowledged feeling prepared to perform well in any of the two sectors. As per teaching, Rodrigo valued his previous Ph.D. work experience as a teacher, which, in his opinion, was his foundation. Also, he said that his faculty advisor was interested in him gaining more teaching experience. His advisor engagement was fundamental in easing the administrative process for this to happen.

> [His advisor] has been the one who has given me the opportunity [to teach]. For example, he is supposed to be the one who gives me the approval to teach a class because those hours are part of research time [the time allocated for research as part of the Ph.D. requirements]. He also offered me a teaching assistantship. (Rodrigo)

Marcos also envisioned becoming a faculty member. He seemed confident to teach at the university level after graduation, primarily because of his experience as a teaching assistant during his Ph.D. In Marcos' opinion, this has resulted from a combination of his agency as a student, peer collaboration, faculty engagement, and, finally, the opportunities provided by the doctoral program: "[The teaching experience] is something extra (...) I designed a course with a colleague offered to another university. Now we co-teach the classes. As a new course, we must still learn and study to provide a well-structured course" (Marcos). Marcos also acknowledged that advisors in his program regularly provided opportunities to undertake teaching assistantships for courses they or

other faculty members offered. Finally, this student valued that his program allowed him to supervise thesis projects for undergraduate students with his primary advisor.

***Research Collaborations***

Participants discussed that several doctoral programs required short-term internships in other national or international institutions to graduate. The training aims to support doctoral students to gain experience and expand their knowledge in their fields while simultaneously contributing to obtaining their degree (CONICYT, 2013a). Participants explained that only a few doctoral programs offered to fund the training if they did not receive public funds. At the same time, participants were not always knowledgeable about these funding alternatives. In such cases, advisors were key in identifying these options.

> Some programs have funds to support their students' internships. However, these funds came from conversations, not by applying to any project (…). These funds were oriented to finance opportunities like this for students who do not have projects or anything. (Rafaella)

Advisors, in several cases, used their professional and personal networks within their field to find a suitable laboratory and supervisor for their advisees. For example, Alejandro had the chance to attend a university in France for his internship. This opportunity was, in his opinion, facilitated by their advisors, who were part of the network of an important national scientist with connections in French universities.

In summary, the results showed that the application process for the program was generally smooth, with no major challenges encountered. However, some students faced individual challenges dependent on their unique characteristics and prior personal and educational backgrounds. Among them, certain groups of students – such as international

students, women, and students with financial constraints – shared common challenges. Findings also showed that administrative staff played an important role in communication and providing information, particularly for those new to the system or from specific backgrounds. Faculty members also played a key role in easing the transition into doctoral programs and training and connecting with resources and peers. Finally, peers provided personal support and shared their learned experiences and knowledge about the processes and community, which was invaluable in helping students adjust to their new environment during the first phase of the program.

During the integration phase of the doctoral programs, several important points were identified regarding the socialization of students. First, the variety of activities and events organized by the programs were highly valued by students and played a key role in creating a sense of community and fostering collaboration among them. However, the organization of work in the laboratories was found to shape and limit interactions with both peers and faculty. While students interacted with faculty members mainly in class, informal mentorship opportunities were relatively rare. Nevertheless, the support and guidance provided by advisors were crucial for students throughout the program. Finally, the participants revealed that their level of interaction with peers was relatively low, highlighting the need for additional efforts to encourage collaboration and peer support among students.

During the candidacy phase, participants felt disconnected from the program community and reported fewer interactions with program leadership. In the dissertation phase, participants reported that while they were more familiar with the program's requirements, they still had questions regarding deadlines and deliverables. Advisors and

dissertation committee members played a crucial role in facilitating the advancement on their dissertation towards completion of the program. Participants' socialization with other students was also limited during the candidacy phase due to reduced class attendance and the need for independent work on the dissertation.

The study results suggest that the pandemic significantly impacted the socialization of these doctoral students at all phases of their training. Firstly, the lack of face-to-face communication seemed to increase feelings of isolation and disconnection from others, which could have harmed the students' mental health and well-being. Secondly, limited online interactions may not have provided the same level of social support as in-person interactions, which could have affected the participants' ability to cope with stress and challenging situations. Thirdly, the quality of virtual communication sometimes seemed to be compromised due to technical issues, connectivity problems, or delays that have resulted in misunderstandings or miscommunication.

Regarding the findings related to socialization and outcomes, participants discussed doctoral students' perceptions of circumstances that hinder or contribute to their success. The study initially highlighted why some students considered dropping out, including stress, mental health issues, family obligations, and unsupportive faculty advisors. In turn, among the reasons for persisting, the results showed the availability of additional funding and the avoidance of debt. Subsequently, the findings suggested that female participants were more likely than male participants to experience stress and not feel good enough to be successful in their programs. The analysis also revealed that the transfer of course credits from another graduate program was perceived as contributing to students' advancement and timely graduation.

Moreover, participants expressed concerns about the program curriculum and unrealistic times allocated for courses and dissertation, which affected their ability to complete the program on time. Some participants also criticized the program's expectations of graduating within 4 years without considering unpredictable factors, such as those that resulted from the pandemic restrictions. Participants emphasized the importance of advisor support in meeting deadlines and academic progress, with some advisors providing flexibility and understanding of unique emerging challenges (personal and research related). Advisors also assisted in planning and organizing work and anticipating academic challenges to help participants progress and graduate on time. Finally, participants' preparedness for success mostly concerned courses, research work, and teaching opportunities. While participants acknowledged the need to be proactive in seeking opportunities, advisors also played a significant role in facilitating them. While research and teaching opportunities arranged by programs are helpful, there is a disparity in the availability of extracurricular teaching training. Other students saw their careers in research or industry. Here, internships are relevant to build students' competencies. Participants expressed that their advisors were crucial in identifying internship options. This led to very different experiences for students. In Chapter 5, I present a discussion of the results. I also offer implications for practice and recommendations for future research.

# CHAPTER 5

# DISCUSSION AND CONCLUSION

This dissertation explored the socialization processes of doctoral students in engineering and technology (E&T) accredited programs at Chilean universities[4] and analyzed how students perceived their experiences had impacted their success outcomes, particularly advancement, time-to-degree, completion, and preparedness for postgraduation success. In this chapter, I present a discussion of major patterns in the socialization of participants across the three phases of doctoral students' development as part of the conceptual framework employed for the analysis and reporting (i.e., admission, integration, and candidacy). Within this analysis, I also offer insight into the main students' outcomes studied, and avenues for future research. Next, I present the implications of this dissertation for practice. At the end of this chapter, I offer the study's conclusions.

The development of doctoral education in Chile is recent compared to other higher education systems, like those in North America and Western Europe. The expansion of doctoral education in this national context was influenced by the continuous changes in Chile's educational policy and social realities starting with the 1981 reform. The fast growth in the number of doctoral programs increased access of individuals to doctoral education and diversity among programs and students. Despite this growth, the expansion introduced several issues related to low completion rates and lengthy graduation times. It also revealed limitations in the Chilean system to absorb graduates in

[4] Accredited programs by the National Accreditation Commission (CNA) by November 1, 2021.

a highly competitive national job market for doctoral degrees. These multiple phenomena in doctoral education also raise questions on what kind of experiences students go through, what type of experiences programs offer, as well as support advancement, timely and successful completion of the program, and how well prepared Ph.D. students are for success after graduation.

Doctoral education in E&T fields in the national setting have experienced significant growth in program provision and enrollment. Considering also that Ph.D. graduates in E&T serve important national goals for innovation and development, the low graduation rates in doctoral programs in such fields in Chilean universities and the long time to completion have become a recurring concern for the government, policymakers, and university administrators. This dissertation explored doctoral students' experiences in E&T in Chilean universities to deeply comprehend issues that emerge during the training process, such as recruitment patterns, program flexibility, support available, and opportunities that might contribute to disappointing rates of Ph.D. graduates. As a result, this study provided empirical evidence to portray some of these issues and a foundation for further research.

These inquiry research questions are substantiated by primarily engaging in scholarship on socialization, student outcomes, and success. These questions aimed (a) to explore the socialization processes current doctoral students in E&T at Chilean-accredited programs experience in their interactions with faculty, staff, and peers within the specific features of the programs; (b) to examine how students experience these socialization processes at different times in their programs (i.e., admission, integration, and candidacy); and (c) to study how students perceive socialization's impact on their

advancement, time to degree, completion, and preparedness for postgraduation success. I employed a generic qualitative research design to address this study's research questions and conducted individual interviews with 23 participants, who were all current students from 10 E&T nationally accredited doctoral programs in eight universities registered for the 2021 academic year. This group of participants represented eight unique doctoral programs in the expertise areas of E&T according to the national accreditation commission (CNA) classification.

## Findings Discussion

The findings of this dissertation offer insight into various factors that influenced the socialization experiences and outcomes of participants in E&T-accredited programs at Chilean HEIs. These factors include (a) individual characteristics, (b) advising and student-advisor relationships, (c) peer interactions, (d) institutional and program-oriented features, and (e) contextual factors of a broader nature.

### Individual Characteristics

Results from this dissertation revealed that individual-related factors, such as gender, socioeconomic background, and nationality, affected the socialization of doctoral students in E&T programs in the Chilean context. Specifically, students who were women, students from financially disadvantaged backgrounds, and those who identified as international students shared common difficulties during their Ph.D. One such challenge pertained to students' lack of familiarity with the doctoral education process, overall administrative procedures, and support offered by the institution. Other challenges related to relationships with advisors and the need for their support beyond their training, which I will discuss later in this section. A second major finding in this dissertation was

the underlying narrative of financial constraints affecting several students' lives and their experiences in the program. These participants tended to discuss how decisive scholarships were in enabling their access to doctoral education when facing financial difficulties during the program and evaluating the possibility of delaying graduation. These experiences were more common among participants who reported growing up in working, middle, and low-income families (16 individuals out of 23). These circumstances were generally described as stressors and factors determining their decisions and strategies toward degree completion and involvement in certain Ph.D.-related activities. Despite the absence in the data of a clear connection between students' background and their socialization, acknowledging the socioeconomic origins of doctoral students remain important in the Chilean context. The significance of this lies in the country's higher education system still operates within a broader structure of high social inequalities and a stratified education system affected to a great extent by the massification and institutional differentiation starting in 1981 (García de Fanelli & Adrogué, 2019; Guzmán-Valenzuela, 2016; Perez Mejias et al., 2018).

The fact that students perceived these conditions affected them suggests potential consequences of policies oriented to broaden access with scarce consideration of mechanisms to support students' success. Therefore, this finding raises questions about how public policies and higher education institutions perpetuate inequities within the system. This finding suggests that students from vulnerable backgrounds may continue to face gaps in their academic performance due to their prior training at secondary, and higher education institutions that vary in terms of prestige, resources, and opportunities available to students.

In addition, some participants in the study who came from financially constrained families were also first-generation higher education students or the first in their families to pursue doctoral-level education. While there is limited research on this phenomenon in the Chilean doctoral education context, studies conducted in the United States suggest that first-generation HE students may encounter difficulties while navigating their doctoral programs. One significant challenge is the need for students to understand the overall pathway and implicit norms of the doctoral training (Gardner & Holley, 2011; Holley & Gardner, 2012). Also, doctoral students from diverse family and cultural backgrounds might experience a sense of disconnection between their upbringing and academic pursuits, which can impact their sense of belonging to both worlds and, subsequently, their academic and professional performance (Gardner & Holley, 2011).

A third essential point to take away from this research is that female students in these doctoral programs seemed to have had distinctive socialization experiences. Female students were highly conscious of their gender minority status within their programs and departments. This perception aligned with statistical data that indicated that E&T doctoral programs in Chilean universities continue to be male-dominated disciplines (Berlien et al., 2016; MinCiencia, 2019).

Furthermore, results showed that female students were more likely to seek out the opportunity to work with female faculty members as mentors and supervisors. These faculty members were also highly valued by female students who appreciated their gender awareness, which enabled them to provide more personalized and suitable academic and personal support. Female faculty were, for most female participants, key sources of support to navigate the transition to coursework successfully. In addition, the

faculty members served as role models for students in their respective fields. This aligns with Sallee (2011a), who claims that faculty members also serve as models for the norms and values that drive disciplines, including those related to gender.

Female students' experiences from this dissertation can serve as a starting point for the further qualitative exploration of the main narratives that make doctoral programs in E&T in Chilean HEIs predominantly male environments and how these discourses can be a barrier/ beneficial for female students' success in these fields. These studies should also include the voices of female and male supervisors and male peers.

In conclusion, the findings of this study, which highlight the experiences of women, students from disadvantaged backgrounds, and international students, are consistent with the transformation in the demographics of the overall doctoral student population in Chile (SIES, 2022a). The Chilean government has prioritized strengthening the doctoral workforce since 2008, resulting in a surge in the doctoral student population across various fields, with a particular emphasis on E&T areas to promote national development and innovation (CONICYT, 2013a; CTCI, 2022). To achieve this goal, the government has increased scholarships for doctoral education within the country and funding for international training (Munoz-Garcia & Bernasconi, 2020). Despite these efforts, Chilean doctoral programs still face a demand-supply imbalance, with excess capacity and insufficient applications from qualified candidates (SIES, 2022a).

Previous studies in the Chilean context have highlighted the increasing diversity of students in doctoral programs and provided general characteristics of these individuals (e.g., Celis & Veliz, 2017; 2020; Martínez, 2020, Véliz, 2018). Also, it is possible to observe increasing scholarship that touches on equity and inclusion issues at this level

(e.g., Chiappa & Muñoz-García, 2015; Perez Mejias, P., Chiappa, R., & Guzmán-Valenzuela, C.,2018). The present dissertation contributes to the existing scholarship by offering a more comprehensive understanding of the experiences of underrepresented populations, including women, students from disadvantaged backgrounds, and international students in Engineering and Technology (E&T) doctoral programs in Chile.

I propose a further examination of these populations' experiences in order to identify specific barriers or challenges they may face during their doctoral training. To this end, a survey would be a valuable tool at this stage, as it could provide greater insight into the experiences of the underrepresented populations highlighted in this study. Additionally, findings from an additional study may be generalizable to the experiences of students in other E&T fields. More critical theoretical frameworks such as Bourdieu's concepts of social capital and habitus (1977, 1986, 1990) and intersectionality (Crenshaw, 1991) can offer unique perspectives on the experiences of underrepresented students in doctoral training and help to visualize structures of inequities in higher education in Chile.

At the same time, these findings introduce important implications for policymakers, program evaluators, university leaders, and other individuals implicated in educational public policy. For example, these findings can provide a research-based foundation for designing and evaluating actions to internationalize graduate education and promote equity in higher education. The Chilean government has strongly supported policies toward these goals in recent years. For one, international has become one strategy for responding to national and international demands for high-quality education (Kaluf, 2014). Also, policies in the past decade have aimed to remove barriers to equity

in higher education. On the one hand, regulations and programs for enhancing the participation of women at advanced educational levels in areas such as science and technology (Berlien et al., 2016). Equity policies have aimed to address issues such as social stratification by ensuring that all individuals have equal access to educational opportunities and receive quality training. While other factors have also been considered, these efforts have been largely influenced by social movements (Bellei et al., 2014; Delisle & Bernasconi, 2018; Olavarría Gambi & Allende González, 2013).

**Advising and Supervisor-Student Relationships**

Research on supervision at the doctoral level in the Chilean system still needs to be developed. But there seems to be a trend of increasing studies published mainly after 2016 addressing this topic and its importance (e.g., Poblete et al., 2018; Proestakis-Maturana & Terraza -Núñez, 2017; Walczak et al., 2017). Much research touches tangentially on this topic while focusing on other aspects of doctoral education in Chile, such as internationalization and accreditation (e.g., Celis & Veliz, 2017). This dissertation contributes to scholarship, presenting evidence that adds valuable insights into the unique experiences and challenges faced by doctoral students in Chile, especially in E&T.

A notable result from the dissertation was that advisor-advisee relationships were paramount to facilitating this group of students' socialization and outcome. This finding aligns with Proestakis-Maturana & Terraza -Núñez (2017) and their observations in three doctoral programs in mathematics, psychology, and geology at one Chilean regional university. Concurring with Proestakis-Maturana & Terraza -Núñez, findings from this dissertation suggest a strong emphasis on supervision very much influenced by the

demands to fulfill the program and external demands such as scientific production. In this context, the supervisor tends to be perceived by students as the expert in a field and from whom students learn to navigate the expected standards and environmental imperatives. The dissertation findings indicate that students may feel that their supervisors are not fully aware of their crucial pedagogical role in supporting students' holistic development, including personal growth and academic success. Specifically, students may view their supervisors as the primary source of guidance and support for navigating unique challenges that may impact their studies.

Findings also showed how advisors contributed to navigating and succeeding in their Ph.D. training. In the participants' opinion, the supervisor contributed to overseeing their academic progress, usually by holding frequent one-on-one meetings. Supervisors also helped students define priorities among academic tasks and strategize to develop their research skills and agenda. In terms of individual meetings, students also highlighted the importance of advisors' availability to hold regular meetings, as well as advisors' flexibility in adapting to online meetings during COVID-19. While previous literature has extensively supported the importance of supervisors' actions, guidance, and support for students' outcomes, regardless of national and institutional contexts (e.g., Friedensen et al., 2023; Khozaei et al., 2015; Pyhältö et al., 2015; Ruud et al., 2018), this area has not been fully explored in the context of Chilean doctoral education. To contribute to the development of this scholarship, I have identified three avenues to continue this study. Firstly, further research could investigate the impact of different advising styles on students' academic progress. This research could compare the outcomes of students who receive frequent one-on-one meetings with their advisor to

those with less frequent or group meetings. It could also examine the impact of different advising styles on students' research skills and productivity. Secondly, based on this dissertation's findings, advisor availability may have influenced students' well-being. To better understand this impact, I propose research that explores the relationships between the availability of advisors to hold regular meetings and students' stress levels, job satisfaction, and mental health. This research could contribute to identifying ways in which advisors can provide emotional support to students, as that was a theme in this dissertation. Finally, the next step in the scholarship can investigate the impact of advising on students' career trajectories, particularly the relationship between the quality of advising relationships and students' post-Ph.D. career outcomes. It could explore whether students with more supportive and effective advisors are more likely to pursue academic careers, land desirable jobs, or achieve career success.

Additionally, this dissertation posits the possibility of varied advising systems across doctoral programs in E&T. The identified differences, as revealed through this study, can be attributed to a multitude of factors, such as the academic and professional backgrounds of supervisors acting as mentors, the formality of the advisory process, the modes of evaluation, and the available institutional and program resources. The examination of these structures holds significance as they may meaningfully impact the students' overall academic experiences and outcomes. The potential differences in levels of experience among faculty members in their supervisory role and therefore recommends that further research be conducted to examine the positive and negative consequences for student success. This topic is particularly relevant considering the recent increase in national programs and graduates with Ph.D. degrees in Chile. By

exploring the impact of different supervisory experiences on student success, future research can inform the development of effective strategies to support doctoral students in Chile.

While important for all students, quality supervisors-student relationships this dissertation provides evidence that can become more be a determining factor for success for specific groups of students, as was the case of women in E&T fields. These findings seemed to be aligned with scholarship in other countries showing that gender might be critical in the relationships between Ph.D. students and their faculty advisors (e.g., Twale et al., 2016). Findings also resonate with research on Ph.D. students and programs in STEM fields that suggests that female doctoral students may experience advantages by having a woman advisor (Main, 2014; Miller, 2015; Tao & Gloria, 2019). For example, doctoral students can develop a sense of compatibility between their gender identity and scientific domain (Clark et al., 2016) and do more successfully in publishing and occupying academic positions when their advisor shares their gender identity (Gaule & Piacentini, 2018; Pezzoni et al., 2016).

Further examining interactions of doctoral students in E&T. fields who identify as women with faculty advisors with different levels of knowledge about gender issues specific to E&T disciplines and research are particularly relevant in the Chilean context. For one, it would contribute to the scholarship on equity and inclusion issues in doctoral education. For two, it contributes to the scholarly and public debates on gender imbalance in doctoral education, particularly in STEM fields where women's participation declines as their research career progresses (Berlien et al., 2016). Studies in other world regions suggest these disciplines, predominantly populated by men, develop

a culture defined by masculine values (Sallee, 2011b). Similar research also shows that male-dominated disciplines, like engineering, show specific socialization patterns. For example, students experience a disciplinary culture that encourages them to accept hierarchy, competition with their peers, and common displays of sexist behaviors (Sallee, 2011a; Wofford & Blaney, 2021) that create a hostile climate for female students and other individuals who differ from the gender norm. While no traceable research on female students and advisors in the context of E&T doctoral education in Chile, additional research could be conducted to examine the impact of academic advising on promoting diversity and inclusion. This research would investigate the ways in which advisors promote or hinder diversity and inclusion in academia, including supporting and empowering underrepresented groups of students such as it is women in E&T.

**Peer Interactions**

While peers were found to be less relevant to the socialization of doctoral students compared to supervisors, they still played an important role, particularly during the application process and first year of Ph.D. training. During the initial period, peers acted as mentors and supported new students in registering for coursework and preparing for their first weeks of doctoral training. They also played a crucial role in offering timely and updated information to help navigate the program. In contrast, findings were limited to confirming what studies on the socialization of doctoral students have concluded in U.S. settings. For example, Weidman et al. (2001) found that by interacting with peers early on, newcomers became more aware of behaviors, attitudes, stereotypes, expectations of students, and professional roles within the Ph.D. program, Despite the

relevance of peer interactions, participants engaged only occasionally and mostly informally during the program's initial phase.

Similar research conducted in the United States has shown that peers have a significant impact on the socialization of doctoral students, especially among those with similar social and cultural backgrounds (Ellis, 2001; Gildersleeve et al., 2011; Le & Gardner, 2010). This dissertation, in contrast, was uncertain whether this holds true in the Chilean doctoral academic context. Various factors, such as cultural differences in the structure of doctoral programs and other influences on the nature and extent of peer support, may contribute to this variation. Further research into these additional factors can help to enhance the understanding of how peer support contributes to E&T students' socialization and outcomes in Chile.

**Institutional and Program-Related Factors**

Based on the evidence offered in this dissertation, I argue that effective communication and providing high-quality information by program representatives (such as directors, coordinators, and secretaries) emerged as key factors in enabling all participants to move efficiently through the different phases of the program. Interactions between students and program representatives seemed particularly helpful during the initial phase of the Ph.D. Also, this dissertation suggests that engaging with program representatives was particularly significant for international students, those from different institutions, and women. According to data from this dissertation, these students' groups required clearer and more specific information from programs.

Despite the acknowledged importance of communication in doctoral programs, little research has been conducted in the Chilean context on this specific topic. However,

studies on institutional and program differences (Baeza, 2017, Celis & Véliz, 2017) suggests that this variation may also affect the communication processes. Further comprehension of the communication patterns between program representatives and doctoral students E&T can serve to better understand the culture of the programs, disciplinary norms, and the power dynamics that can affect students' experience and outcomes of success. This dissertation also indicated that students from other countries and vulnerable socioeconomic backgrounds were inclined to report the need for clearer and more information from program representatives, faculty, and peers. An examination of these patterns of communication can be beneficial to learn about possible differences between the experiences of students with a minimal acquaintance with doctoral education and peers with greater knowledge about this process.

A notable trend in the experiences of this group of E&T doctoral students was the importance of faculty involvement in the recruitment process. Students experienced advantages when they had established connections with faculty members other than their Ph.D. mentors. These faculty members had previously acted as their instructors or supervisors during prior academic degrees or research projects, often within the same institution. Through these relationships, students reported a more effective means of communicating, facilitating their understanding of the demands of doctoral training and research within their field of study. Furthermore, students indicated that they felt a greater sense of legitimacy in their position and were more at ease in addressing inquiries while navigating the process.

Previous research has suggested that engineering programs in Chile tend to engage in academic inbreeding, whereby they seek out top Ph.D. graduates from their

own programs to join the department as faculty members (Celis & Kim, 2018). The context in engineering fields raises questions about the relationship between faculty involvement in recruiting doctoral students for their department and the issue of academic inbreeding. This pattern in recruitment also sparks concerns about possible differences in socialization experiences between students who were recruited by faculty members from the same institutional background as opposed to those who were not. Data from this dissertation suggest that students not recruited from a department faculty might face more difficulties compromising their outcomes. Participants not recruited by faculty members in the program also often expressed difficulties navigating the program's requirements efficiently. They were unsure how to address specific questions and identify the appropriate resource or person to provide specific answers. Participants not recruited by program faculty members also were likely to claim to have more difficulties developing early relationships with other faculty members and peers, as the “recruiter” often plays the role of introducing the newcomer to the faculty research team and close professional network and peers. Students who did not have the opportunity to build solid personal and professional relationships with their faculty advisors before entering the program can also increase the time needed to allocate to build a relationship or may advance slower toward degree completion.

A different finding from this dissertation relates to the fact that program-led activities, including informational, scholarly, and social events, contributed to the socialization of graduate students. For example, welcoming events often allowed students first-hand information about administrative procedures and explicit and implicit expectations of their doctoral training. In this way, these instances added pertinent and

timely information to navigate the first months of the doctoral process, where students also could request guidance on certain common issues. While the findings concur with studies in the American context pointed out that activities may help students at this stage to cope with feelings of uncertainty, a lack of clarity, and overall ambiguity about the actions they must take during the current and future phases of the Ph.D. training process (Gardner, 2007). Participation in activities such as seminars, lectures, and joint classes can also facilitate the socialization of doctoral students into the scholar role. For example, these activities can create the space to generate scholarly conversations; receive feedback from faculty, peers, and other researchers; and engage in social interaction (Roksa et al., 2018; Weidman & Stein, 2003). However, evidence from this dissertation rather is limited to determining a similar impact in the E&T Chilean setting. Evaluating these activities in E&T programs and their impact need to be further explored, especially because doctoral programs fields are in high demand for contributing primarily to research by publishing in respected journals in the discipline and generating patents (CNA, 2016).

Finally, data from this dissertation also identified differences in the perceptions of students regarding the support from their program in multiple areas that hint at possible impacts on their socialization and outcomes. Regarding preparedness for postgraduation success, participants strongly perceived an emphasis on their preparation as researchers in the fields. Not so much into teaching roles. Regarding teaching, students were likely to seek teaching positions as part of their careers after graduation and critiqued the limited exposure to teaching training over research, as they tended to look individually for alternative activities that could help to develop these skills. In this sense, students

concurred that they had become agents in identifying and engaging additional opportunities as part of their doctoral training. In contrast to these students, most recognized the primary role of their advisors in facilitating some of these teaching opportunities. Advisors, according to participants, mainly communicated the importance of student engagement in such activities and facilitated access to such experiences. According to the students, some of them were able to secure a teaching assistantship position through their supervisors or leveraging their supervisor's professional network to create such opportunities. This data related to prior findings of this dissertation about insufficient or unclear information about professional pathways and realistic assessments of national job markets in their respective disciplines. International scholarship points to the ideal clear and detailed information about job requirements to ensure they are effectively socialized for their future professional roles (e.g., Perry and Abruzzo, 2020), Recall, Chilean policies primarily expanded doctoral education access, while the national job market for graduates has not been substantially adjusted to the new reality (Gonzalez & Jiménez, 2014). The unclear information about professional pathways from the program might reflect a deeper problem in the design of such government structures.

**Contextual Factors of a Broader Nature**

Another essential takeaway from this research centers on the role of national policies on doctoral education and the field in shaping and influencing doctoral students' experiences. Data from this dissertation aligns with prior scholarly debates that suggest that they establish operational boundaries for institutions and programs, such as internal regulations, procedures, and management, but through them, also model students' perceptions, expectations, and decision-making processes (e.g., Colyvas & Powell, 2007;

Mars et al., 2014; Mendoza, 2007, 2012). Evidence from this dissertation revealed the impact of public funding policies on completion rates and time-to-degree for these Ph.D. students. Two main trends emerged. First, most students who received government funding through ANID acknowledged that financial assistance was crucial in preventing them from dropping out of their doctoral studies. Participants' concerns about incurring debt motivated them to persist and complete their studies. Failing to complete the program would mean reimbursing the scholarship amount, which participants found difficult to afford and burdensome. Additionally, the possibility of extending the ANID scholarship for an additional 6 months had a positive impact on students who faced delayed graduation, incentivizing them to prioritize completing their studies within the given timeframe. In conclusion, the evidence presented in this dissertation sheds light on how the availability of public funding, along with the accompanying penalties, can shape students' expectations of their doctoral training. Furthermore, funding regulations can serve as both a source of pressure and motivation that can significantly impact students' outcomes, including their ability to persist and complete their degree program within a reasonable timeframe. By understanding the impact of these policies, institutions can better support Ph.D. students in achieving their academic goals.

In addition to national policies, this dissertation has shown that external factors, such as the COVID-19 pandemic, can have a direct and indirect impact on the experiences of doctoral students. Students reported that they were particularly affected in areas such as their learning, access to educational opportunities, interpersonal interactions with peers and supervisors, and sense of belonging. These factors should be recognized

as part of the doctoral training context, in order to identify additional challenges and opportunities that may affect students' socialization and outcomes.

## Implications for Practice

This study was exploratory, focusing on the experiences of E&T doctoral students in Chilean universities. The goal was not to present generalizable results but rather to provide a rich description and understanding of students' socialization processes and success outcomes. These experiences offer insight for program leadership, faculty, advisory teams, and staff concerned with program policies and procedures and supporting students. This study also provides empirical evidence for university officers who play a role in decision making, such as setting policies and procedures for the program, overseeing the awarding of degrees, and providing or facilitating resources to support the program. I identified several implications for Chilean doctoral programs' practices by analyzing this dissertation's main findings and discussions. Specifically, I discuss implications related to programs' information and communication systems, advising structures, peer-mentoring programs, and student mental health and well-being support.

This research offered evidence of the importance of maintaining a coordinated and responsive communication system. This may assist students in clarifying the overall ambiguity of graduate school through clear guidelines, deadlines, and descriptions of both implicit and explicit expectations. At the same time, this system can support students' transition from one phase to another. Programs should maintain faculty and staff on top of the main information shared with students to improve fluent dissemination and understanding and to develop a higher sense of community.

This research also highlighted the importance of enhancing information and communication systems by providing relevant formats and content for all students and catering to the specific needs of groups of students at different phases of their doctoral journeys. This study found that students lack information about professional pathways and realistic assessments of the national job market in their respective disciplines. Thus, creating a space to disseminate this data among students can be beneficial for them, both to make appropriate decisions during their training and to enhance individual and program resources.

This dissertation examined the importance of establishing positive personal and professional relationships between doctoral students and supervisors for their socialization and outcomes. The findings of this study provide a valuable starting point for initiating a dialogue at the level of programs on the role of advising in doctoral training from both the faculty and student perspectives. Additionally, this study raises questions about how E&T doctoral programs in Chile can identify the most suitable and efficient advising models, such as one-on-one, co-advising, or team advising, to encourage completion and better serve the existing diverse population of students. The study's findings also suggest that doctoral programs and institutions must evaluate how they can better support supervisors in fulfilling their role's multiple expectations while competing academic responsibilities. A synthesis of the literature on doctoral student success and well-being supports this point by emphasizing that all relationships and structures involving individuals, resources, and institutions beyond the Ph.D. researcher – including supervision, the department, and financial support opportunities – can directly or indirectly impact progress and completion (Sverdlik et al., 2018). To

ensure the successful completion of doctoral programs and promote the well-being of students, institutional and program leaders should invest in efforts such as exploring more suitable supervising models that accommodate the needs of both students and faculty, such as co-advising or team advising models (e.g., Robertson, 2017), providing resources for supervisor training, implementing supervising evaluation systems, and offering incentives to faculty.

Evidence from this thesis also indicated that peer support can be very helpful for all students, especially those who are unfamiliar with the system or are women, international, and first-generation students in HE. Program and department administrators can support students by implementing more opportunities for the first year, and advanced students can interact. Implementing a peer mentoring system may be useful in matching incoming students with those more advanced in their program with similar backgrounds to assist students in understanding and successfully navigating their own experiences. Support groups and opportunities for interaction could be similarly structured with these student populations at either the departmental or institutional level. Referrals to support services should also be available for students upon entrance to their programs.

Considering informal interaction with peers at this phase may or may not occur, as supported by these findings, some benefits of establishing more structured peer mentoring initiatives that programs can implement. Peer mentoring is often referred to as a best practice from the programmatic standpoint (e.g., Badger, 2010; Huizing, 2012). In the context of Chilean doctoral education, similar opportunities provide students with the general knowledge of different aspects of the program to navigate this system more effectively. Peer mentoring recognizes the expertise and knowledge of advanced students,

enabling them to offer valuable insights and support to their peers, especially during the initial phase.

Finally, this dissertation offers evidence that doctoral training can be a demanding and stressful process, negatively impacting mental health and well-being. This dissertation can serve programs to openly discuss mental health as one important aspect of students' well-being. In addition, programs must assess how they can contribute to providing and improving mental health support services; encourage students' work-life balance self-care practices; and create a supportive community for students to mitigate these challenges and enhance advancement, time, and completion rates. These conversations can, in turn, help as input to evaluate national and institutional policies and funding allocation to support students.

## Final Remarks

The concept of socialization used as the conceptual framework for this study proved to be a useful starting point in exploring the experiences of E&T doctoral students in the Chilean context from a program perspective. This dissertation makes an important contribution to the emerging scholarship on doctoral education in E&T in Chile. The study provides valuable insights into the experiences of doctoral students and their process of transitioning into doctoral training and professional practice. As such, it has the potential to inform policy and practice in doctoral education, as well as contribute to new avenues for research on doctoral education.

This dissertation highlights the experiences of underrepresented populations in E&T, namely women, students from financially disadvantaged backgrounds, and

international students. These groups have traditionally been marginalized in doctoral education in Chile. Their situated experiences shed light on the transformation in the demographics of the overall doctoral student populations in Chile, resulting from national regulations and changes in the E&T field. These experiences also bring implications for program leaders, faculty, and administrators to support such student populations and facilitate their degree completion. Finally, this dissertation contributes to scholarship in E&T doctoral education that addresses equity issues. In this way, this dissertation is an opportunity for critically examining conventional socialization models that tend to enforce a uniform doctoral experience while overlooking the unique needs and perspectives of those who deviate from established norms.

Secondly, this dissertation underscores the importance of the faculty supervisor in the socialization and outcomes of the success of students. At the same time, it is possible to observe an emphasis on supervisors training experts in the field (researchers). rather focusing on the holistic development of the professional. Also, this study reveals dissimilar structures of advising and variable support for advising from programs that can impact students' outcomes of success.

Socialization was also helpful in identifying certain institutional and program features influencing the interactions between students and faculty, peers, and administrators in the program, such as funding, control, faculty composition, and state of development. Baeza's (2017) research on the diversity of doctoral programs in Chile could serve as a valuable starting point for developing a framework that accounts for the variability and differentiation among programs when examining the impact of these dimensions on students' experiences and success.

Moreover, the data suggests that there are various relationships between current national policies, such as public funding availability, high noncompliance scholarship penalties, and accreditation, and the experience of students and outcomes, such as time to degree and Ph.D. completion. Further exploration is needed to understand the impact of these policies on the student's success. By better understanding the impact of policies on student success, research can provide policymakers with a clear picture of the challenges that students face and the areas where policy intervention may be needed. Future studies on these relationships can help governments and institutions identify more effective ways to promote positive outcomes. They may focus their efforts on aspects most likely to impact student success. Gaining a deeper comprehension of how policies affect the success of doctoral students can help decision-makers evaluate and address the unintended consequences of policies. For example, offering monetary rewards for students to finish their degrees quickly may discourage students from pursuing more challenging courses that could ultimately enhance their career prospects. Lastly, research can help involved authorities understand policies' equity implications and ensure their design promotes equity and fairness.

# REFERENCES


Abraham, R. (2000). The role of job control as a moderator of emotional dissonance and emotional intelligence-outcome relationships. *The Journal of Psychology*, *134*(2), 169–184. https://doi.org/10.1080/00223980009600860

Acker, S., & Haque, E. (2015). The struggle to make sense of doctoral study. *Higher Education Research & Development*, *34*(2), 229–241. https://doi.org/10.1080/07294360.2014.956699

Aitchison, C., Catterall, J., Ross, P., & Burgin, S. (2012). 'Tough love and tears': Learning doctoral writing in the sciences. *Higher Education Research & Development*, *31*(4), 435–447. https://doi.org/10.1080/07294360.2011.559195

Álvarez, G., & Colombo, L. (2021a). Dialogic approaches to writing: Student perspectives on two Argentinian doctoral initiatives. *Teaching in Higher Education*, 1–14. https://doi.org/10.1080/13562517.2021.1952566

Álvarez, G., & Colombo, L. (2021b). Dialogic approaches to writing: Student perspectives on two Argentinian doctoral initiatives. *Teaching in Higher Education*, 1–14. https://doi.org/10.1080/13562517.2021.1952566

Ampaw, F. D., & Jaeger, A. J. (2012). Completing the three stages of doctoral education: An event history analysis. *Research in Higher Education*, *53*(6), 640–660. https://doi.org/10.1007/s11162-011-9250-3

ANID. (2020). ANID Departamento de Estudios y Gestión Estratégica. https://www.anid.cl/blog/2020/12/17/anid-publica-reporte-de-participacion-femenina-2020/

ANID. (2022). *Ex Becarios(as) Graduados*. Agencia Nacional de Investigación y Desarrollo. Subdirección Capital Humano. https://www.conicyt.cl/becasconicyt/estadisticas/informacion-general/

Antony, J. S. (2002). Reexamining doctoral student socialization and professional development: Moving beyond the congruence and assimilation orientation. In Smart, J.C. & Tierney, W.G. (Eds.), *Higher Education: Handbook of Theory and Research.* (Vol. 17, pp. 349–380). Springer.

Arango, M., Evans, S., & Quadri, Z. (2016). *Education Reform in Chile. Designing a Fairer, Better Higher, Education System*. Woodrow Wilson School of Public and International Affairs, Princeton University. https://wws.princeton.edu/sites/default/files/content/Chile Workshop Report_HigherEd 3.15.pdf

Austin, A. E. (2002a). Creating a bridge to the future: Preparing new faculty to face changing expectations in a shifting context. *Review of Higher Education*, *26*(2), 119–144.

Austin, A. E. (2002b). Preparing the next generation of faculty: Graduate school as socialization to the academic career. *The Journal of Higher Education*, *73*(1), 94–122. https://doi.org/10.1080/00221546.2002.11777132

Austin, A. E., & McDaniels, A. E. (2006). Preparing the professoriate of the future: Graduate student socialization for faculty roles. In J. C. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. 21, pp. 397–456). Kluwer Academic Publishers. https://doi.org/10.1007/1-4020-4512-3_8

Azizova, Z. T. (2016). Complexity of academic socialization of historically underrepresented doctoral students: De-privileging distinctions between macro- and micro-theoretical approaches. *Journal Committed to Social Change on Race and Ethnicity (JCSCORE)*, *2*(2), 2–39.

Badger, K. (2010). Peer teaching and review: A model for writing development and knowledge synthesis. *Social Work Education*, *29*(1), 6–17. https://doi.org/10.1080/02615470902810850

Baeza, P. (2017). Diversidad y diferenciación en la oferta de programas de doctorado en Chile. *Calidad En La Educación*, *47*, 179–214. https://doi.org/10.4067/S0718-45652017000200179

Baeza, P. (2018). Programas doctorales en Chile: Una propuesta tipológica para interpretar su diversidad. *Calidad En La Educación*, *49*, 188. https://doi.org/10.31619/caledu.n49.580

Bair, C. R., & Haworth, J. G. (2005). Doctoral student attrition and persistence: A meta-synthesis of research. In J. C. Smart (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 19, pp. 481–534). Kluwer Academic Publishers. https://doi.org/10.1007/1-4020-2456-8_11

Barker, M. J. (2011). Racial context, currency, and connections: Black doctoral student and white advisor perspectives on cross-race advising. *Innovations in Education & Teaching International*, *48*(4), 387–400. https://doi.org/10.1080/14703297.2011.617092

Barkhuizen, G. (2021). Identity dilemmas of a teacher (educator) researcher: Teacher research versus academic institutional research. *Educational Action Research*, *29*(3), 358–377. https://doi.org/10.1080/09650792.2020.1842779

Barnes, B. J., & Randall, J. (2012). Doctoral student satisfaction: An examination of disciplinary, enrollment, and institutional differences. *Research in Higher Education*, *53*(1), 47–75. https://doi.org/10.1007/s11162-011-9225-4

Barr, M. J., & McClellan, G. S. (2018). *Budgets and financial management in higher education*. John Wiley & Sons.

Barro, S. (Ed.). (2015). *La transferencia de I+D, la innovación y el emprendimiento en las universidades. Educación superior en Iberoamérica. Informe 2015.* Centro Interuniversitario de Desarrollo (CINDA).

Bellei, C., Cabalin, C., & Orellana, V. (2014). The 2011 Chilean student movement against neoliberal educational policies. *Studies in Higher Education*, *39*(3), 426–440.

Berlien, K., Varela, P., & Robayo, C. (2016). *Realidad nacional en formación y promoción de mujeres científicas en ciencia, tecnología, ingeniería y matemáticas*. CONICYT. https://www.anid.cl/blog/2021/04/05/estudios-de-genero-y-stem/

Bloom, S. W. (1963). The process of becoming a physician. *The Annals of the American Academy of Political and Social Science*, *346*, 77–87.

Boice, R. (1993). Writing blocks and tacit knowledge. *The Journal of Higher Education*, *64*(1), 19–54. https://doi.org/10.2307/2959976

Bostwick, V. K., & Weinberg, B. A. (2022). Nevertheless she persisted? Gender peer effects in doctoral STEM programs. *Journal of Labor Economics*, *40*(2), 397–436. https://doi.org/10.1086/714921

Bragg, A. K. (1976). *The Socialization Process in Higher Education* (No. 7; pp. 1–54). George Washington University. ERIC Clearinghouse on Higher Education.

Brailsford, I. (2010). Motives and aspirations for doctoral study: Career, personal, and inter-personal factors in the decision to embark on a history PhD. *International Journal of Doctoral Studies*, *5*, 015–027. https://doi.org/10.28945/710

Braxton, J. M., & Baird, L. L. (2001). Preparation for professional self-regulation. *Science and Engineering Ethics*, *7*(4), 593–610. https://doi.org/10.1007/s11948-001-0016-8

Brim, O. G., Jr., & Wheeler, S. (Eds.). (1966). Socialization through the life cycle. In *Socialization after childhood: Two essays* (pp. 1–49). Little Brown and Co.

Brinkmann, S. (2018). The interview. In N. K. Denzin & Y. S. Lincoln (Eds.), *The SAGE Handbook of Qualitative Research* (Fifth, pp. 576–599). SAGE Publishing.

Brown, L., & Watson, P. (2010). Understanding the experiences of female doctoral students. *Journal of Further and Higher Education*, *34*(3), 385–404. https://doi.org/10.1080/0309877X.2010.484056

Brunner, J. J., & Villalobos, C. (Eds.). (2014). *Políticas de educación superior en Iberoamérica, 2009-2013.* Ediciones Universidad Diego Portales.

Burt, B. (2014). *The influence of doctoral research experiences on the pursuit of the engineering professoriate* [Doctoral dissertation]. University of Michigan.

Burt, B. A., Williams, K. L., & Smith, W. A. (2018). Into the storm: Ecological and sociological impediments to black males' persistence in engineering graduate programs. *American Educational Research Journal*, *55*(5), 965–1006. https://doi.org/10.3102/0002831218763587

Campbell, C., & O'Meara, K. (2014). Faculty agency: Departmental contexts that matter in faculty careers. *Research in Higher Education*, *55*(1), 49–74. https://doi.org/10.1007/s11162-013-9303-x

Cao, L. (2012). Differences in procrastination and motivation between undergraduate and graduate students. *Journal of the Scholarship of Teaching and Learning*, 39–64. https://doi.org/10.14434/josotl.v12i2.2018

Castelló, M., McAlpine, L., & Pyhältö, K. (2017). Spanish and UK post-PhD researchers: Writing perceptions, well-being and productivity. *Higher Education Research & Development*, *36*(6), 1108–1122. https://doi.org/10.1080/07294360.2017.1296412

Castelló, M., Pardo, M., Sala-Bubaré, A., & Suñe-Soler, N. (2017). Why do students consider dropping out of doctoral degrees? Institutional and personal factors. *Higher Education*, *74*(6), 1053–1068. https://doi.org/10.1007/s10734-016-0106-9

Celis, S., & Kim, J. (2018). The making of homophilic networks in international research collaborations: A global perspective from Chilean and Korean engineering. *Research Policy*, *47*(3), 573–582. https://doi.org/10.1016/j.respol.2018.01.001

Celis, S., & Véliz, D. (2017). La acreditación como agente de mejora continua en los programas de postgrado en ciencia y tecnología. *Cuaderno de Investigación*, *5*.

Celis, S., & Véliz, D. (2020). A decade of Chilean graduate program accreditation: A push for internationalization and issues of multidisciplinarity. *Higher Education Policy*, 1–22.

Chiappa, R., & Muñoz García, A. L. (2015). (2015. Equidad y capital humano avanzado: Análisis sobre las políticas de formación de doctorado en Chile. *Psicoperspectivas*, *14*(3), 17–30.

Clark, S. L., Dyar, C., Maung, N., & London, B. (2016). Psychosocial pathways to STEM engagement among graduate students in the life sciences. *CBE—Life Sciences Education*, *15*(3), ar45. https://doi.org/10.1187/cbe.16-01-0036

CNA. (2016). *Operacionalización de criterios de evaluación para la acreditación de programas de postgrado: Doctorado, magíster académico y magíster profesional*. Comisión Nacional de Acreditación, Chile. https://www.cnachile.cl/paginas/acreditacion-postgrado.aspx

CNA. (2021). *Búsqueda Avanzada de Acreditaciones [Advanced Accreditation Search]. Retrieved in November 2021*. https://www.cnachile.cl/Paginas/buscador-avanzado.aspx

CNA. (2022). *Actas de acreditación de doctorados en universidades chilenas*. https://www.cnachile.cl/Paginas/buscador-avanzado.aspx

CNED. (2022). *Índices Educación Superior Posgrado*. Consejo Nacional de Educación. https://www.cned.cl/indices_New_~/posgrado.phpv

Colombo, L., & Rodas, E. L. (2021). Interdisciplinarity as an opportunity in Argentinian and Ecuadorian writing groups. *Higher Education Research & Development*, *40*(2), 207–219. https://doi.org/10.1080/07294360.2020.1756750

Colyvas, J. A., & Powell, W. W. (2007). From vulnerable to venerated: The institutionalization of academic entrepreneurship in the life sciences. In *Research in the Sociology of Organizations* (Vol. 25, pp. 219–259). Emerald (MCB UP ). https://doi.org/10.1016/S0733-558X(06)25007-9

CONICYT. (2013a). *25 años de Becas de Doctorado*. Comisión Nacional de Investigación Científica y Tecnológica, Chile. https://ctci.minciencia.gob.cl/wp-content/uploads/2018/04/25-A%C3%B1os-Becas-Doctorado-CONICYT-2012.pdf

CONICYT. (2013b). *Becas de pasantía doctoral en el extranjero*. Comisión Nacional de Ciencia y Tecnología, Chile. https://www.conicyt.cl/becas-conicyt/files/2013/01/Bases-Pasant%C3%ADa-Doctoral-BCH-2013.pdf

Corcelles, M., Cano, M., Liesa, E., González-Ocampo, G., & Castelló, M. (2019). Positive and negative experiences related to doctoral study conditions. *Higher Education Research & Development*, *38*(5), 922–939. https://doi.org/10.1080/07294360.2019.1602596

Cotterall, S. (2013). More than just a brain: Emotions and the doctoral experience. *Higher Education Research & Development*, *32*(2), 174–187. https://doi.org/10.1080/07294360.2012.680017

Crede, E., & Borrego, M. (2014). Understanding retention in US graduate programs by student nationality. *Studies in Higher Education*, *39*(9), 1599–1616. https://doi.org/10.1080/03075079.2013.801425

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publications.

Crotty, M. J. (1998). *The foundations of social research: Meaning and perspective in the research process*. Sage Publications Ltd. https://www.torrossa.com/en/resources/an/5019222

CTCI. (2022). *Estrategia Nacional de Ciencia, Tecnología, Conocimiento e Innovación para el Desarrollo de Chile -2022*. Consejo Nacional de Ciencia, Tecnología, Conocimiento e Innovación para el Desarrollo, Chile. https://cens.cl/wp-content/uploads/2022/06/Est2021_CTCI_220510-simple.pdf

Danso, K., & Aalgaard, R. (2019). Socialization of doctoral students: Implications for social work education. *Journal of Teaching in Social Work*, *39*(3), 260–270. https://doi.org/10.1080/08841233.2019.1606132

De la Fare, M., Rovelli, L., & Unzué, M. (2021). Formación e inserción de personas doctoradas en ciencias sociales y humanas en América Latina. *Revista Mexicana de Investigación Educativa*, *26*(91), 999–1005.

Delisle, J., & Bernasconi, A. (2018). Lessons from Chile's transition to free college. *Evidence Speaks*, *2*(43). http://hdl.handle.net/10919/95158

Devés, R., & Marshall, M. T. (2008). El desarrollo de postgrado. In Brunner & C. Peña (Eds.), *Reforma de la Educación Superior* (First, pp. 265–304). Ediciones Universidad Diego Portales.

Devos, C., Boudrenghien, G., Van der Linden, N., Azzi, A., Frenay, M., Galand, B., & Klein, O. (2017). Doctoral students' experiences leading to completion or attrition: A matter of sense, progress and distress. *European Journal of Psychology of Education*, *32*(1), 61–77. https://doi.org/10.1007/s10212-016-0290-0

DHET. (2019). *Statistics on post-school education and training in South Africa: 2017*. South Africa Department of Higher Education and Training. https://www.dhet.gov.za/

Diaz-Bazo, C. (2021). Una mirada al ecosistema de formación en tres programas doctorales en Perú. *Revista Mexicana de Investigación Educativa*, *26*(91), 1061–1086.

Didou-Aupetit, S. (2020). Internacionalización de la educación superior y riesgo sanitario en América Latina: ¿Reconfiguración o descomposición? *Pensamiento Universitario*, *19*, 28–37.

Doran, J. M., Kraha, A., Marks, L. R., Ameen, E. J., & El-Ghoroury, N. H. (2016). Graduate debt in psychology: A quantitative analysis. *Training and Education in Professional Psychology*, *10*(1), 3–13. https://doi.org/10.1037/tep0000112

Ellis, E. M. (2001). The Impact of race and gender on graduate school socialization, satisfaction with doctoral Study, and commitment to degree completion. *Western Journal of Black Studies*, *Spring*(25), 30–45.

Erickson, F. (2012). Qualitative research methods for science education. In B. J. Fraser, K. Tobin, & C. J. McRobbie (Eds.), *Second International Handbook of Science Education* (pp. 1451–1469). Springer Netherlands. https://doi.org/10.1007/978-1-4020-9041-7_93

Espinoza, O., & González, L. (2009). Desarrollo de la formación de postgrado en Chile. *Revista Iberoamericana de Ciencia, Tecnología y Sociedad*, *5*(13), 207–232.

Evans, T. M., Bira, L., Gastelum, J. B., Weiss, L. T., & Vanderford, N. L. (2018). Evidence for a mental health crisis in graduate education. *Nature Biotechnology*, *36*(3), 282–284. https://doi.org/10.1038/nbt.4089

Felder, P., & Barker, M. (2013). Extending Bell's concept of interest convergence: A Framework for understanding the African American doctoral student experience. *International Journal of Doctoral Studies*, *8*, 001–020. https://doi.org/10.28945/1754

Felder, P. P., Stevenson, H. C., & Gasman, M. (2014). Understanding race in doctoral student socialization. *International Journal of Doctoral Studies*, *9*, 021–042. https://doi.org/10.28945/1947

Fernández Darraz, E. (2015). Políticas públicas de educación superior desde 1990 hasta el presente. [Higher education public policies from 1990 to the present]. In A. Bernasconi, *La educación superior de Chile. Transformación, desarrollo y crisis* (pp. 173–218).

Frasier, H. S. (2013). *An analysis of institutional characteristics that contribute to extended time to doctoral degree* [Doctoral dissertation]. University of Maryland, College Park. https://www.proquest.com/docview/1504840088/abstract/BE93F1AE081742FAPQ/1

Friedensen, R. E., Bettencourt, G. M., & Bartlett, M. L. (2023). Power-conscious ecosystems: Understanding how power dynamics in US doctoral advising shape students' experiences. *Higher Education*. https://doi.org/10.1007/s10734-023-00998-x

Gacel-Ávila, J., Bustos-Aguirre, M., & Freire, J. C. (2017). Student mobility in Latin America and the Caribbean: Latest trends and innovative programs. In *In the*

*globalization of internationalization: Emerging voices and perspectives* (pp. 61–72). Routledge.

García de Fanelli, A. M., & Adrogué, C. (2019). Equidad en el acceso y la graduación en la educación superior: Reflexiones desde el cono sur. *Education Policy Analysis Archives*, *27*, 96. https://doi.org/10.14507/epaa.27.3943

Gardner, S. K. (2007). "I heard it through the grapevine": Doctoral student socialization in chemistry and history. *Higher Education*, *54*(5), 723–740. https://doi.org/10.1007/s10734-006-9020-x

Gardner, S. K. (2008a). "What's too much and what's too little?": The process of becoming an independent researcher in doctoral education. *The Journal of Higher Education*, *79*(3), 326–350.

Gardner, S. K. (2008b). Fitting the mold of graduate school: A qualitative study of socialization in doctoral education. *Innovative Higher Education*, *33*(2), 125–138. https://doi.org/10.1007/s10755-008-9068-x

Gardner, S. K. (2009a). The development of doctoral students: Phases of challenge and support. *ASHE Higher Education Report*, *34*(6), 1–127. https://doi.org/10.1002/aehe.3406

Gardner, S. K. (2009b). Student and faculty attributions of attrition in high and low-completing doctoral programs in the United States. *Higher Education*, *58*(1), 97–112. https://doi.org/10.1007/s10734-008-9184-7

Gardner, S. K. (2010). Contrasting the socialization experiences of doctoral students in high- and low-completing departments: A qualitative analysis of disciplinary contexts at one institution. *The Journal of Higher Education*, *81*(1), 61–81.

Gardner, S. K., & Doore, S. A. (2020). Doctoral student socialization and professional pathways. In J. C. Weidman & L. DeAngelo (Eds.), *Socialization in Higher Education and the Early Career: Theory, Research and Application* (pp. 113–127). Springer International Publishing. https://doi.org/10.1007/978-3-030-33350-8_7

Gardner, S. K., & Holley, K. A. (2011). "Those invisible barriers are real": The Progression of First-Generation Students Through Doctoral Education. *Equity & Excellence in Education*, *44*(1), 77–92. https://doi.org/10.1080/10665684.2011.529791

Gaule, P., & Piacentini, M. (2018). An advisor like me? Advisor gender and post-graduate careers in science. *Research Policy*, *47*(4), 805–813. https://doi.org/10.1016/j.respol.2018.02.011

Gildersleeve, R. E., Croom, N. N., & Vasquez, P. L. (2011). "Am I going crazy?!": A critical race analysis of doctoral education. *Equity & Excellence in Education*, *44*(1), 93–114. https://doi.org/10.1080/10665684.2011.539472

Gilligan, C. (1978). *In a different voice: Psychological theory and women's development.* Harvard University Press.

Golde, C. (1998). Beginning graduate school: Explaining first-year doctoral attrition. *New Directions for Higher Education, 101*, 55–64. https://doi.org/10.1002/he.10105

Golde, C. M. (2005). The Role of the department and discipline in doctoral student attrition: Lessons from four departments. *The Journal of Higher Education, 76*(6), 669–700. https://doi.org/10.1353/jhe.2005.0039

González, H. (2021). Analysis of the dimensions of the profile of law doctorate graduates from Peruvian universities. *IBIMA Business Review*, 1–18. https://doi.org/10.5171/2021.471037

Gonzalez, H., & Jiménez, A. (2014). Inserción laboral de nuevos investigadores con grado de doctor en Chile. *Journal of technology management & innovation, 9*(4), 132–148. https://doi.org/10.4067/S0718-27242014000400010

González-Ocampo, G., & Castelló, M. (2018). Writing in doctoral programs: Examining supervisors' perspectives. *Higher Education, 76*(3), 387–401. https://doi.org/10.1007/s10734-017-0214-1

Gopaul, B. (2015). Inequality and doctoral education: Exploring the "rules" of doctoral study through Bourdieu's notion of field. *Higher Education, 70*(1), 73–88. https://doi.org/10.1007/s10734-014-9824-z

Gopaul, B. (2019). "Nothing succeeds like success": Doctoral education and cumulative advantage. *The Review of Higher Education, 42*(4), 1431–1457. https://doi.org/10.1353/rhe.2019.0071

Graham, E. (2013). The experiences of minority doctoral students at elite research institutions. *New Directions for Higher Education*, *2013*(163), 77–87. https://doi.org/10.1002/he.20067

Griffin, K. A., Baker, V. L., & O'Meara, K. (2020). Doing, caring, and being: "Good" Mentoring and its role in the socialization of graduate students of color in STEM. In J. C. Weidman & L. DeAngelo (Eds.), *Socialization in Higher Education and the Early Career* (Vol. 7, pp. 223–239). Springer International Publishing. https://doi.org/10.1007/978-3-030-33350-8_13

Griffin, K., Baker, V., O'Meara, K., Nyunt, G., Robinson, T., & Staples, C. L. (2018). Supporting scientists from underrepresented minority backgrounds: Mapping

developmental networks. *Studies in Graduate and Postdoctoral Education*, *9*(1), 19–37. https://doi.org/10.1108/SGPE-D-17-00032

Gube, J., Getenet, S., Satariyan, A., & Muhammad, Y. (2017). Towards "Operating within" the field: Doctoral students' views of supervisors' discipline expertise. *International Journal of Doctoral Studies*, *12*, 001–016. https://doi.org/10.28945/3641

Guerin, C., Jayatilaka, A., & Ranasinghe, D. (2015). Why start a higher degree by research? An exploratory factor analysis of motivations to undertake doctoral studies. *Higher Education Research & Development*, *34*(1), 89–104. https://doi.org/10.1080/07294360.2014.934663

Gutiérrez, D. C. (2012). *Chile, eliminar o reproducir la segrecación social? Dos siglos de disputas sobre modelos educacionales.* Ceibo Ediciones.

Guzmán-Valenzuela, C. (2016). *Global trends and their impact on Latin America: The role of the state and the private sector in the provision of higher education* (Working Paper No. 4). Centre for Global Higher Education, UCL Institute of Education. https://academic-cms.prd.the-internal.com/sites/default/files/breaking_news_files/global-trends-and-their-impact-on-latin-america.pdf

Hakala, J. (2009). Socialization of junior researchers in new academic research environments: Two case studies from Finland. *Studies in Higher Education*, *34*(5), 501–516. https://doi.org/10.1080/03075070802597119

Herman, C. (2010). Emotions and being a doctoral student. In P. Thomson & M. Walker (Eds.), *Doctoral student's companion: Getting to grips with research in education and the social sciences* (pp. 283–294). Routledge.

Herman, C. (2011). Obstacles to success – doctoral student attrition in South Africa. *Perspectives in Education*, *29*, 13.

Holley, K. A., & Gardner, S. (2012). Navigating the pipeline: How socio-cultural influences impact first-generation doctoral students. *Journal of Diversity in Higher Education, 5*(2), 112–121. https://doi.org/10.1037/a0026840

Horta, H., Cattaneo, M., & Meoli, M. (2019). The impact of Ph.D. funding on time to Ph.D. completion. *Research Evaluation*, *28*(2), 182–195. https://doi.org/10.1093/reseval/rvz002

Huizing, R. L. (2012). Mentoring together: A literature review of group mentoring. *Mentoring & Tutoring: Partnership in Learning*, *20*(1), 27–55. https://doi.org/10.1080/13611267.2012.645599

Inanc, O., & Tuncer, O. (2011). The effect of academic inbreeding on scientific effectiveness. *Scientometrics*, *88*(3), 885–898. https://doi.org/10.1007/s11192-011-0415-9

Ives, G., & Rowley, G. (2005). Supervisor selection or allocation and continuity of supervision: Ph.D. students' progress and outcomes. *Studies in Higher Education*, *30*(5), 535–555. https://doi.org/10.1080/03075070500249161

Jaksztat, S., Neugebauer, M., & Brandt, G. (2021). Back out or hang on? An event history analysis of withdrawal from doctoral education in Germany. *Higher Education*, *82*(5), 937–958. https://doi.org/10.1007/s10734-021-00683-x

Jeong, S., Blaney, J. M., & Feldon, D. F. (2019). Identifying faculty and peer interaction patterns of first-year biology doctoral students: A latent class analysis. *CBE—Life Sciences Education*, *18*(4), ar59. https://doi.org/10.1187/cbe.19-05-0089

Kehm, B. (2020). Reforms of doctoral education in Europe and diversification of types. In S. Cardoso, Tavares, C. Sin, & T. Carvalho (Eds.), *Structural and institutional transformations in doctoral education: Social, political and student expectations* (pp. 85–104). Springer.

Khozaei, F., Naidu, S., Khozaei, Z., & Salleh, N. A. (2015). An exploratory study of factors that affect the research progress of international PhD students from the Middle East. *Education + Training*, *57*(4), 448–460. https://doi.org/10.1108/ET-09-2013-0115

Kim, D., & Otts, C. (2010). The effect of loans on time to doctorate degree: differences by race/ethnicity, field of study, and institutional characteristics. *The Journal of Higher Education*, *81*(1), 1–32. https://doi.org/10.1353/jhe.0.0079

Kyvik, S., & Olsen, T. B. (2014). Increasing completion rates in Norwegian doctoral training: Multiple causes for efficiency improvements. *Studies in Higher Education*, *39*(9), 1668–1682. https://doi.org/10.1080/03075079.2013.801427

Labraña, J., Ognio, K., & Sion, R. (2021). Economía del conocimiento y formación de doctores(as) en ciencias sociales Reflexión desde el caso chileno. *Revista Mexicana de Investigación Educativa*, *26*(91), 1217–1244. Scopus.

Le, T., & Gardner, S. K. (2010). Understanding the doctoral experience of Asian international students in the science, technology, engineering, and mathematics (STEM) fields: An exploration of one institutional context. *Journal of College Student Development*, *51*(3), 252–264. https://doi.org/10.1353/csd.0.0127

Lee, S. (2018). *Servant leadership: A phenomenological study of Southeast Asian women's career advancement experiences in community colleges*. California State University, Stanislaus.

Leijen, Ä., Lepp, L., & Remmik, M. (2016). Why did I drop out? Former students' recollections about their study process and factors related to leaving the doctoral studies. *Studies in Continuing Education*, *38*(2), 129–144. https://doi.org/10.1080/0158037X.2015.1055463

Leon Reyes, J. J. (2018). *Derecho y política de la educación superior chilena evolución, crisis y reforma*. Leiden University. https://scholarlypublications.universiteitleiden.nl/handle/1887/66123

Levecque, K., Anseel, F., De Beuckelaer, A., Van der Heyden, J., & Gisle, L. (2017). Work organization and mental health problems in PhD students. *Research Policy*, *46*(4), 868–879. https://doi.org/10.1016/j.respol.2017.02.008

Lin, Y.-N. (2012). Life experiences of dissatisfied science and engineering graduate students in Taiwan. *College Student Journal*, *46*(1), 51–66.

Lonka, K. (2014). How to measure PhD students' conceptions of academic writing – and are they related to well-being? *Journal of Writing Research*, *5*(3), 245–269. https://doi.org/10.17239/jowr-2014.05.03.1

Lovitts, B. E. (2005). Being a good course-taker is not enough: A theoretical perspective on the transition to independent research. *Studies in Higher Education*, *30*(2), 137–154. https://doi.org/10.1080/03075070500043093

Lovitts, B. E., & Nelson, C. (2000). The hidden crisis in graduate education: Attrition from Ph.D. programs. *Academe*, *86*(6), 44. https://doi.org/10.2307/40251951

Main, J. B. (2014). Gender homophily, Ph.D. completion, and time to degree in the humanities and humanistic social sciences. *The Review of Higher Education*, *37*(3), 349–375. https://doi.org/10.1353/rhe.2014.0019

Mars, M. M., Bresonis, K., & Szelényi, K. (2014). Science and engineering doctoral student socialization, logics, and the national economic agenda: Alignment or disconnect? *Minerva*, *52*(3), 351–379. https://doi.org/10.1007/s11024-014-9256-z

Matear, A. (2006). Barriers to equitable access: Higher education policy and practice in Chile since 1990. *Higher Education Policy*, *19*(1), 31–49.

McAlpine, L., & Amundsen, C. (2018). Chapter 3: Identity-Trajectory. In L. McAlpine & C. Amundsen, *Identity-Trajectories of Early Career Researchers* (pp. 27–56). Palgrave Macmillan UK. https://doi.org/10.1057/978-1-349-95287-8_3

McAlpine, L., Castello, M., & Pyhältö, K. (2020). What influences PhD graduate trajectories during the degree: A research-based policy agenda. *Higher Education*, *80*(6), 1011–1043. https://doi.org/10.1007/s10734-019-00448-7

McAlpine, L., & McKinnon, M. (2013). Supervision – the most variable of variables: Student perspectives. *Studies in Continuing Education*, *35*(3), 265–280. https://doi.org/10.1080/0158037X.2012.746227

Mello, A. L., Fleisher, M. S., & Woehr, D. J. (2015). Varieties of research experience: Doctoral student perceptions of preparedness for future success. *The International Journal of Management Education*, *13*(2), 128–140. https://doi.org/10.1016/j.ijme.2015.01.007

Mendoza, P. (2012). The role of context in academic capitalism: The industry-friendly department case. *The Journal of Higher Education*, *83*(1), 26–48.

Mendoza, Pilar. (2007). Academic capitalism and doctoral student socialization: A case study. *The Journal of Higher Education*, *78*(1), 71–96. https://doi.org/10.1353/jhe.2007.0004

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. John Wiley & Sons.

Merton, R. K. (1957). *Social theory and social structure*. The Free Press.

Miller, E. (2015). Examining factors associated with the success of women in mathematics doctoral programs. *Journal of Women and Minorities in Science and Engineering*, *21*(1), 47–85. https://doi.org/10.1615/JWomenMinorScienEng.2015010814

MinCiencia. (2019). *Informe final encuesta de trayectoria doctorados en Chile*. Ministerio de Ciencia, Tecnología, Conocimiento e Innovación, Chile. https://api.observa.minciencia.gob.cl/api/datosabiertos/download/?handle=123456789/593&filename=2019-CDH-informe-final-del-estudio.pdf

MinCiencia. (2020). *Encuesta Nacional de Innovación 2019-2020. Presentación de resultados.* https://observa.minciencia.gob.cl/encuesta/encuesta-nacional-de-innovacion

MinCiencia. (2021). *Resultados Encuesta Trayectoria de Profesionales con grado de doctor en Chile. Año de referencia 2019.* https://www.minciencia.gob.cl/areas-de-trabajo/estudios-y-estadisticas/encuesta-de-trayectoria-de-profesionales-con-es

MINECON. (2014). *Presentacion-Resultados-3ra-Encuestas-sobre-Gasto-y-Personal-I+D.pdf*. Ministerio Economía Gobierno de Chile. http://www.economia.gob.cl/wpcontent/uploads/2014/01/Presentacion-Resultados-3raEncuestas-sobre-Gasto-y-Personal-I+D.pdf

MINECON. (2017). *Investigación y desarrollo en las empresas chilenas. Cuarta encuesta longitudinal de empresas*. Ministerio de Economía Fomento y Turismo. División de Política Comercial e Industrial. Chile.

https://www.economia.gob.cl/wp-content/uploads/2017/07/ELE4_Bolet%C3%ADn-ID_final.pdf

*Law 20129.* (2006). Establece un Sistema Nacional de Aseguramiento de la Calidad de la Educación Superior. https://bcn.cl/30czz

*Law 21.091.*(2018). Sobre Educación Superior, (MINEDUC). https://www.leychile.cl/Navegar?

MINEDUC. (2014). *Estudio evaluativo de un conjunto de programas doctorales chilenos 2013–2014.* Ministerio de Educación de Chile. https://bibliotecadigital.mineduc.cl/handle/20.500.12365/14535

Muñoz-García, A. L., & Bernasconi, A. (2020). Reassessing the progress of doctoral education in Chile. In M. Yudkevich, P. G. Altbach, & H. de Wit, *Trends and Issues in Doctoral Education: A Global Perspective* (pp. 414–440). SAGE Publications Pvt Ltd. https://doi.org/10.4135/9789353885991.n17

Naidoo, D. (2015). Understanding non-traditional PhD students' habitus–implications for PhD programmes,. *Teaching in Higher Education*, *20*(3), 340–351.

Nind, M., & Lewthwaite, S. (2018). Methods that teach: Developing pedagogic research methods, developing pedagogy. *International*. *41*(4), 398–410. https://doi.org/10.1080/1743727X.2018.1427057

Núñez-Valdés, K., & González Campos, J. (2019). Hacia la estandarización de los perfiles de egreso de los programas de doctorado. *Revista Digital de Investigación En Docencia Universitaria*, *13*(2), 3–18. https://doi.org/10.19083/ridu.2019.1080

OECD. (2020). *Income Inequality*. OECD Data. https://data.oecd.org/inequality/income-inequality.htm

OECD. (2021a). *Education at a Glance 2021: OECD Indicators*. https://doi.org/10.1787/b35a14e5-en

OECD. (2021b). *OECD Science, technology, and innovation outlook 2021: Times of crisis and opportunity*. OECD Publishing. https://doi.org/10.1787/75f79015-en

Olavarría Gambi, M., & Allende González, C. (2013). Endeudamiento estudiantil y acceso a la educación superior en Chile. [Student Debt and Access to Higher Education in Chile]. *Revista Española de Investigaciones Sociológicas*, *141*, 91–112.

Olavarría, J. (2012). *Trayectoria laboral de los doctorados nacionales.* [Final Report]. Ministerio de Educación de Chile, Ministerio de Economía, Fomento y Turismo, Consejo Nacional de Innovación para la Competitividad.

O'Meara, K., Campbell, C., & Terosky, A. (2011). *Living agency in the academy: A conceptual framework for research and action.* Association for the Study of Higher Education, Charlotte, NC.

O'Meara, K., Jaeger, A., Eliason, J., Grantham, A., Cowdery, K., Mitchall, A., & Jingjing Zhang, K. (2014). By design: How departments influence graduate student agency in career advancement. *International Journal of Doctoral Studies*, *9*, 155–179. https://doi.org/10.28945/2048

O'Meara, K., Knudsen, K., & Jones, J. (2013). The role of emotional competencies in faculty-doctoral student relationships. *The Review of Higher Education*, *36*(3), 315–347. https://doi.org/10.1353/rhe.2013.0021

Onwuegbuzie, A., Rosli, R., Ingram, J., & Frels, R. (2014). A Critical Dialectical Pluralistic Examination of the Lived Experience of Select Women Doctoral Students. *The Qualitative Report*. https://doi.org/10.46743/2160-3715/2014.1283

Perez Mejias, P., Chiappa, R., & Guzmán-Valenzuela, C. (2018). Privileging the privileged: The effects of international university rankings on a Chilean fellowship program for graduate studies abroad. *Social Sciences*, *7*(12), Article 12. https://doi.org/10.3390/socsci7120243

Perry, J. A., & Abruzzo, E. (2020). Preparing the scholarly practitioner: The importance of socialization in CPED-Influenced EdD programs. In J. C. Weidman & L. DeAngelo (Eds.), *Socialization in Higher Education and the Early Career* (Vol. 7, pp. 129–146). Springer International Publishing. https://doi.org/10.1007/978-3-030-33350-8_8

Petersen, A. M., Riccaboni, M., Stanley, H. E., & Pammolli, F. (2012). Persistence and uncertainty in the academic career. *Proceedings of the National Academy of Sciences*, *109*(14), 5213–5218. https://doi.org/10.1073/pnas.1121429109

Pezzoni, M., Mairesse, J., Stephan, P., & Lane, J. (2016). Gender and the publication output of graduate students: A case study. *PLOS ONE*, *11*(1), e0145146. https://doi.org/10.1371/journal.pone.0145146

Poblete, D., Baeza, P., & Droguett, N. (2018). Aseguramiento de la calidad de programas doctorales en Chile: Estado actual y desafíos. In *Aseguramiento de la calidad de programas de doctorado: Convergencias y desafíos para Iberoamérica. Seminario Internacional* (pp. 67–76). Comisión Nacional de Acreditación. https://www.cnachile.cl/SiteAssets/Paginas/estudios/Seminario-MAD-Version-Difusion.pdf

Portnoi, L. M., Chlopecki, A. L. A., & Peregrina-Kretz, D. (2015). *Expanding the doctoral student socialization framework: The central role of student agency*. 12.

Pyhältö, K., & Keskinen, J. (2012). Doctoral students' sense of relational agency in their scholarly communities. *International Journal of Higher Education*, *1*(2), p136. https://doi.org/10.5430/ijhe.v1n2p136

Pyhältö, K., Vekkaila, J., & Keskinen, J. (2015). Fit matters in the supervisory relationship: Doctoral students and supervisors' perceptions about the supervisory activities. *Innovations in Education and Teaching International*, *52*(1), 4–16. https://doi.org/10.1080/14703297.2014.981836

Ramirez, E. (2017). Unequal socialization: Interrogating the Chicano/Latino(a) doctoral education experience. *Journal of Diversity in Higher Education*, *10*(1), 25–38. https://doi.org/10.1037/dhe0000028

Reich Albertz, R., Machuca, F., López Stefoni, D., Prieto, J. P., Music, J., Rodríguez-Ponce, E., & Yutronic, J. (2011). Bases y desafíos de la aplicación de convenios de desempeño en la educación superior de Chile. *Ingeniare. Revista chilena de ingeniería*, *19*(1), 08–18. https://doi.org/10.4067/S0718-33052011000100002

Reich, R. (2012). The MECESUP Program in Chile. 15 Years Supporting Higher Education Quality Improvement. *Harvard Review of Latin America*, *12*(1), 32–34.

Rigler Jr., K. L., Anastasia, C. M., El-Amin, A., & Throne, R. (2021). Scholarly voice and academic identity: A systematic review of doctoral student agency. In A. S. Zimmerman (Ed.), *Advances in Higher Education and Professional Development* (pp. 63–89). IGI Global. https://doi.org/10.4018/978-1-7998-7267-2.ch004

Robertson, M. (2017). Aspects of mentorship in team supervision of doctoral students in Australia. *The Australian Educational Researcher*, *44*(4–5), 409–424. https://doi.org/10.1007/s13384-017-0241-z

Roksa, J., Feldon, D. F., & Maher, M. (2018). First-generation students in pursuit of the PhD: comparing socialization experiences and outcomes to continuing-generation peers. *The Journal of Higher Education*, *89*(5), 728–752. https://doi.org/10.1080/00221546.2018.1435134

Rose, M. (1980). Rigid rules, inflexible plans, and the stifling of language: A cognitivist analysis of writer's block. *College Composition and Communication*, *31*(4), 389–401. https://doi.org/10.2307/356589

Rovelli, L., & De la Fare, M. (2021). Mutar sin retroceder: Formación e inserción doctoral en transición hacia la educación superior en pospandemia. *Revista Mexicana de Investigación Educativa*, *26*(91), 1245–1266.

Ruud, C. M., Saclarides, E. S., George-Jackson, C. E., & Lubienski, S. T. (2018). Tipping points: Doctoral students and consideration of departure. *Journal of College Student Retention: Research, Theory & Practice*, *20*(3), 286–307. https://doi.org/10.1177/1521025116666082

Sala-Bubaré, A., & Castelló, M. (2017). Exploring the relationship between doctoral students' experiences and research community positioning. *Studies in Continuing Education*, *39*(1), 16–34. https://doi.org/10.1080/0158037X.2016.1216832

Saldana, J. (2021). The Coding Manual for Qualitative Researchers. *The Coding Manual for Qualitative Researchers*, 1–440.

Sallee, M. W. (2011a). Performing masculinity: Considering gender in doctoral student socialization. *The Journal of Higher Education*, *82*(2), 187–216. https://doi.org/10.1353/jhe.2011.0007

Sallee, M. W. (2011b). Toward a theory of gendered socialization. *NASPA Journal About Women in Higher Education*, *4*(2). https://doi.org/10.2202/1940-7890.1086

Schneegans, S., Straza, T., & Lewis, J. (Eds.). (2021). *UNESCO science report: The race against time for smarter development*. UNESCO Publishing.

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

SIES. (2020a). *Base de Datos Matrícula 2020 (Pregrado y Postgrado). Evolución Matrícula de Postgrado 2007– 2020.* c. https://www.mifuturo.cl/informes-de-matricula/v

SIES. (2020b). *Base de Datos Titulación 2020. Evolución Titulación de Posgrado 2007 – 2020*. Servicio de Información de Educación Superior. Ministerio de Educación de Chile. www.mifuturo.cl/informes-de-titulacion/

SIES. (2021a). *Duración Real y Sobreduración de las Carreras de Educación Superior (2010 – 2021).* Servicio de Información de Educación Superior. Ministerio de Educación de Chile. https://www.mifuturo.cl/informes-de-duracion-real-y-sobreduracion/

SIES. (2021b). *Instituciones de educación superior vigentes*. Servicio de Información Educación Superior. Ministerio de Educación de Chile. https://www.mifuturo.cl/instituciones-de-educacion-superior-en-chile/

SIES. (2022a). *Base Matrícula Histórica 2007 – 2022*. Servicio de Información de Educación Superior. Ministerio de Educación de Chile. https://www.mifuturo.cl/bases-de-datos-de-matriculados/

SIES. (2022b). *Informe Personal Académico en Educación Superior 2022*. The Higher Education Information Service (SIES) Chile Ministry of Education. https://www.mifuturo.cl/informes-personal-academico/

Skakni, I. (2018a). Doctoral studies as an initiatory trial: Expected and taken-for-granted practices that impede PhD students' progress. *Teaching in Higher Education*, *23*(8), 927–944. https://doi.org/10.1080/13562517.2018.1449742

Skakni, I. (2018b). Reasons, motives, and motivations for completing a PhD: A typology of doctoral studies as a quest. *Studies in Graduate and Postdoctoral Education*, *9*(2), 197–212. https://doi.org/10.1108/SGPE-D-18-00004

Skopek, J., Triventi, M., & Blossfeld, H.-P. (2022). How do institutional factors shape PhD completion rates? An analysis of long-term changes in a European doctoral program. *Studies in Higher Education*, *47*(2), 318–337. https://doi.org/10.1080/03075079.2020.1744125

Smagorinsky, P. (2008). The method section as conceptual epicenter in constructing social science research reports. *Written Communication*, *25*(3), 389–411. https://doi.org/10.1177/0741088308317815

Sverdlik, A., C. Hall, N., McAlpine, L., & Hubbard, K. (2018). The PhD experience: A review of the factors influencing doctoral students' completion, achievement, and well-being. *International Journal of Doctoral Studies*, *13*, 361–388. https://doi.org/10.28945/4113

Tao, K. W., & Gloria, A. M. (2019). Should I stay or should I go? The role of impostorism in STEM persistence. *Psychology of Women Quarterly*, *43*(2), 151–164. https://doi.org/10.1177/0361684318802333

Terrell, S., Snyder, M., Dringus, L., & Maddrey, E. (2012). A grounded theory of connectivity and persistence in a limited residency doctoral program. *The Qualitative Report*. https://doi.org/10.46743/2160-3715/2012.1747

Thiry, H., L Laursen, S., & G. Loshbaugh, H. (2015). "How do I get from here to there?" An examination of Ph.D. science students' career preparation and decision making. *International Journal of Doctoral Studies*, *10*, 237–256. https://doi.org/10.28945/2280

Thomson, P., & Walker, M. (2010). Doctoral education in context. The changing nature of the doctorate and doctoral students. In *The Routledge doctoral student's companion* (pp. 27–44). Routledge.

Tierney, G. (1997). Organizational socialization in higher education. *Journal of Higher Education*, *68*(1), 1–16.

Torche, F. (2005). Privatization reform and inequality of educational opportunity: The case of Chile. *Sociology of Education*, *78*(4), 316–343.

Torka, M. (2020). Change and continuity in Australian doctoral education: PhD completion rates and times (2005-2018). *The Australian Universities' Review*, *62*(2), 69–82.

Torrance, M., Thomas, G. V., & Robinson, E. J. (1994). The writing strategies of graduate research students in the social sciences. *Higher Education*, *27*(3), 379–392.

Twale, D. J., Weidman, J. C., & Bethea, K. (2016). Conceptualizing Socialization of graduate students of color: Revisiting the Weidman-Twale-Stein framework. *Western Journal of Black Studies*, *40*(2), 80–94.

Ülkü-Steiner, B., Kurtz-Costes, B., & Kinlaw, C. R. (2000). Doctoral student experiences in gender-balanced and male-dominated graduate programs. *Journal of Educational Psychology*, *92*(2), 296–307. https://doi.org/10.1037/0022-0663.92.2.296

Uqdah, A. L., Tyler, K. M., & DeLoach, C. (2009). Academic attitudes and psychological well-being of Black American psychology graduate students. *Negro Educational Review*, *60*, 23–38.

Van de Schoot, R., Yerkes, M. A., Mouw, J. M., & Sonneveld, H. (2013). What took them so long? Explaining PhD delays among doctoral candidates. *PLoS ONE*, *8*(7), 1–11. https://doi.org/10.1371/journal.pone.0068839

Véliz, D. (2020). The socialization of international doctoral students in the USA. In J. C. Weidman & L. DeAngelo (Eds.), *Socialization in Higher Education and the Early Career* (Vol. 7, pp. 149–160). Springer International Publishing. https://doi.org/10.1007/978-3-030-33350-8_9

Virtanen, V., & Pyhältö, K. (2012). What engages doctoral students in biosciences in doctoral studies? *Psychology*, *03*(12), 1231–1237. https://doi.org/10.4236/psych.2012.312A182

Wainerman, C., & Matovich, I. (2016). El desempeño en el nivel doctoral de educación en cifras: Ausencia de información y sugerencias para su producción. *Education Policy Analysis Archives*, *24*, 124. https://doi.org/10.14507/epaa.24.2584

Walczak, M., Dermmer, A., Zapata Larraín, G., Lange, M. A., & Reyes, M. (2017). *Acreditación de doctorados vinculados a la industria- Análisis de buenas prácticas internacionales y lineamiento para su desarrollo en Chile.* https://repositorio.uc.cl/handle/11534/37009

Weidman, J. C., & Stein, E. L. (2003). Socialization of doctoral students to academic norms. *Research in Higher Education*, *44*(6), 641–656.

Weidman, J. C., Twale, D. J., & Stein, E. L. (2001). *Socialization of graduate and professional students in higher education: A perilous passage?* Jossey-Bass and ERIC Clearinghouse on Higher Education, Association for the Study of Higher Education, Graduate School of Education and Human Development, the George Washington University.

Wenworth, W. M. (1980). *Context and understanding: An inquiry into socialization theory*. Elsevier.

Wildy, H., Peden, S., & Chan, K. (2015). The rise of professional doctorates: Case studies of the doctorate in education in China, Iceland and Australia. *Studies in Higher Education*, *40*(5), 761–774. https://doi.org/10.1080/03075079.2013.842968

Williams, M. S., Brown Burnett, T. J., Carroll, T. K., & Harris, C. J. (2018). Mentoring, managing, and helping: A critical race analysis of socialization in doctoral education. *Journal of College Student Retention: Research, Theory & Practice*, *20*(2), 253–278. https://doi.org/10.1177/1521025116657834

Wofford, A. M., & Blaney, J. M. (2021). (Re)Shaping the socialization of scientific labs: Understanding women's doctoral experiences in STEM lab rotations. *The Review of Higher Education*, *44*(3), 357–386. https://doi.org/10.1353/rhe.2021.0001

Zheng, G. (2019). Deconstructing doctoral students' socialization from an institutional logics perspective: A qualitative study of the socialization of Chinese doctoral students in Finland. *Frontiers of Education in China*, *14*(2), 206–233. https://doi.org/10.1007/s11516-019-0011-y

Zhou, E., & Okahana, H. (2019). The role of department supports on doctoral completion and time-to-degree. *Journal of College Student Retention: Research, Theory & Practice*, *20*(4), 511–529. https://doi.org/10.1177/1521025116682036

# APPENDIX A

## LIST OF CNA-ACCREDITED DOCTORAL PROGRAMS IN FIELDS OF ENGINEERING AND TECHNOLOGY IN CHILEAN UNIVERSITIES

| | Original Name Program | Institution | Accreditation Years |
|---|---|---|---|
| 1 | DOCTORADO EN BIOTECNOLOGÍA | PONTIFICIA UNIVERSIDAD CATÓLICA DE VALPARAÍSO / UNIVERSIDAD TÉCNICA FEDERICO SANTA MARÍA | 6 |
| 2 | DOCTORADO EN BIOTECNOLOGÍA | UNIVERSIDAD DE SANTIAGO DE CHILE | 6 |
| 3 | DOCTORADO EN CIENCIAS DE LA INGENIERÍA, ÁREA INGENIERÍA CIVIL | PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE | 8 |
| 4 | DOCTORADO EN CIENCIAS DE LA INGENIERÍA ÁREA INGENIERÍA MECÁNICA | PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE | 4 |
| 5 | DOCTORADO EN INGENIERÍA DE PROCESOS DE MINERALES | UNIVERSIDAD DE ANTOFAGASTA | 6 |
| 6 | DOCTORADO EN CIENCIAS DE LA INGENIERÍA MENCIÓN FLUIDODINÁMICA | UNIVERSIDAD DE CHILE | 5 |
| 7 | DOCTORADO EN CIENCIAS DE LA INGENIERÍA MENCIÓN MODELACIÓN MATEMÁTICA | UNIVERSIDAD DE CHILE | 9 |
| 8 | DOCTORADO EN SISTEMAS DE INGENIERÍA | UNIVERSIDAD DE TALCA | 3 |
| 9 | DOCTORADO EN CIENCIA E INGENIERÍA DE MATERIALES | UNIVERSIDAD DE CONCEPCIÓN | 7 |
| 10 | DOCTORADO EN CIENCIAS DE LA INGENIERÍA CON MENCIÓN EN INGENIERÍA ELÉCTRICA | UNIVERSIDAD DE CONCEPCIÓN | 7 |
| 11 | DOCTORADO EN CIENCIAS DE LA INGENIERÍA MENCIÓN CIENCIA E INGENIERÍA DE LOS MATERIALES | UNIVERSIDAD DE SANTIAGO DE CHILE | 6 |
| 12 | DOCTORADO EN CIENCIAS DE LA INGENIERÍA MENCIÓN INGENIERÍA DE PROCESOS | UNIVERSIDAD DE SANTIAGO DE CHILE | 5 |
| 13 | DOCTORADO EN INGENIERÍA ELECTRÓNICA | UNIVERSIDAD TÉCNICA FEDERICO SANTA MARÍA | 7 |
| 14 | DOCTORADO EN INGENIERÍA INFORMÁTICA | UNIVERSIDAD TÉCNICA FEDERICO SANTA MARÍA | 4 |
| 15 | DOCTORADO EN INGENIERÍA INFORMÁTICA | PONTIFICIA UNIVERSIDAD CATÓLICA DE VALPARAÍSO | 4 |
| 16 | DOCTORADO EN CIENCIAS DE LA COMPUTACIÓN | UNIVERSIDAD DE CONCEPCIÓN | 4 |
| 17 | DOCTORADO EN INGENIERÍA EN SISTEMAS COMPLEJOS | UNIVERSIDAD ADOLFO IBÁÑEZ | 4 |
| 18 | DOCTORADO EN INGENIERÍA EN ALIMENTOS Y BIOPROCESOS | UNIVERSIDAD DE LA SERENA | 3 |
| 19 | DOCTORADO EN CIENCIAS DE LA INGENIERÍA, MENCIÓN INGENIERÍA QUÍMICA Y BIOTECNOLOGÍA | UNIVERSIDAD DE CHILE | 5 |

| | | | |
|---|---|---|---|
| 20 | DOCTORADO EN INGENIERÍA INDUSTRIAL E INVESTIGACIÓN DE OPERACIONES | UNIVERSIDAD ADOLFO IBÁÑEZ | 3 |
| 21 | DOCTORADO EN CIENCIAS DE LA INGENIERÍA MENCIÓN BIOPROCESOS | UNIVERSIDAD DE LA FRONTERA | 3 |
| 22 | DOCTORADO EN COMPUTACIÓN | UNIVERSIDAD DE CHILE | 7 |
| 23 | DOCTORADO EN INGENIERÍA MECÁNICA | UNIVERSIDAD DE CHILE | 3 |
| 24 | DOCTORADO EN ENERGÍA, AGUA Y MEDIO AMBIENTE | UNIVERSIDAD DE LA SERENA | 2 |
| 25 | DOCTORADO EN ENERGÍA SOLAR | UNIVERSIDAD DE ANTOFAGASTA | 3 |
| 26 | DOCTORADO EN INGENIERÍA BIOLÓGICA Y MÉDICA | PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE | 3 |
| 27 | DOCTORADO EN CIENCIAS DE LA INGENIERÍA ÁREA CIENCIA DE LA COMPUTACIÓN | PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE | 5 |

Data was retrieved from the National Accreditation Agency (CNA) on November 1, 2021.

Note: In terms of geographical location, 50% (n=13/26) of programs' institutions operate in regions, and the other 50% concentrate in the capital city. Concerning state control, this is whether they are public or private, 50% (n=13/26) of doctoral programs in engineering and technology are in public institutions, and 50% are in private universities. Finally, 94% (n=25/26) programs are part of the CRUCH, while 6% is in a non- CRUCH institution (n=1/26) (CNA, 2021).

This list excludes 18 other programs from a total of 44 currently in operation, which by November 1, 2021, remained in process or not accredited by CNA.

# APPENDIX B

## INSTITUTION INVITATION LETTER

<DATE>

<INCLUDE NAME>
<POSITION>

Dear <INCLUDE NAME>,

I am a doctoral student under the direction of Professors Dr. Jeongeun Kim and Dr. Gustavo Fischman in the Mary Lou Fulton Teachers College at Arizona State University. I am conducting a research study to examine the socialization experiences of current students at the different phases of engineering and technology (E&T) doctoral programs in Chilean higher education institutions. This study also aims to explore students' perceptions of the impact of socialization on their advancement in the program and success post-graduation.

Therefore, the information gained through this study will hopefully benefit the doctoral program and institution by offering insights on students' interactions with program structures, faculty, and peers at different phases of their program and perceptions on socialization on their advancement in the program and success post-graduation. In addition, I hope that this study can also explore issues of attrition, delay in graduation time, and post-graduation success in doctoral programs in Chile.

Thus, I am requesting your support as head of the program to disseminate an invitation to all current students for a brief background questionnaire and individual interview via Zoom. The questionnaire includes questions about your personal and student characteristics, while the interview contains 24 questions and subquestions. Participation is expected to take between 60-90 minutes for the participants to complete.

I will record this interview using Zoom. Zoom records an audio and video track of the interview. The research team will retain only the audio track for analysis. The interview will not be recorded without students' permission. If students would like to participate in an audio only interview, they will be able to turn off their camera. They also will be asked if they do not want the interview to be recorded; and change their mind after the interview starts. Finally, Zoom also generates a verbal transcript. The research team will also retain the transcripts for analysis.

Students interested in participating will be able to directly schedule an appointment at https://calendly.com/iparra2/minutes_90, which will lead to further individual direct communications with me. To compensate for students' participation, they will receive a gift card, equivalent to US$12 (approximately CL$10).

This study has been reviewed and approved by the ASU Institutional Review Board (STUDY00014791: Socialization of Doctoral Students in Chile) to ensure participants in this study are treated ethically and that their rights and welfare are adequately protected. If you have any questions concerning the research study, please contact the research team at: Jeongeun.Kim@asu.edu or 1(480) 727-2425, and at fischman@asu.edu or (480) 965-

5225. 1. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at 1 (480) 965-6788.

I greatly appreciate your time and collaboration. I am sure experiences from doctoral students will be a source of learning for all those involved in doctoral education in Chile and advance research on Chilean higher education.

Sincerely,

**Ivet Parra-Gaete**
*(Pronouns she, her, hers)*
Ed.M. Higher and Postsecondary Education
Ph.D. Candidate and Research Assistant
Educational Policy and Evaluation (EPE)
**Mary Lou Fulton Teachers College**
**Arizona State University**
1(480) 553 4037
iparra2@asu.edu

# APPENDIX C

## STUDENTS' LETTER INVITATION

<DATE>

Dear doctoral student,

I am a doctoral student under the direction of Professors Dr. Jeongeun Kim and Dr. Gustavo Fischman in the Mary Lou Fulton Teachers College at Arizona State University. I am conducting a research study to examine the socialization experiences of current students at the different phases of engineering and technology (E&T) doctoral programs in Chilean higher education institutions. This study also aims to explore students' perceptions of the impact of socialization on their advancement in the program and success post-graduation.

I am inviting your participation, which will involve answering a brief background questionnaire and individual interviews via Zoom in Spanish. The questionnaire includes twelve multiple-choice checkboxes and short answer questions about your personal and student characteristics. The interview contains 24 questions and subquestions. Participation is expected to take between 60-90 minutes for the participants to complete. You have the right not to answer any question and to stop participation at any time.

You must be 18 or older to participate in this study and be registered for the 2021 Chilean academic year at an engineering and technology accredited doctoral program at a higher education institution located in Chile.

Your responses will be anonymous. The results of this study may be used in reports, presentations, or publications, but your name will not be used. Results will only be shared in the
aggregate form, while de-identified data collected as a part of the current study will be shared with investigators and higher education leaders for future research purposes and evaluation uses.

I will record this interview using Zoom. Zoom records an audio and video track of the interview. The research team will retain only the audio track for analysis. The interview will not be recorded without your permission. If you want to participate in an audio-only interview, turn off your camera. Please let me know if you do not want the interview to be recorded; you also can change your mind after the interview starts, just let me know. Finally, Zoom also generates a verbal transcript. The research team will also retain the transcripts for analysis.

To compensate for your time and effort, you will receive a gift card, equivalent to US$12 (approximately CL$10).

Thank you for your time and your willingness to help. Sincerely,

**Ivet Parra-Gaete**
*(Pronouns she, her, hers)*
Ed.M. Higher and Postsecondary Education
Ph.D. Candidate and Research Assistant
Educational Policy and Evaluation (EPE)
**Mary Lou Fulton Teachers College**
**Arizona State University**
1(480) 553 4037
iparra2@asu.edu

# APPENDIX D

## COMPLETE CONSTRUCTS, DEFINITIONS, AND INTERVIEW QUESTIONS

| Section in Interview | Construct | Scholarship | Construct Definition | Interview Questions |
|---|---|---|---|---|
| Socialization of students during the application process until before attending courses | Support | (Baird & Haworth, 2004; Gardner, 2008; 2009; Greene, 2015) | Any form of help students perceived from the program or institutions, staff, faculty, or peers. | Thinking about the application process until you enroll in the program,<br>1. How would you describe this process?<br>2. Any particular person or resource in the program who were helpful or relevant during this process?<br>2a. Why was this the case? Can you describe this situation?<br>3. If you recall, what were the most complicated/difficult factors/situations as you entered the program? (e.g., financial, housing, paperwork)<br>3.a. How did you solve any issues at this phase?<br>3.b. Did the program or anybody in it help you solve the situation (financial, housing, paperwork)?<br>3.c. If yes, how? |
| | Program climate | (Berger & Milem, 2000; Pyhältö et al., 2009; Stein & Weidman 1989, Weidman & Stein 2003). | Students perceive different aspects as the program/ department's patterns of norms, values, practices, beliefs, and assumptions that guide the behavior of individuals and their interactions. | |
| | Challenge(s) | (Sandford, 1966; Gardner, 2009) | Any form of difficulty students perceived to encounter during this period. | |
| Socialization of students during course taking period, qualification exams, and dissertation | **Program Structure** | | | |
| | Level of knowledge about the program structure | (Golde, 1996, Gardner, 2007) | In what ways students perceive they knew about different aspects of their program. | 4. How familiar were you with the program requirements, costs, organization, graduation times, communication, and support during your first year?<br>4.a. Has your knowledge about these aspects changed over the years?<br>4.b. If yes, how has it changed? What do you know now that |
| | Program climate | (Pyhältö et al., 2009; Stein & Weidman, 1989; Weidman & Stein, 2003) | Different aspects students perceive as the program/ department's culture or patterns of norms, values, practices, beliefs, and assumptions that guide the behavior of | |

| Section in Interview | Construct | Scholarship | Construct Definition | Interview Questions |
|---|---|---|---|---|
| | | | individuals and their interactions. | you did not know in the first year?<br>4.c. What person or resource has been the most helpful to learn about diverse aspects of the program?<br>5. How would you describe the relationships among faculty, faculty-students, and students in the program when you first came in? (Prompt: If you had to explain to prospective students how the climate among people in the program is, what would you tell them?)<br>5.a. How do you perceive these relationships now?<br>5.b. Has your perception changed over time?<br>5.c. If yes, how have these relationships changed?<br>6. How integrated do you feel in the doctoral program community?<br>6.a. Anything that makes you feel that way?<br>6.b. Has this changed over the years?<br>6.c. If yes, how has it changed? |
| | Support systems | (Baird & Haworth, 2004; Gardner, 2008; 2009b; Greene, 2015) | Forms in which students perceive the program, institutions, staff, faculty, or peers helping. | |
| | Sense of belonging | (Golde, 1998; Lin, 2012; Zhen, 2019) | How students perceive themselves as accepted, included, and identified as a member of the Program community. | |
| | **Student-Faculty Relationship** | | | |
| | Relationship with the advisor(s) | (Barnes et al., 2010; McAlpine, & McKinnon, 2013; Pyhältö et al., 2015) | Perceptions of the different interactions with the advisor(s) over time. | Thinking about your interactions with your advisor,<br>7. How were you assigned to your advisor in the first place and started to work with him/her?<br>8. How would you describe the relationship |
| | Support from advisor to | (McAlpine et al., 2020; | Ways in which students perceived | |

| Section in Interview | Construct | Scholarship | Construct Definition | Interview Questions |
|---|---|---|---|---|
| | academic progress and complete program | Pyhältö et al., 2015, Skopek et al., 2022). | their advisor(s) assisted them in making academic progress and completing the program. | with your advisor during your first year? (Think of communication, attention to your needs as student/scholar)<br>9. Has this relationship changed over time?<br>9a. If yes, how?<br>10. Has your advisor supported you to progress and complete the program?<br>10.a. If yes, how?<br>10.b. Has your advisor supported you to become part of the program?<br>10.c. If yes, how?<br>10.d. Has your advisor supported you to become part of your field community?<br>10.e. If yes, how? |
| | Support from advisor(s) to increase the sense of belonging to program/ department/field or scholarly communities | (McAlpine et al., 2020; Pyhältö et al., 2015, Skopek et al., 2022). | Ways in which students perceived their advisor(s) were facilitating their sense of belonging to program/ department/field or scholarly communities. | |
| | Relationships with other faculty in the program | (McAlpine et al., 2020; Pyhältö et al., 2015, Skopek et al., 2022). | Interactions with other faculty and the nature of the interaction. | 11. In what situations have you interacted with the program faculty? (Different from advisor)<br>11.a. How did you start the contact/work/ engagement with them?<br>11.b. Can you please describe these relationships? Can you provide an example(s) of one relationship you want to highlight? |
| | **Student-Student Relationship** | | | |
| | Relationships with peers | | Interactions with other fellow students in the same program, over time. | Thinking about your interactions with other doctoral students (peers) during your first year,<br>12. Can you provide examples of some relationships with your |

| Section in Interview | Construct | Scholarship | Construct Definition | Interview Questions |
|---|---|---|---|---|
| | | | | peers during the first year?<br>13. Who are you most close with?<br>13.a. Any particular reason?<br>14. Have relationships with your peers changed over time?<br>14a. If yes, how? |
| Socialization experiences and advancement in the program | Academic advancement | (Kim & Ott, 2010) | The program's academic milestones (completion of required courses, qualification exams, proposal defense, and dissertation) were achieved within the program's given time to completion. | 15. What is the expected timeline for completion?<br>16. How would you describe your academic progress in that timeline?<br>16.a. What reasons have influenced your progress within this timeline?<br>16.b. Are you thinking about taking more time to complete your degree? If yes, why?<br>16.c. Have you ever thought about quitting the program?<br>17. If you are already working on your dissertation, can you tell me the topic and how the program has helped (if it has) in this process (lab, funding, closer supervision)?<br>18. What other resources/activities have been organized by your program/institution to help you complete the program?<br>18.a. Can you provide some examples? |

| Section in Interview | Construct | Scholarship | Construct Definition | Interview Questions |
|---|---|---|---|---|
| | | | | 18.b. What do you think about the resources/activities provided? How did you access them?<br>19. Who would you say has helped you the most to complete the program?<br>19.a. How have they helped you? How did you meet?<br>19.b. Why have they been of help? |
| Socialization and success post-graduation | Preparedness post-graduation | (Golde & Dore 2001; Mello et al., 2015) | | 20. What are your plans after degree completion?<br>21. Do you feel prepared to meet your post-graduation plans?<br>21.a. Why is that the case?<br>22. What resources/activities would you say have been available to you throughout the program to prepare you for post-graduation plans?<br>22.a. Can you provide some examples? |

| Section in Interview | Construct | Scholarship | Construct Definition | Interview Questions |
|---|---|---|---|---|
| Final Questions | | | | 23. Would you like to add anything else that has been relevant to your experience as a doctoral student?<br>24. If you could design a doctoral program, what would you do differently from what you have/experience?<br>Thank you for your time and valuable contribution to this study. Please let me know if you have further questions about this interview and the study. Thank you, for your time and valuable contribution to this study. Please let me know if you have further questions about this interview and the study. |

# APPENDIX E

# INDIVIDUAL INTERVIEW PROTOCOL

DATE _____
PARTICIPANT PSEUDONYM _____

**(1) SOCIALIZATION OF STUDENTS DURING THE APPLICATION PROCESS THROUGH COURSEWORK BEGINS (ADMISSION PHASE)**

Thinking about the application process until you enroll in the program,
1. How would you describe this process?
2. Any particular person or resource in the program who were helpful or relevant during this process?
    2a. Why was this the case? Can you describe this situation?
3. If you can recall, what were the most complicated/difficult factors/situations as you entered the program? (e.g., financial, housing, paperwork)
    3.a. How did you solve any issues at this phase?
    3.b. Did the program or anybody in it help you solve the situation (financial, housing, paperwork)?
    3.c. If yes, how?

**(2) SOCIALIZATION OF STUDENTS OVER THE YEARS (COURSEWORK AND THESIS PHASES)**

***EDUCATIONAL SETTING***
4. During your first year, how familiar were you with the program requirements, costs, organization, graduation times, communication, and support available?
    4.a. Has your knowledge about these aspects changed over the years?
    4.b. If yes, how has it changed? What do you know now that you did not know in the first year?
    4.c. What person or resource has been the most helpful to learn about diverse aspects of the program?
5. How would you describe the relationships among faculty, faculty-students, and students in the program when you first came in? (Prompt: If you had to explain to prospective students how the climate among people in the program is, what would you tell them?)
    5.a. How do you perceive these relationships now?
    5.b. Has your perception changed over time?
    5.c. If yes, how have these relationships changed?
6. How integrated do you feel in the doctoral program community?
    6.a. Anything in particular that makes you feel that way?
    6.b. Has this changed over the years?
    6.c. If yes, how has it changed?

***STUDENT - FACULTY RELATIONSHIPS***

ADVISOR

Thinking about your interactions with your advisor,

7. How were you assigned to your advisor in the first place and started to work with him/her?

8. How would you describe the relationship with your advisor during your first year? (think of communication, attention to your needs as student/scholar)

9. Has this relationship changed over time?

9a. If yes, how?

10. Has your advisor supported you to progress and complete the program?

10.a. If yes, how?

10.b. Has your advisor supported you to become part of the program?

10.c. If yes, how?

10.d. Has your advisor supported you to become part of your field community?

10.e. If yes, how?

INSTRUCTORS/OTHER FACULTY

11. In what situations have you interacted with the program faculty? (different from advisor)

How did you start the contact/work/ engagement with them?

11.a. Can you please describe these relationships? Can you provide an example(s) of one relationship you want to highlight?

***STUDENT - STUDENT RELATIONSHIPS***

Thinking about your interactions with other doctoral students (peers) during your first year,

12. Can you provide examples of some relationships with your peers during the first year?

13. Who are you most close with?

13.a. Any particular reason?

14. Have relationships with your peers changed over time?

14a. If yes, how?

**(3) SOCIALIZATION AND PROGRESS IN THE PROGRAM**

PROGRESS, SUPPORT FOR PROGRESS, AND COMPLETION

15. What is the expected timeline for completion?

16. How would you describe your academic progress thinking in that timeline?

16.a. What reasons have influenced your progress within this timeline?

16.b. Are you thinking about taking more time to complete your degree? If yes, why?

16.c. Have you ever thought in quitting the program?

17. If you are already working on your dissertation, can you tell me the topic and how the program has helped (if it has) in this process (lab, funding, closer supervision)?

18. What other resources/activities have been organized by your program/institution to help you complete the program?

18.a. Can you provide some examples?

18.b. What do you think about the resources/activities provided? How did you access to them?

19. Who would you say has helped you the most to complete the program?

19.a. How have they helped you? How did you meet?

19.b. Why have they been of help?

**(4) SOCIALIZATION AND SUCCESS POST-GRADUATION**

*PREPAREDNESS POST-GRADUATION*

20. What are your plans after degree completion?

21. Do you feel prepared to meet your post-graduation plans?

21.a. Why is that the case?

22. What resources/activities would you say have been available to you throughout the program to prepare you for post-graduation plans?

22.a. Can you provide some examples?

**FINAL QUESTIONS**

23. Would you like to add anything else that has been relevant to your experience as a doctoral student?

24. If you could design a doctoral program, what would you do differently from what you have/experience?

Thank you for your time and valuable contribution to this study. Please let me know if you have further questions about this interview and the study.

# APPENDIX F

## CONSIDERATIONS FOR A ZOOM INTERVIEW

*Before the interview, please:*

- Find a place with a stable Internet connection.
- Make sure you are connected to a trusted device.
- Download or update and test the software if necessary.
- If you prefer, you can remove your name from the screen.

*Interview day*

- Make sure your device is charged or charging before the interview.
- Make sure that the space where we communicate is private.
- Anticipate interruptions and minimize distractions (phone, people, etc.)
- Please close non-essential apps during the interview.

*During the interview*

- Please keep your phone on silent.
- Let the interviewer know if you need to attend to an unavoidable matter.
- Try to offer as many details as possible, descriptions, and examples.
- Stay flexible and calm if there is a technical problem.
- Express yourself calmly and as clearly as possible.
- Be open to repeating answers and questions.

*THANK YOU!*

Based on Seitz's (2016) checklist of recommendations for online interviewing.

# APPENDIX G

## STUDENT CONSENT FORM

<DATE>

Dear doctoral student,

I am a doctoral student under the direction of Professors Dr. Jeongeun Kim and Dr. Gustavo Fischman in the Mary Lou Fulton Teachers College at Arizona State University. I am conducting a research study to examine the socialization experiences of current students at the different phases of engineering and technology (E&T) doctoral programs in Chilean higher education institutions. This study also aims to explore students' perceptions of the impact of socialization on their advancement in the program and success post-graduation.

I am inviting your participation, which will involve answering a brief background questionnaire and individual interview via Zoom in Spanish. The questionnaire includes twelve multiple-choice checkboxes, and short answer questions about your personal and student characteristics. The interview contains 24 questions and subquestions. Participation is expected to take between 60-90 minutes for the participants to complete. You have the right not to answer any question, and to stop participation at any time.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. You must be 18 or older to participate in this study and be registered for the 2021 Chilean academic year at an engineering and technology accredited doctoral program at a higher education institution located in Chile. There are no foreseeable risks or discomforts to your participation.

Your responses will be anonymous. The results of this study may be used in reports, presentations, or publications but your name will not be used. Results will only be shared in the
aggregate form, while de-identified data collected as a part of the current study will be shared with investigators and higher education leaders for future research purposes and evaluation uses.

I will record this interview using Zoom. Zoom records an audio and video track of the interview. The research team will retain only the audio track for analysis. The interview will not be recorded without your permission. If you would like to participate in an audio only interview, turn off your camera. Please let me know if you do not want the interview to be recorded; you also can change your mind after the interview starts, just let me know. Finally, Zoom also generates a verbal transcript. The research team will also retain the transcripts for analysis.

To compensate for your time and effort, you will receive a gift card, equivalent to US$12 (approximately CL$10). The information to redeem the gift card will be communicated after the interview by personal email. No other compensation nor credit will be given in exchange for your participation.

If you have any questions concerning the research study, please contact the research team at: Jeongeun.Kim@asu.edu or 1(480) 727-2425, and fischman@asu.edu or (480) 965-

5225. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at 1 (480) 965-6788.

By signing below, you are agreeing to be part of the study.

Name
Date (mm/dd/yy)
Signature

Thank you for your time and your willingness to help.

**Ivet Parra-Gaete**
*(Pronouns she, her, hers)*
Ed.M. Higher and Postsecondary Education
Ph.D. Candidate and Research Assistant
Educational Policy and Evaluation (EPE)
**Mary Lou Fulton Teachers College**
**Arizona State University**
1(480) 553 4037
iparra2@asu.edu

# APPENDIX H

## BACKGROUND INFORMATION QUESTIONNAIRE

In the following section, you will answer questions related to your personal and student background. This information will remain anonymous and identifiable information will be removed to provide confidentiality and protect your privacy.

Thank you for your time and your willingness to help. Please let me know if you have further questions about this section.

1. What is your gender?

Female
Male
I prefer not to say.
Other _____

2. What is your age?

under 22
22-25
26-29
30-34
35-39
40-49
50 and above

3. What activity(es) better represents your occupation right before entering the doctoral program? Select all applicable answers.

Undergraduate student
A graduate student (master's)
A graduate student (other Ph.D.)
Worked on research activities.
Worked in non-research activities

4. What group better represents your family's socioeconomic background as you grew up?

Upper
Upper middle
Middle
Working
Lower
Not sure

5. What statement better describes your current marital status?

Single (never married)
Married, or in a domestic partnership.
Widowed
Divorced
Separated

Other _____

6. If you already have children, how many do you have?

1
2
More than 2
No children

7. What is the name of your doctoral program?

_____

8. What year did you start your program?

2021
2020
2019
2018
2017before

9. What program milestones are you currently working on? Select all responses that apply.

Coursework
Qualification exams
Dissertation
Other _____

10. Did you stop the program and come back?

Yes
No

11. Are you a domestic or international student?

Domestic student
International student

0. What is your country of origin?

_____

# APPENDIX I

## IRB APPROVAL DOCUMENT

ASU Knowledge Enterprise Development

EXEMPTION GRANTED

Jeongeun Kim
Division of Educational Leadership and Innovation - Tempe
480/727-2425
Jeongeun.Kim@asu.edu

Dear Jeongeun Kim:

On 10/25/2021 the ASU IRB reviewed the following protocol:

| | |
|---|---|
| Type of Review: | Initial Study |
| Title: | Socialization of Doctoral Students. A Qualitative Analysis of Programs Within a Disciplinary Context in Chilean Universities. |
| Investigator: | Jeongeun Kim |
| IRB ID: | STUDY00014791 |
| Funding: | None |
| Grant Title: | None |
| Grant ID: | None |
| Documents Reviewed: | • Consent Form, Category: Consent Form;<br>• Interview Protocol, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);<br>• Parra IRB application , Category: IRB Protocol;<br>• Questionnaire , Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);<br>• Recruitment Institutions , Category: Recruitment Materials;<br>• Recruitment Students, Category: Recruitment Materials; |

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 10/25/2021.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

If any changes are made to the study, the IRB must be notified at research.integrity@asu.edu to determine if additional reviews/approvals are required. Changes may include but not limited to revisions to data collection, survey and/or interview questions, and vulnerable populations, etc.

REMINDER - All in-person interactions with human subjects require the completion of the ASU Daily Health Check by the ASU members prior to the interaction and the use of face coverings by researchers, research teams and research participants during the interaction. These requirements will minimize risk, protect health and support a safe research environment. These requirements apply both on- and off-campus.

The above change is effective as of July 29th 2021 until further notice and replaces all previously published guidance. Thank you for your continued commitment to ensuring a healthy and productive ASU community.

Sincerely,

IRB Administrator

cc: Ivet Marion Parra Gaete
Gustavo Fischman