ABSTRACT

TELLEZ BOHORQUEZ, FABIO ANDRES. Empathy Expression and Development in the Context of Industrial Design Education (Under the direction of Professor Meredith J. Davis)

This study explored the development and expression of empathy in industrial design education. The literature on current design approaches emphasizes the importance of empathy for designers to understand and connect with users and stakeholders so that designed products, services, environments, systems, and experiences meet human needs, expectations, and aspirations. However, literature in psychology reports a decline in empathy among American college students since the year 2000, which raises questions about how new generations of design students develop this ability. There is little empirical research that examines empathy development in design education, which represents a gap in the literature addressed by this dissertation. The study examined educational practices in the industrial design studio that had the potential to promote student empathy and how design students expressed empathy for users and stakeholders. The ultimate goal of the study was to contribute to the discussion of how to educate new generations of designers who are sensitive and responsive to people’s experience.

A mixed methods strategy was used to collect data from faculty and students in three courses in industrial design offered by a major land-grant public research university in the southeastern United States. The data collection techniques used were participant observation, semi-structured interviews, discourse analysis, document analysis, questionnaires, and surveys. The data analysis techniques used were thematic coding and memoing, visual
content analysis, quantification of qualitative data, correlational analysis, and analysis of variance (ANOVA).

The study found how faculty promoted student empathy through the project brief, design research, and dialogue and critique in the studio. Likewise, the studio found how students expressed empathy for users and stakeholders through their use of language, images, and design and research methods. The study concludes by discussing the implications of findings for design education at the classroom level, covering aspects such as the curricular structure of the design studio, project brief and problems posed to students, design and research methods used in the studio, and teaching and evaluation practices used by design faculty.
Empathy Expression and Development in the Context of Industrial Design Education

by
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DEDICATION

I dedicate this work to the two Amelias who have made an impact on my life:

To Amelia, my great grandmother, who tirelessly fought the circumstances to create opportunities for her family.

To Amelia, my daughter, who fills my days with joy and laughter and who embodies unconditional love and hope.

Also, I dedicate this work to my dear wife Meme, my parents Beatriz and Nelson, and my sisters Natalia and Sarita for their love, advice and support.
BIOGRAPHY

I am a design researcher and educator with a background in industrial design (BID) and pedagogy (M.Ed). My research area of interest is defined by the intersection of design, education, and psychology. I have explored topics related to design education, design-based learning, human-centered design, and empathy development. I have experience planning and conducting empirical research in educational settings combining qualitative and quantitative methods of inquiry. I have planned and taught courses on design thinking, human-centered design, and design research at multiple levels—elementary, secondary, and postsecondary—and in diverse cultural environments. Additionally, I have collaborated with experienced faculty in teaching courses in industrial and graphic design. I received my M.Ed. and BID from Universidad de los Andes in Bogota, Colombia.
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CHAPTER 1: INTRODUCTION

1.1. Personal Motivation

I would like to start my dissertation by sharing the personal motivations behind this study. I want to offer the reader an appropriate context to interpret my work but also I want to honor the circumstances that inspired my decision to study empathy and to explore educational strategies to promote it.

As I was growing up in Colombia, my great-grandmother Amelia used to take care of me while my parents were studying or working. She was a strong and cultured woman who used to captivate me with her many stories that intertwined the worlds of Scheherazade, Jean Valjean, and Colonel Aureliano Buendia. She was an avid reader who only attended primary school, as it was the tradition in rural Colombia in the early 20th century.

Around 1948, my great-grandmother and her family lost everything they had. They were violently expelled from their farm by armed groups that despised them for having different political opinions. My great-grandmother Amelia and her numerous family fled to Bogotá, the Colombian capital, seeking refuge with nothing more than a couple of trunks loaded with clothes. By the time I was born, my family had rebuilt their lives in the city, but the memory of the forced displacement stayed with them forever.

Learning about my family’s struggle impacted me deeply and made me think about the motives behind intolerance and ideological violence. Also, this experience inspired questions
that I explored in this dissertation at a personal level: How can we understand and connect emotionally with others despite our differences? How can educators promote respect and tolerance for others, especially for those who are perceived as different? How can design and design education contribute to build a more open and democratic society?

At the heart of these questions resides the concept of empathy—the ability to feel and understand other’s emotions and circumstances, which is discussed in this dissertation in the context of industrial design education.

1.2. The Role of Empathy in Society and Design

Empathy is considered one of the most important abilities for social interaction. It allows individuals to adopt the perspective of others, understand and feel their thoughts and feelings, and respond accordingly. This ability is associated with pro-social behavior and is characterized by reducing aggression, violence, and bullying. Empathy is considered a trait of emotional intelligence, a precursor to healthy human relations, and a catalyst for civic engagement. Consequently, empathy can be considered an instrument for resolving interpersonal differences and a skill that inhibits violence and aggression, fosters collaboration, and strengthens our social structures. Empathy, in sum, is essential for the quality and fluidity of our human relations (Howe, 2013; Gerdes et al., 2011; Baron-Cohen & Wheelwright, 2004; Gordon, 2001; Partnership for 21st Century Skills, 2003).
In the field of design, empathy is central to current approaches to problem-solving such as human-centered design, user-centered design, empathic design, co-design, and design thinking. Under these approaches, empathy is considered a fundamental ability for designers to acquire an in-depth understanding of people (i.e., end-users and other stakeholders) so that designed products, services, environments, systems, and experiences meet human needs, expectations, and aspirations. Likewise, empathy is integral to the design process; it enables practitioners to approach other people’s realities and perspectives, to uncover insights, and to develop solutions informed and inspired by people’s experiences and behavior. Additionally, empathy is an ability that promotes “people-centered” innovation, and a competency that is crucial to dealing with the complex socio-technical issues that humanity faces in the 21st century (Brown, 2009; Brown & Katz, 2011; IDEO, 2011; d.school, 2010; Plattner et al., 2012; Norman, 2014; Kouprie & Sleeswijk Visser, 2009; Dandavate et al., 1996; Carroll et al., 2010; Sanders, 2006a).

The recognition of empathy as an essential skill for the practice of design under current human-centered approaches reveals an important aspect of the role that designers play—or are expected to play in representing and advocating for users and stakeholders in projects and organization. The designers’ role has shifted from shaping the appearance of spaces, objects, and visual messages, to collaborating in the construction of interrelated systems—tangible and intangible—that are rooted in human and social experiences.
This shift has been part of a larger movement towards a postindustrial perspective (at least in the Western world) in which design has turned its focus from creating products to tailoring human-centered experiences. In this new scenario, design creates value by improving and enriching people’s physical, emotional and social interactions with objects and environments. In this scenario, designers are required to have a profound understanding of people’s different dimensions to create meaningful products, services, experiences, systems, and environments (Krippendorff, 2006; Sanders & Stappers, 2008; Norman, 2014; Davis, 2016).

1.3. Empathy in Decline

Despite the central role that empathy plays in society and the design field, there is empirical evidence that points to a decline in empathy since the year 2000 among American college students. Konrath and colleagues (2011) conducted a cross-temporal meta-analysis on 72 samples of students (N=13,737) who completed the Interpersonal Reactivity Index (IRI, a test frequently used to measure empathy) between 1979 and 2009. This study found a decrease in empathic concern and perspective-taking since 2000 (EC and PT are two of the four components of the IRI; the other two are fantasy and Personal Distress).

This decline, visually presented in Figure 1, represents a drop of 0.65 standard deviations on empathic concern and 0.44 standard deviations on perspective-taking when comparing and normalizing the results from 1979 and 2009. In terms of percentiles, these results indicate that while the average student in 1979 could be located at the 50th percentile of the distribution of EC or PT, the average student in 2009 could be placed at the 26th percentile of...
EC and the 33rd percentile of PT. This “represents a 48% decrease in EC and a 34% decrease in PT” (Konrath, O'Brien & Hsing, 2011, p. 186).

The causes of this situation are still undetermined. However, Konrath and colleagues suggest that this decline in empathy might be associated with phenomena such as the rise of narcissism, the impact of technology on how people communicate and interact, and the pursuit of more materialistic and individualistic life goals by successive generations (Konrath, O'Brien & Hsing, 2011).

**Figure 1.** Empathy in decline: American college student scores in empathic concern and perspective-taking by period 1979-2009 (Konrath, O'Brien & Hsing, 2011, p. 186).

1.4. Research Opportunity

The decline in empathy cannot be generalized to the entire American population since the studied samples correspond exclusively to college students. Given the social importance of this ability, however, the phenomenon calls for greater attention to its consequences. In the field of design (in which empathy is central for current human-centered approaches) the decline in college student empathy raises questions about how this ability is acquired, developed, and expressed by new generations of design students (who may be less empathic
than their predecessors), and about how design education contributes to the development of empathy.

Despite the relevance of these questions, there is little empirical research that examines empathy development in the fields of design and design education. The scarcity of research in these areas represents a gap in the literature that is addressed by this dissertation. Specifically, this dissertation explores educational practices that may intervene in the development of student empathy for people (end-users and stakeholders) in specific instances of design education.

1.5. Study Overview

With the purpose to contribute to the understanding of how empathy is expressed and developed through design education, the study started by exploring the concepts of empathy, human-centered design, and the design studio. The exploration of these topics informed and inspired the formulation of a conceptual framework along with a series of researchable questions aimed at identifying curricular, pedagogical, and methodological practices in design education that may contribute to students’ development of empathy for users.

The research questions informed the study’s methodology, which consisted on a mixed-methods strategy that combined qualitative and quantitative techniques to study three instances of industrial design instruction aiming at identifying the educational practices mentioned above and students’ expressions of empathy. Once the described study was
approved, data was collected during an academic semester from three courses in industrial
design offered by a major land-grant public research university in the southeastern United
States. For this purpose, techniques such as participant observation, semi-structured
interviews, discourse analysis, document analysis, questionnaires, and surveys were utilized.
The collected data was reduced and analyzed using techniques such as thematic coding for
the qualitative data, and analysis of variance and correlations for the quantitative data. These
analyses were combined, compared, integrated into a single and coherent set that is presented
and discussed in Chapter 5: Findings and Discussion.

These findings were used to propose a contextualized answer to the research questions,
showing how different curricular, pedagogical, and methodological approaches in the studied
instances of industrial design education may lead to a range of empathy expressions of
students for users. Finally, the study concludes by offering a series of evidence-based
recommendations and considerations aimed at promoting student empathy for users in
educational settings that are similar to the ones that were observed and analyzed.
CHAPTER 2: LITERATURE REVIEW

This chapter reviews the literature that informed the conceptual framework and research questions presented in Chapter 3. The reviewed literature covers three different areas: (1) Empathy as defined and characterized in psychology; (2) empathy as applied and discussed in design; and (3) practices and theories in design education. The purpose of reviewing these areas is to create for the reader a common framework of understanding of concepts and theories that informed and guided this study. Also, this review aims at identifying and relating this study to ongoing dialogues in design, education, and psychology.

2.1. Empathy from a Psychological Perspective

Empathy has received a lot of attention in recent years from a variety of disciplines. It has been studied and used as a framework for theories and applications in areas such as healthcare, education, business administration, political science, and design. However, the formulation and development of theories about empathy have occurred in the field of psychology. As a consequence, this section presents the definition, characterization, and operationalization that this field has built for empathy since the 19th Century. The following review aims at establishing a common ground for understanding the application of empathy in the context of design and design education.

2.1.1. Empathy Definition

The word empathy is derived from the Greek word ἐμπάθεια (empathia) which means “an active appreciation of another person's feeling experience” (Astin 1967, in Goldstein &
Michaels 1985, p. 1). British psychologist Edward Titchener coined the term in 1909 as an attempt to translate the German word *Einfühlung*. Used in philosophical discussions about aesthetics at the end of the 19th century (Howe, 2013), this German word described the human ability to get inside a work of art and “to project yourself into what you observe” (Baron-Cohen & Wheelwright, 2004, p. 163). Fast forwarding to present day, current views on empathy define it as the ability to identify, understand, and feel other individual's feelings, thoughts, and circumstances, and to respond consequently to them (Howe, 2013; Davis, 2006; Baron-Cohen, 2011; Gerdes et al., 2011).

This definition evidences the two apparently opposed perspectives that scholars have proposed for understanding empathy: empathy as a purely emotional phenomenon in which an individual shares the emotional state of another, and empathy as a purely cognitive phenomenon in which an individual accurately discerns the internal state of another (Davis, 2006).

Howe (2013) has acknowledged both approaches and characterizes empathy as an ability that encompasses emotional and cognitive responses. Similarly, Davis (1994; 2006) has asserted that empathy is a multidimensional phenomenon and has proposed an “organizational model” that aims to unify a broad range of constructs and ideas that researchers and theorists have associated with this ability. In the following sections, the two approaches to empathy mentioned above are discussed and the organizational model developed by Davis is presented.
2.1.2. Empathy Components

As previously stated, empathy encompasses an affective and a cognitive response that, according to Gerdes (2011) and Howe (2013), do not work independently but are interrelated: thought and feeling, cognition and affect, both act together to shape empathy. In Howe’s words, “[Empathy] consists of affective and cognitive responses, feeling what another person is feeling and understanding why that person feels as he or she does” (2013, p. 13).

Gerdes and colleagues agree that empathy is a “multidimensional construct that includes both bottom-up and top-down components” (2011, p. 112). In their definition of empathy, the bottom-up component (affective) is the unconscious recognition of another’s emotional state, while the top-down component (cognitive) is the conscious process that allows the subject to understand and even predict others’ behaviors (Gerdes et al., 2011).

The affective component of empathy is defined as “an observer’s emotional response to the affective state of another” (Baron-Cohen & Wheelwright, 2004, p. 164). This reaction includes physical and emotional involuntary reactions that are triggered by the affective situation of another. It is characterized by the ability to feel another’s feelings and is accompanied by the ability to distinguish that the origin of those feelings is the other, not the self (Gerdes, 2011; Howe, 2013).
The cognitive component of empathy is defined as a mental process aimed at understanding another’s thoughts and feelings. It is characterized by being a voluntary process that may take years to develop. The cognitive component of empathy is based on “seeing, imagining and thinking about a situation from the other person’s point of view” (Howe, 2013, p. 14). This reaction involves a change in perspective in which an individual adopts the view another person. In contrast with the affective component, the cognitive component requires that the empathizer has some knowledge of the another's context, history, and situation (Howe, 2013; Baron-Cohen & Wheelwright, 2004; Gerdes et al., 2011).

Some authors, including Gerdes and colleagues (2011), propose decision-making as the third component of empathy. Decision-making, in this context, is defined as the reaction that the observer has toward another, after going through an affective and/or cognitive processing of the other person’s feeling, thoughts, and circumstances. Baron-Cohen (2011) considers this component as part of the cognitive dimension of the empathic response since it involves both will and thought. He adds that an authentic empathic reaction must be consistent with the other person’s emotions. This means that “inappropriate” emotions and behaviors triggered by a person’s emotional state do not count as empathy (e.g., feelings envy of another’s success or feelings happiness because of another’s disgrace).

2.1.3. Empathy Organizational Model

An understanding of empathy as a multidimensional and cohesive concept that comprises diverse phenomena is present in the work of different authors. On of these authors, Mark
Davis, proposed an organizational model of empathy (1994; 2006): a comprehensive approach to this ability in which different empathy-related concepts are related and connected. Davis defines empathy-related concepts as “a set of constructs having to do with the response of one individual to the experiences of another” (Davis, 1994, p. 12). As can be seen in Figure 2, the model by Davis classifies empathy-related constructs in four different categories: (a) antecedents, (b) processes, (c) intra-personal outcomes, and (d) inter-personal outcomes. These categories are derived from the prototypical empathic episode described by Davis as “an observer being exposed in some fashion to a target, after which some response on the part of the observer occurs” (Davis, 2006, p. 443).

<table>
<thead>
<tr>
<th>ANTECEDENTS</th>
<th>PROCESSES</th>
<th>INTRA-PERSONAL OUTCOMES</th>
<th>INTER-PERSONAL OUTCOMES</th>
</tr>
</thead>
</table>
| **The Person**  
- Biological readiness  
- Personality  
- Learning history |
| **The Situation**  
- Strength of situation  
- Observer-Target similarity |
| **Non-Cognitive**  
- Primary circular reaction  
- Motor mimicry |
| **Simple Cognitive**  
- Classical conditioning  
- Direct association  
- Labeling |
| **Advanced Cognitive**  
- Language-mediated association  
- Elaborated cognitive networks  
- Perspective taking |
| **Cognitive Outcomes**  
- Interpersonal accuracy  
- Attributional judgements  
- Cognitive representations |
| **Affective Outcomes**  
- Parallel emotion  
- Reactive emotion  
- Empathic concern  
- Personal distress |
| **Motivational Outcomes**  
- Forgiveness  
- Valuing other's outcomes |
| **Helping Behavior** |
| **Reduced Aggressive Behaviors** |
| **Social Behavior** |

**Figure 2.** Organizational model of empathy-related constructs (Davis, 2006, p. 444).

**Antecedents:** refers to the characteristics of the *observer*—the person who experiences empathy; the *target*—the person for whom empathy is experienced; and the *situation*. This description includes the observer's biological capacity for empathy, his or her personal
history, and the individual differences in the tendency to experience some of the empathy-related processes described next. Also, the antecedents encompass the characteristics of the empathic situation, such as its strength to evoke a response from the observer, and the degree of similarity between the observer and the target (Davis, 1994; Davis, 2006).

**Processes** refers to the mechanisms that cause the empathic response in the target, ranging from non-cognitive, simple cognitive, and advanced cognitive processes. Non-cognitive processes are those in which little or no cognitive activity is required (e.g., primary circulatory reaction, motor mimicry). Simple cognitive processes are those that require at least some cognitive activity (e.g., classical conditioning, direct association, and labeling). Advanced cognitive processes are those that require more advanced mental skills (e.g., language mediated association, the use of elaborated cognitive networks, and perspective taking).

The capacity to take on another's perspective is especially relevant for the purpose of this study since it is essential for designers and design students to understand users and stakeholders. Perspective taking, as defined by Davis, consists of “the attempts by one individual to understand another by imagining the other's perspective. It is typically an effortful process, involving both the suppression of one's egocentric perspective on events and the active entertaining of someone else’s” (Davis, 1994, p. 17).
Intra-personal outcomes: refers to the observer's responses that are not necessarily expressed or manifested toward the target. These outcomes can be cognitive, affective, or motivational. Cognitive outcomes comprise changes in the attributional judgments from the observers regarding the target's behavior, changes in the cognitive representations that observers form of targets, and interpersonal accuracy (the accurate estimation of another's feelings, thoughts, and circumstances). Affective outcomes comprise the observer’s emotions in response to the target's experience. They can be expressed as parallel emotions—the reproduction of the target's emotion by the observer—and as reactive emotions—the affective reaction of the observer to the target's experience. Motivational outcomes comprise "motivational states produced in the observer by empathy-related processes" (Davis, 2006, p. 446). These are emotions expressed, for instance, by the reduction in desire for revenge and the increase of desires of reconciliation that a victim of an aggression feels for a transgressor with whom the victim empathizes.

Inter-personal outcomes: refers to the observer's behavior toward the target, such as helping behavior, reduced aggressive behavior, and social behavior. Helping behavior comprises actions aimed at helping others and is motivated by the discomfort of seeing another person in distress (an egoistic motivation) and by the concern for the other person’s well-being (an altruistic motivation). Reduced aggressive behavior comprises a decrease in the likelihood of an observer’s aggression toward another person motivated by vicarious distress (sharing the emotions of distress of the potential victim) and by the adoption of the other’s point of view (perspective-taking). Social behavior comprises considerate actions with others (e.g.,
Showing tolerance and support, being warm, adopting a positive outlook), to accommodate others’ attitudes and behaviors, and to take the perspective of others (Davis, 1994; Davis, 2006).

2.1.4. Empathy Expressions

This section provides detail on observable behaviors and empathy-related abilities that are considered manifestations or expressions of empathy in daily life according to several authors.

**Effective collaboration:** according to Howe (2013), empathy fosters cooperation, collaboration, and safe environments for creation. Empathy helps individuals to appreciate and understand others' viewpoints, to offer thoughts and opinions respectfully, to build agreements based on shared views, and to get involved in a balanced, reciprocal, and constructive dialogue. Even though these behaviors are not a precondition for collaboration, they make it more fluid, authentic, and satisfactory for all parties involved (Baron-Cohen & Wheelwright, 2004; Baron-Cohen, 2011; Howe, 2013).

**Effective communication:** is associated with effective collaboration and considered a manifestation of empathy. Listeners acknowledge their counterpart's perspective, focus on another’s words, thoughts, and recounted experiences in a conversation, recognize the feelings elicited by their interlocutor, and accurately interpret their facial expressions and body language (Baron-Cohen & Wheelwright, 2004; Howe, 2013).
**Sensitivity:** is also associated with an individual's empathy to sensitivity to external stimuli regarding others’ feelings, thoughts, and behavior. It manifests in how well people tune in with others and how well they perceive their emotional states. Empathy helps to recognize others' feelings rapidly and intuitively (as well as the events and stimuli that trigger those emotions). It is instrumental in expressing awareness about others’ emotional states, and it plays a major role in predicting others’ feelings, thoughts, and behaviors.

**Discernment:** the ability to discern others’ thoughts, feelings, intentions, and emotions is associated with empathy. Empathy helps the individual to discern another's emotions according to their facial gestures or their tone of voice. It contributes in identifying another's concealed intentions and in detecting when an idea has been misunderstood by others. Additionally, it helps in assessing the rudeness or kindness of another’s behavior as well as the own (Baron-Cohen & Wheelwright, 2004; Wiggins & McTighe, 2005; Howe, 2013).

**Concern for others:** empathy is manifested when an individual experiences feelings of concern for others. For instance, empathy is manifested in situations when a person gets emotionally involved with the problems of others or when the person is sensitive to the needs or suffering of others. Also, empathy is expressed in situations in which an individual experiences feelings of anger and indignation in the face of injustice against others. Also, it is expressed in behaviors such as being welcoming to someone who is new to a group or by taking care of people that require special attention (Baron-Cohen & Wheelwright, 2004).
**Conflict management:** most of the previously described abilities and behaviors are helpful to avoid or to confront conflicts. By being empathic, people can ascertain their thoughts, to acknowledge others’ points of view, to accurately understand others’ positions, and to propose satisfactory solutions for all involved parties. Also, empathy is associated with tolerance, forgiveness, and mercy, which are valuable assets to successfully deal with interpersonal conflicts and to build stronger relationships (Baron-Cohen & Wheelwright, 2004; Baron-Cohen, 2011; Howe, 2013).

**Openness to otherness:** according to Wiggins & McTighe (2005), empathy is expressed in the ability to be open to others’ ideas and views, even when they seem divergent from one's perspectives or even when they come from people with whom one differs. Empathy, in this case, helps to consider and acknowledge others' viewpoints, which in turn contributes to building a more tolerant and open relationship.

**2.1.5. Empathy Promotion**

For years it was thought that the foundations of empathy in an individual were built exclusively during the early years of childhood (Gerdes et al., 2011), which implied that it was considered a stable personality trait. However, research in neuropsychology has demonstrated that it is possible, even for adults, to rewire the brain by enhancing or creating new neural networks capable of supporting empathic responses that previously were weak or reduced (Perry, 2002; Gerdes et al., 2011). This capacity of the brain to strengthen empathy-related neural pathways opens the possibility for increasing empathy by stimulating those
networks through different strategies. This section presents some of the strategies that have proven to be effective in promoting empathy in educational settings.

**Experiential learning:** In experiential learning students are engaged in direct experiences with the subject matter. For instance, when design students are learning to formulate questions to get insights from people, they acquire this skill by practicing it; that is, by formulating and asking questions to test how well they work. In short, people learn by doing. From a neuropsychological perspective, these activities are particularly powerful in stimulating neural networks in the brain and enhancing empathy levels due to the intensity of the cognitive, emotional, and behavioral experiences that they comprise (Gerdes et al., 2011). From an educational perspective, these activities have proven to help the learner to understand abstract ideas (e.g., others’ thoughts and feelings) in a much more effective way than other more passive learning strategies (Wiggins & McTighe, 2005). The use of design activities in educational settings fall into this larger category due to the level of interaction that the learner has with peers, materials, context, and instructor.

**Alternative perspectives:** This strategy consists of providing scenarios and activities that require students to consider how others perceive and feel the world. It encourages changes in the learner's view point, which requires perspective-taking skills. For Howe, empathy is improved when people “make a cognitive effort to see and imagine the world from the other person's point of view” (Howe, 2013, p. 173). This strategy is found in the Design Thinking
process (described later in this chapter) that invites designers to see the world through the eyes of the users.

**Empathic discussions:** Psychologists consider discussing others' thoughts, feelings, and experiences as a strategy that promotes empathy. The discussion of other people’s emotional states, thoughts, and behaviors helps students to identify and understand these elements and to think about what others’ might be thinking or feeling (Howe, 2013). In the design process, these empathic discussions occur when members of a design team (students and instructors) are briefing their peers about their findings on the users' lives and when they are proposing design solutions that are consistent with these experiences.

**Collaborative experiences:** Providing students with the opportunity to interact, collaborate, and cooperate with others is recognized as a strategy to foster empathy. It creates a setting in which they can practice their social skills, learn pro-social behaviors, and develop their emotional intelligence (Howe, 2013). From a design perspective, this strategy implies that empathy can be promoted not only through the relationship that designers build with users but also through the interactions that they have with other members of the design team. Facing a design challenge as a group puts students in a situation in which they have to share, negotiate, and build ideas, which result in a setting to exercise empathy and other social skills.
Model empathic behavior: Psychologists suggest that by being empathic to children and students, parents and instructors model that behavior for them. Howe (2013) asserts that the way children understand relationships comes from the relationships they experience themselves. This strategy functions in two ways: when they are on the receiving end of empathy, children and students learn how it feels to be treated empathically, and at the same time, they have a role model (the parent or teacher) who exemplifies how to be empathic.

2.2. Empathy in Design

Empathy is considered a fundamental ability in the design field, especially regarding the relationship that designers establish with users and stakeholders. The process of design usually involves the direct interaction between designers and people with the purpose of creating products that are more useful, usable, and desirable. This interaction allows designers to gain insights into the user’s world by uncovering and understanding their thoughts, feelings, expectations, and realities. The empathic relationship that this process fosters is the subject of this section in which different approaches to design are presented to explore the role that empathy plays in the design field.

2.2.1. Human-Centered Design

Human-centered design (HCD) is an umbrella term that encompasses several design theories and practices (e.g., empathic design, co-design, participatory design, user-centered design, applied ethnography) that place people at the heart of their theories and practices. These different approaches aim at developing concepts, products, services, and systems based on
people’s needs, desires, capabilities, and behavior (Steen, 2008; Sanders & Stappers, 2008; IDEO, 2011; Norman, 2013). Human-centered design has evolved from diverse traditions and disciplines such as product design, human factors and ergonomics, computer science, and business administration (Giacomin, 2014; ISO, 2010). The practice of HCD involves the use of processes, methods, and techniques that provide an in-depth understanding of people to inform and inspire the design process (Steen, 2008; Liem & Sanders, 2011). Usually, it is practiced by multi-disciplinary teams that cooperate with users and stakeholders to articulate problems, identify design opportunities, and develop solutions (Steen, 2012).

The origin of the term human-centered design is diverse but reflects an evolution in how different disciplines, industries, and practitioners perceive, approach, and understand the people who are being served through design. As noted by several authors, the term human-centered design suggests a broader understanding of people compared to other approaches that offer a more limited perspective. For instance, Steen (2008) claims that the term user-centered design emphasizes issues of usability and confines a person to the role of a mere user, while the term human-centered design emphasizes issues of usefulness, and is associated with the experience of people interacting with products or services. Likewise, Jordan (2002) argues that usability-based approaches, such as user-centered design, offer a limited view of people and tend to dehumanize the person. These two stances represent a larger discussion in the design field about how people are perceived, addressed, and involved in the design process.
People Served Through Human-Centered Design

The discussion is illuminated by the work of authors such as Liz Sanders, Gerhard Fischer, and Klaus Krippendorff. Liz Sanders, pioneer in participatory and generative design methods, argues that there has been a transition in the labels and roles that people being served though design play in the design process. Sanders (2006) points out that since the 1980s, people’s roles and labels have evolved from “customers” to “co-creators,” as their involvement in the design process increases. This evolution can be seen in Figure 3. According to the author, “the labels we use to refer to everyday people have been changing. We are slowly becoming sensitive to the fact that they are first and foremost people, as opposed to users or consumers” (2006, p. 66).

![Figure 3](image)

*Figure 3.* Evolution of the labels used to refer to the people served through design (Sanders, 2006, p. 3).

Gerhard Fischer, researcher in human-centered computing and design, claims that more than a transition in how people get involved in the design process, what has happened are new scenarios for involvement and participation. Fischer (2002) noted that in these new spaces
people assume different roles in the design process and get involved at various levels. Different roles can be seen in Figure 4. He argues that diverse roles can co-exist since they provide different kinds of insights and opportunities for participation: “I also do not assume that being a consumer or being a designer would be a binary choice: it is rather a continuum ranging from passive consumer, to active consumer, to end-user, to user, to power users, to domain designer, all the way to meta-designer. It is also the case that the same person is and wants to be a consumer in some situations and in others a designer; therefore ‘consumer/designer’ is not an attribute of a person, but of a context” (Fischer, 2002).

![Figure 4. Roles within the consumer/designer spectrum (Fischer, 2002).](image)

Klaus Krippendorff, pioneer in the fields of product semantics and human-centered design, re-evaluates the idea of “the user” as the stereotypical average end-user of a product and acknowledges the need to address the entire network of stakeholders that is affected or can affect the design solution. Krippendorff (2006) defines stakeholders as those who have an interest in the design process, can support or oppose the solution in development, and can
mobilize resources toward it (e.g., information, expertise, money, time, connections). For the author, acknowledging this network of people is a way to show respect for them and their voices and a way to “succeed in the postindustrial era where authority and knowledge are no longer centralized and institutionalized, but distributed over many active stakeholder communities” (2006, p. 65).

In summary, the changes in labels and roles described and proposed by Sanders (2006), Fischer (2002), and Krippendorff (2006) show a turn in how different disciplines and practices value the involvement of and interaction with people served through design. This turn is also evident in the variety of design approaches covered by the human-centered design umbrella, which are presented in the following section.

**Approaches to Human-Centered Design**

In the reviewed literature, three main ways to understand human-centered design were identified: (1) HCD as a strategy to bring together users and developers in order to improve the usability of digital products, proposed by the computer science and human-computer interaction communities; (2) HCD as a source of insights to create more innovative, successful and profitable products and services, proposed by the business community; and (3) HCD as a philosophy and a methodology used to inform and inspire the design process in order to propose design solutions attuned to their target audience, proposed by the design community. These three ways of understanding HCD are not mutually exclusive and tend to overlap depending on the context and nature of the design problem. They have in common a
drive to consider people’s needs and preferences to develop new products and services and the assumption that there is value in involving users and stakeholders in the design process (ISO, 2010; IDEO, 2011; LUMA, 2012; Kurosu, 2011; Krippendorff, 2006; Liem & Sanders, 2011; Steen, 2012; Fulton Suri, 2003).

These perspectives emerged through different approaches to human-centered design and vary in their assumptions, emphasis, and methods. To contrast and compare these different approaches, Sanders proposes a “cognitive collage of the [human-centered] design research space” (2006, p. 4) that can be seen in Figure 5. Her diagram presents most of the current “flavors” of human-centered design such as user-centered design, participatory design, critical design, generative design, and emotional design. Interestingly, this diagram does not include empathic design, which Sanders mentions in the text as a smaller emerging category located in the center of the map, “drawing eclectically from all the other areas of the design research space” (2006, p. 7).

Approaches are mapped depending on two dimensions: the nature of the involvement of users in the design process and the force that has led the emergence and evolution of the approaches. On the horizontal axis, approaches to the left tend to consider “users as subjects”—that is, as mere sources of information—and approaches to the right tend to consider “users as partners”—that is, as active participants in the design process. On the vertical axis, approaches on the top half have been led by designers, were introduced from a design perspective, and have focused on transforming and understanding the experience of
users. Meanwhile, approaches on the bottom half have been led by researchers, were introduced from a research perspective, and have focused on building an understanding of users (Sanders, 2006; Postma, 2012).

![Figure 5. Landscape of human-centered design approaches (Sanders, 2006, p. 4).](image)

Sanders recognizes that this diagram represents a field in a state of flux in which different approaches compete, collide, and overlap (2008). Similarly, Steen (2012) and Zhang and Dong (2009) recognize the complexity of approaches to human-centered design but agree with Sanders in that they all share a common goal: “to drive, inspire, and inform the design development process” (Sanders, 2008, p. 13). The proliferation of approaches under human-centered design suggests the existence of conflict and confusion in the field about how to involve people in the design process, as well as a diversity of philosophies, methodologies,
disciplines, and traditions that have contributed to this discussion (Sanders, 2008). However, beyond this chaos, conflict, and confusion lies a growing interest in the human being in design and associate disciplines; what Krippendorff (2006) calls the semantic turn from a technology-centered perspective to a human-centered perspective.

**Empathy in Human-Centered Design**

The semantic turn described by Krippendorff is acknowledged by other authors such as Liz Sanders (2008), Koskinen and Battarbee (2003), Kouprie and Sleeswijk Visser (2009), and Daniel Pink (2005). Liz Sanders (2008) advocates for a participatory approach to design and argues that despite these methods having been used for more than sixty years in Northern Europe, they have been adopted by organizations and individuals in North America on the last two decades. This turn, she argues, has been motivated by different circumstances like the use of the internet by consumers as a means to voice their concerns and preferences, the exploration of new forms of conscious consumption that respond to recent economic and environmental crises, an increasing recognition of the value of research by some industries, and an increasing awareness of the importance of the user experience by companies that used to be technology-driven.

Koskinen and Battarbee (2003) argue that as technologies have matured and basic needs have been satisfied, the demand for more meaningful experiences has increased in most of Western urban environments. Likewise, Kouprie and Sleeswijk Visser (2009) claim that for more than two decades, a movement toward context-sensitive design (that includes human-
centered design approaches) has evolved as a response to the limited perspective that
designers and organizations used to have about people’s lives. The situations and transitions
described by these authors have configured some of the conditions that made possible the
emergence and evolution of human-centered design approaches. These changes also marked
a transition in how industries and practitioners conceived their relationships with the people
they serve, which in turn has transformed how they approach, get involved with, and
understand these same people (users and stakeholders).

As Sanders points out, “designers have been moving increasingly closer to the future users of
what they design” (2008, p. 5), which has impacted design philosophies, values, methods,
and practices. In this emerging scenario, roles have changed and evolved. Designers have
become explorers of people’s realities, and people have become partners and experts of their
own experiences (Postma, 2012; Michlewski, 2008). Adopting these new roles has required
from designers a new skill set, in which empathy is fundamental as it allows for rationally
understanding and emotionally connecting with other people’s lives and circumstances
(Segal & Fulton Suri, 1997).

Empathy is also required by human-centered designers to move “beyond [their] egocentric
views of the world and no longer design based on their own needs, desires, experiences or
preferences” (Goldman et al., 2012, p. 18). By considering other people’s perspectives while
keeping their focus on the design problem, human-centered designers can uncover needs and
requirements of different users and stakeholders, identify and balance possible conflicting
demands, and design satisfactory solutions that are functional, understandable, usable, and enjoyable (IDEO, 2011; Norman, 2013).

For Thomas and McDonagh, empathy is a critical component in human-centered design, as it allows for the generation of holistic design solutions that address functional and emotional needs of people. These holistic—or balanced—approach is possible thanks to empathy, which “enables designers to gain intimate insights and understanding into human experiences” (2013, p. 3). Likewise, Altay (2014) argues that the practice of human-centered design approaches requires empathy, as it increases designers’ awareness of how diverse people interact and experience their social environments. According to the author, this awareness is achieved by interacting with users, sharing their everyday experiences, and inviting them to participate in the design process.

Some authors argue that empathy is especially important in human-centered design when designers have less in common with the populations they are designing for and when they have little or no experience in the contexts and situations that frame the design problem. For instance, Carmel-Gilfilen and Portillo (2016) suggest that skills associated with empathy like listening, observation, and attention to the human experience are particularly essential in the context of health-care design. Likewise, Lee (2012) highlights the importance of empathy when designing for elderly people, as it helps in dislodging designers’ preconceptions and prejudices, and build an emotional commitment with them. As stated by Lee, these changes in the designers’ mindset can lead to reframing the design problem and proposing more
successful design concepts. A key player in understanding and communicating the importance of empathy in human-centered design has been the international design consultancy IDEO. As previously mentioned, this firm pioneered the use of human-centered design methods and influenced the inception of an empathic approach to design (Battarbee et al., 2014, Mattelmäki, Vaajakallio & Koskinen, 2013).

In one of the toolkits that IDEO publishes with certain frequency, empathy is presented as a strategy and an ability that enables design teams to create products, services, and systems that reflect a deep understanding of people’s problems and realities (IDEO, 2011). According to this publication, empathy for users emerges when designers use qualitative research methods to uncover insights, evaluate people’s response to proposed solutions, and, especially, understand people’s behavior. Building this understanding enables designers to “identify physical, cognitive, social and/or cultural needs that we [designers] can meet through the products, services and experiences we create” (IDEO, 2011, p. 68).

In conclusion, authors agree in considering empathy a fundamental ability in human-centered design approaches. It allows designers to transcend their assumptions and egocentrism, get immersed into the lives of users and stakeholders, and uncover their latent needs and expectations. Also, it is instrumental for designers in building an emotional connection and a deep understanding of people’s reality, which is of particular importance to design for a diverse range of users in contexts that are new to the design team.
2.2.2. Empathic Design

Empathic design is a branch of human-centered design that aims at building cognitive and affective understanding of people (potential users and stakeholders) for the development of concepts, products, services, strategies, and systems. This approach has its roots in design practices that focus on people’s daily experiences, emotions, behaviors, and desires (Postma, Zwartkruis-Pelgrim, Daemen, & Du, 2012; Wright & McCarthy, 2008; Mattelmäki, Vaajakallio, & Koskinen, 2013; Battarbee, Fulton Suri, & Gibbs, 2014).

Empathic design comprises methods and techniques that help design teams to uncover people’s latent needs, expectations, aspirations, and preferences. These methods aim at understanding people’s emotions and life experiences to inform and inspire the design process. They involve collecting and analyzing data from people’s everyday lives through the designer’s immersion and direct interaction with potential users and stakeholders (Battarbee et al., 2014; Leonard & Rayport, 1997; Mattelmäki et al., 2013; Fulton Suri, 2003).

This approach to design research is intended to provide a unique perspective based on people’s experiences and emotions that enrich and complement the insights uncovered by other methods of inquiry such as market research (Leonard & Rayport, 1997; Postma et al., 2012). Koskinen and Battarbee (2003) argue that this turn in design practice was motivated by the increasing demand for richer and more meaningful experiences in wealthier urban environments. Also, they argue that as technologies have matured and are reaching larger audiences, the demand for stable and enriched experiences that offer value, meaning, and
connection to consumers has increased in the last two decades. Against this scenario, empathic design emerged as an approach for providing these experiences based on an improved understanding of people’s needs, emotions, and situation (Koskinen & Battarbee, 2003).

**Origins and Evolution**

The first mention of empathic design was in 1991 when Professor Dorothy Leonard-Barton, researcher on innovation and creativity at Harvard Business School, published “Inanimate Integrators: A Block of Wood Speaks” in the *Design Management Journal*. This article discussed the use of models and prototypes to foster effective communication in the product development process. Leonard-Barton mentioned empathic design for the first time when discussing strategies to communicate with potential users of those new products and services in development. She presented empathic design as a process of gathering information about potential users to uncover their unrecognized needs and desires (Leonard-Barton, 1991). The author stated that empathic design was inspired by the work of renown industrial designer Henry Dreyfuss, who advocated for an approach to design based on “[direct] experience, observation, and research” (Dreyfuss, 1955, p. 65).

Another important influencer of empathic design was Bill Moggridge, co-founder of the international design consultancy IDEO and former director of the Cooper-Hewitt Design Museum in New York. According to Battarbee and colleagues (2014), in the 1970s Moggridge’s studio introduced the observation of people and their context as a method for
informing their design work. When Moggridge’s studio merged with other firms to form IDEO in 1991, this human-centered approach was adopted by the newly created consultancy (Battarbee et al., 2014). Mattelmäki, Vaajakallio, and Koskinen (2013) also acknowledge the influence of IDEO in the inception of empathic design in the mid- and late-nineties and identify other influencers such as Liz Sanders at SonicRim, Patrick Jordan at Philips, and Dorothy Leonard-Barton at Harvard Business School. Additionally, the authors argue that empathic design originated from the human-centered design community as part of “a larger movement toward context-sensitive design” (Mattelmäki et al., 2013, p. 68).

According to Kouprie and Sleeswijk Visser (2009), this movement was a response to the limited information that current methods offered about the experience, situation, and emotions of users, which in turn limited the designer’s capacity to innovate and develop new and successful products. The user-centered perspective brought by this movement was embraced by the business community, which saw in these new approaches an opportunity to strengthen the connection with their customers at an emotional level (Postma et al., 2012). Since its emergence, empathic design has evolved and has influenced other approaches to design. Initially, empathic design intended to make sense of the human experience with the purpose to inform and inspire the design process. Later, it involved users more actively through co-design and participatory design methods and recently has been used to foster imagination and explore and build possible alternate futures.
Likewise, empathic design has spread and influenced the work of people working in places such as Aalto University in Finland; TU/Delft, TU/Eindhoven, and Philips in The Netherlands; Carnegie Mellon University, Ohio State University, University of Illinois, IDEO, and SonicRim in the United States; The Hong Kong Polytechnic and Tongji University in China; Politecnico di Milano in Italy; and Universidade Federal do Rio de Janeiro in Brazil (Mattelmäki et al., 2013; Sanders & Dandavate, 1999; Battarbee et al., 2014; Ho, Ma & Lee, 2011; Cipolla & Bartholo, 2014).

**Characteristics**

Empathic design is characterized by proposing a balance between rationality and emotion (Postma et al., 2012). Several authors argue that designing under this framework requires finding equilibrium between the affective involvement of empathizing with another’s experience and the cognitive process of analyzing it (Kouprie & Sleeswijk Visser, 2009; Battarbee et al., 2014). For Postma and colleagues, this balance implies combining “objective observation of people behavior with more “subjective” interpretations of “what people think, feel and dream” (2012, p. 60). As Fulton Suri points out, “through observation, we become informed, and through empathy, the human connection, we are inspired to imagine new and better possibilities for people” (2003, p. 54).

Another important characteristic of empathic design is the involvement of users and stakeholders as partners in the design process. According to Mattelmäki (2006), such participation requires the designer to develop a sense of respect and commitment to their
needs and to build a holistic understanding of their experiences. From an empathic design perspective, users and stakeholders are considered “experts of their experiences and crucial partners in building creative understanding of these experiences” (Postma et al., 2012, p. 60).

Additional to this balanced approach and respectful attitude, empathic design is guided by a set of underlying theoretical and methodological assumptions that Mattelmäki, Vaajakallio, and Koskinen have synthesized in the form of “four key beliefs” (2013, p. 68). These assumptions revolve around the creation of meaning by people, the discovery and interpretation of these meanings by designers, and the nature of the methods used in empathic design. These key beliefs are as follows:

1. People construct meanings that arise and change through interaction with the environment.
2. To explore these meanings, empathic design needs to be done in real life, where these meanings are created and transformed.
3. This meanings exploration should use design-specific methods such as visualization, mockups making, and storyboarding.
4. The research methods used in empathic design are “visual and tactile, inspiration-enhancing, deliberately cheap and low tech, playful, tested in reality, and targeted at the fuzzy front end of the design process” (2013, p. 69).
**Role of the Designer**

In empathic design, practitioners are expected to have direct interaction with people (users and stakeholders). This means that the designer’s role requires getting immersed in the user’s world, their lives, and experiences to learn from them and inform and inspire their designs (van Rijn, Sleeswijk Visser, Stappers, & Özakar, 2011). This immersion also comprises user participation, since they are considered “experts on their experience” (Sleeswijk Visser, Stappers, van der Lugt, & Sanders, 2005). As a consequence, designers are expected to set the stage for users to participate and to facilitate activities for them to share their expertise with the team (Battarbee et al., 2014, p. 10). However, to maintain a balanced perspective, the user’s viewpoint needs to be combined with the designer’s personal insights, creativity, vision, and experience (Kouprie & Sleeswijk Visser, 2009; Postma et al., 2012).

These competencies are part of the skill set that empathic designers require according to several authors. The set is comprised by abilities such as being open-minded, aware of one's context, and self-aware about how one thinks and feels. Also, this empathic skill set includes the capacity to observe meticulously, use visual information and tools of visual communication, and switch between empathizing and analyzing modes (Leonard-Barton & Rayport, 1997; Mattelmäki et al., 2013; Battarbee et al., 2014; Kouprie & Sleeswijk Visser, 2009).
Methods and Practices

A significant portion of the literature in empathic design is dedicated to proposing, discussing, and presenting applications of methods created or adapted for practicing this approach to design. Most of these methods and techniques are intended to be used during the research phase of the design process, and their purpose is to prompt an empathic understanding of other people’s experiences (Vaajakallio, 2012).

Empathic design methods are characterized by being user-centered (as they involve users and stakeholders at different extents); visual and tactile (as they provide inspiration and a means of communication to designers); cheap and low-tech (as they are easily and quickly deployed in any context); interpretive (as they are intended to make sense of other people’s reality), playful and fun (as they offer opportunities to dream about alternate futures); tested in reality (as they are used to address real-world issues); and targeted at the fuzzy front end (as they are most effective in the early stages of product development) (Koskinen, Mattelmäki, & Battarbee, 2003).

Even though most methods are focused on the research and concept development stages of the process, Leonard and Rayport (1997) offer an overview of the empathic design process that goes beyond these initial phases. This process is comprised of five steps, namely, (1) observation, (2) capturing data; (3) reflection and analysis; (4) brainstorming for solutions; and (5) developing prototypes of possible solutions. In this model, observation is presented
as the preferred method for learning about users on the basis that it allows for uncovering their unarticulated and latent needs.

Kouprie and Sleeswijk Visser (2009) propose a four-phase framework to practice empathy in the design process. This model is based on current literature in psychology and is intended to support designers in implementing empathy in their practice by offering them a guide to approach, interact, and understand users and stakeholders. The four phases proposed by the authors are (1) discovery, in which the designer makes a first contact with the user that raises his curiosity, interest, and motivation; (2) immersion, in which the designer explores the user’s world to expand his knowledge and understanding of another’s experience; (3) connection, in which the designer connects with the user on an emotional level by recalling his own feelings and experiences; and (4) detachment, in which the designer detaches from his emotional connection with the user to analyze and distill insights from his immersion.

The same authors also propose a system to classify a variety of empathic design methods depending on the purpose and phase of the process in which they can be applied. The categories proposed by these authors are as follows: “(1) techniques for direct contact between designers and users (research); (2) techniques for communicating findings of user studies to design teams (communication); and (3) techniques for evoking the designer’s own experiences in a domain relevant to the user (ideation)” (Kouprie & Sleeswijk Visser, 2009; p. 439).
The first category—“techniques for direct contact between designers and users”—includes methods based on user observation (e.g., observing users performing a task at their workplace); designer immersion (e.g., spending the night at the user’s home); and generative sessions (e.g., facilitating a session in which users make a collage that captures their experience using public transit) (Kouprie & Sleeswijk Visser, 2009; IDEO, 2011; Stappers & Sanders, 2003).

The second category—“techniques for communicating findings of user studies to design teams”—involves methods used when direct contact with users is not possible. This category includes storytelling techniques such as personas (i.e., fictional characters based on user data); scenarios (i.e., fictional situations based on data from users and context); and storyboards (i.e., sequence of images that represent specific situations in the life of a user). Such methods are effective when they “convey the flavour of the user’s world, as well as an understanding of it” (Kouprie & Sleeswijk Visser, 2009, p. 446; Sleeswijk Visser, 2009).

The third and final category—“techniques for evoking the designer’s own experiences in a domain relevant to the user”—refers to methods that simulate the user’s reality so designers can experience them and adopt their perspective. This category includes role-playing techniques such as product handling (i.e., use of sample products or prototypes by designers); experience prototyping (i.e., simulation of the experience mediated by a product or service); bodystorming (i.e., brainstorming that uses body and space); and informance (i.e., informative performance of a situation or behavior witnessed or researched) (Kouprie &
Another classification of empathic design methods is offered by Jane Fulton Suri, Partner Emeritus and Executive Design Director at IDEO, who proposes the following three categories: (1) “looking at what people do,” which includes techniques such as observing people in their natural environment, and exposing potential users to prototypes to observe their behavior; (2) “asking people to participate,” which includes techniques that help to reveal people’s unarticulated attitudes and thoughts such as drawing, collage-making, storytelling, and diary-keeping; and (3) “trying things ourselves,” which includes immersive techniques such as role-playing, experience prototyping, and simulations (Fulton Suri, 2003).

An example of the first category—“looking at what people do”—is the immersion of members of the design team into the users’ context, as discussed by IDEO in their human-centered Design Toolkit (2011). This technique aims at providing designers with an experiential understanding of the users’ everyday life through an immersive and prolonged exposure to their context and experiences. When using this method, designers spend two to four of days with members of the community of potential users, sharing their daily experiences in the context in which they live, work and socialize. According to IDEO “this kind of deep immersion gives us [designers] informed intuition that we take back with us to design solutions. We begin to take on the perspective of the interview participant which enables us to make design decisions with their perspective in mind” (2011, p. 59). Also, this
strategy allows designers to contrast what the potential users say they do, with what they really do, which might not coincide.

An example of the second category—“asking people to participate”—is the use of empathy probes proposed by Mattelmäki and Battarbee (2002). This technique aims at uncovering what people say, do, and make (Sanders, 2002) through self-documentation. The package given to potential users includes a diary, a sheet of stickers (to use on the diary), disposable camera with a list of photos that users need to take (e.g., an object they user every day), and set of cards with questions to be answered depending on the nature of the project. The design team analyzes the information collected by potential users, and later conducts interviews with some of them to validate their preliminary findings. This method helps to promote empathy by providing the design team a glimpse into the users’ reality from their own perspective.

An example of the third and last category, “trying things ourselves”, is modeling everyday activities as a person with a disability as proposed by Thomas, McDonagh, and Strickfaden (2012). This strategy offers designers the opportunity to undergo the challenges and experiences that a person with a different level of ability encounters every day. An immersive technique is preferred when the presence of the design team into the user’s world can be intrusive or when time and resources prevent the team from conducting extensive research with external participants. When using this method, designers execute everyday activities while reducing their specific abilities. For instance, designers can wear devices that limit their range of motion, obstruct their hearing, or restrict their peripheral vision. While they are
wearing these devices and executing everyday activities, designers document their experiences in order to reflect on them and present findings to the team in a debriefing session. The purpose of this strategy is to promote empathy with potential users who represent physical disabilities.

Another remarkable example of this third category is offered by industrial designer and gerontologist Pat Moore. In her book *Disguised!,* Moore (1985) recounts her experience living and traveling for three years prosthetically disguised as an elder woman. This empathic experiment—initiated when Moore was at the age of 26—gave her an immersive experience of an older adult. In an interview conducted by author Roman Krznaric, Moore expressed her intention to gain true empathy with this population through total immersion: “I didn’t just want to be an actress pretending to be an elderly person… I wanted a true immersion character, an empathic character, where I could really walk in someone else’s shoes” (Krznaric, 2015, loc. 69-70). During this empathic experiment, Moore created different personas to explore the experience of elderly women of diverse health and economic conditions. She visited more than a hundred cities in disguise, and almost lost her life after being attacked by a gang on the streets of New York City (Moore, 1985).

**Scope and Limitations**

Empathic design has limitations and is not well suited for addressing every design problem. According to Postma and colleagues (2012), this approach is most valuable in the early stages of the design process when opportunities are being identified and new concepts are
being proposed. For Koskinen and Battarbee (2003), the insights from the user’s perspective obtained through empathic design have the most value in the “fuzzy front end” of the process; that is, in the search for new concepts for products, services, strategies, and systems. Sanders reiterates the importance of empathic approaches in these early phases of the development process and highlights that “the action in the fuzzy front end is all about new ways to understand and to empathize with the needs and dreams of people” (Sanders, 2006, p. 1).

Another limitation to empathic design is the risk of running into what has been called the “empathy trap;” that is, focusing only on another’s needs while ignoring the designer’s own concerns (Stern & Divecha, 2015). In the case of empathic design, this situation is seen when the design team focuses only on the user experience and loses its drive to find insights that inform and inspire new products and services (Mattelmäki et al., 2013). This situation is often accompanied by the loss of objectivity and a global frame of reference, which occurs when designers establish a strong connection with another person’s feelings and perspectives (Fulton Suri, 2003). According to Segal and Fulton Suri (1997), the key to avoiding this trap is to maintain a balanced perspective by combining “loose” empathic strategies with “strict” observation techniques. However, keeping this balance between an empathic and an analytic mindset may be challenging for design teams and individuals. This requires of self-awareness and the capacity to make the switch between these two mindsets (Battarbee et al., 2014).
Another difficulty that empathic design poses is the uncertainty of the process in its early stages. As the initial phase of the process is devoted to getting immersed into the user’s world and does not provide an immediate solution to the posed problem, designers and organizations may not perceive its value at first and may be reluctant to embrace this approach (Kouprie & Sleeswijk Visser, 2009). For this reason, Kouprie and Sleeswijk Visser highlight the importance of motivation and willingness to pursue an empathic design process. For them, “motivation is crucial for an effective process. When designers do not see the advantages of empathy in design, the results can be unsatisfying” (2009, p. 447).

2.2.3. Design Thinking

Design thinking (DT) is an approach to innovation based on the skills, practices, and processes that designers have applied for decades to “match human needs with available technical resources within the practical constraints of business” (Brown, 2009, p. 4). Its application in business and technology industries emerged as the knowledge economy sought greater advantage in the competition for innovative products and services. According to Jon Kolko, design thinking it is based on a set of principles that include “empathy with users, a discipline of prototyping, and tolerance for failure” (2015, p. 68). For Carroll and colleagues (2010), this set of practices and processes are built upon a particular mindset that they call the design thinking mindset, which features seven specific characteristics in which empathy plays a central role. This model emphasizes the human-centered feature of DT, which invites the designer to know the users; understand what they think, feel, need, and want; and focus his work toward them. To achieve this goal, designers need to develop empathy to know the
users better, connect with them, and uncover their latent needs. According to the authors, this model promotes the development of empathy “through a process of ‘need-finding’ in which one focuses on discovering people’s explicit and implicit needs” (Carroll et al., 2010, p. 41).

Associated with this mindset, the “d.school” (the Institute of Design at Stanford University) promotes a design thinking process in which empathy is its starting point. This strategy, utilized by the REd Lab (Research in Education & Design Lab, at Stanford) in educational settings in which design thinking is taught and promoted, consists of several phases that “provide each learner with a relevant, socially situated, complex problem-solving environment in which to generate solutions” (Goldman et al., 2012, p. 18).

“Empathize,” the first phase of this approach, is considered “the foundation of a human-centered design process” (d.school, 2010, p. 4). This phase includes the observation of people in their natural context, direct interaction with them in formal and informal settings, and immersion in their everyday experiences. The importance of this phase resides in the need for design thinkers to empathize with the people they intend to serve, understanding their situation, needs, feelings, and lifestyles. The authors argue that design thinkers can uncover useful insights to propose innovative and coherent solutions and they add that “the best solutions come out of the best insights into human behavior” (d.school, 2010, p. 4).

According to Shelley Goldman, director of the REd Lab at Stanford, engaging students in a design thinking process helps them to gain greater empathy for others, as they are challenged
to design solutions that resonate with another’s needs, which enriches students’ perspectives as they explore others’ viewpoints (Goldman et al., 2012).

In summary, empathy is considered a fundamental ability because it provides in-depth understanding of people’s reality. In design thinking, practitioners explore the users’ world, connect with them an emotional level, consider and understand their points of view, and build solutions that are coherent with their reality. Empathy bridges the experiences of others, and based on that perspective, uncover insights that are used to propose new concepts, products, services, and systems.

2.2.4. Criticism of Empathy in Design
The application of empathy in design approaches and business strategies has been questioned by researchers and designers such as Elizabeth (Dori) Tunstall, Lilly Smith, Kamil Michlewski, Steve Selzer, and Dan Saffer.

For design anthropologist Dori Tunstall (2014), the use of empathy in design strategy has serious limitations. Empathy may offer the designer an understanding and/or an emotional connection with people, but it does not necessarily offer a path to take action for others. She proposes that more than having empathy for users and stakeholders, designers should have compassion and design from a position of caring. This approach means for design practitioners to have a “sustained emotional investment in an individual’s well being,
characterized by a desire to take actions that will benefit that person” (Tunstall, 2014, paragraph 4).

In an op-ed published in AIGA Eye on Design blog, Lilly Smith (2016) questions the use of empathy in the design and business communities. For her, empathy has become a “buzzword” that is being used by companies mostly as a sales pitch. She argues that even if designers use empathy to understand people’s needs and create legitimately better products, the purpose is to sell those products. From her perspective, empathy in business and design is less about compassion and more about profit. This viewpoint is summarized by Roman Krznaric, who calls this strategy “empathy marketing” and argues that when businesses apply empathy, they are only “stepping into someone else’s shoes to sell them another pair” (as cited in Smith, 2016).

Similarly, Kamil Michlewski, author of the book Design Attitude, differentiates real empathy from that with commercial purposes, which he calls “commercial empathy” (2008, p. 383). He argues that firms such as IDEO have incorporated a light version of practices and methods from anthropology, psychology, and sociology, which fail to offer the same in-depth understanding shown by their academic counterparts. For Michlewski, designers working in these environments “exhibit an attitude that might be described as commercial empathy. That is to say they are sympathetic towards commercially bound reference points of their work” (2008, p. 383).
Even designers who work within this commercial framework recognize that empathy poses its own challenges in the design process. For instance, Steve Selzer, design manager at Airbnb and former creative director at Frog Design, argues that the human-centered design process requires not only a deep understanding of others through empathy but also a deep understanding of oneself (2015). Selzer warns against the “empathy trap” mentioned before, in which designers and researchers center their attention only on the user’s needs while ignoring their own perspectives. He proposes that an alternative to avoid such situations is to acknowledge and understand one’s values, perspectives, goals, and biases before trying to understand others through empathy.

Likewise, Dan Saffer, vice-president of product at Mayfield Robotics and former creative director at Smart Design, claims that empathy is not enough in human-centered design, but it needs to be combined with an objective understanding of the problem, and the informed perspective of the designer (2015). According to Saffer, empathy helps to designers see a problem from the user’s perspective, but does not help them to see the solution. For him, empathy is only a stepping stone that helps designers moving from their egocentric perspectives to a real understanding of people and context.

In conclusion, designers have acknowledged the value of empathy in the design process, but there are also voices that warn about the limitations and the pitfalls of using empathy as a design and business strategy. The strongest criticism of this kind of approaches is that they
commodify empathy reducing its power to strengthen human relations, as they adopt it as a disposable buzzword to increase sales and profits.

2.3. Elements of Design Pedagogy

The purpose of this section is twofold. First, this review of educational theories, practices, and approaches in design builds a framework to study the teaching and learning practices that were documented in this study. Second, this section connects and reconciles existing theories in psychology and education, to explain the learning processes that occur in design education and, more specifically, in the academic design studio. With these purposes in mind, this section explores and connects three major ideas:

1. Design education is characterized by particular forms of teaching and learning that are present in most design programs in the world.

2. Design students actively construct their knowledge by working on projects that deal with situated problems and with the help of different kind of artifacts.

3. Design educators introduce students to the culture, values, and practices of design through a system of apprenticeship located within a community of learners and practitioners that mutually contribute the learning process.
2.3.1. Signature Pedagogies in Design Education

Lee Shulman, educational psychologist who served as president of the Carnegie Foundation for the Advancement of Teaching, defines signature pedagogies as “characteristic forms of teaching and learning” (2005, p. 52). These pedagogies are used to educate the future practitioners of a profession, who learn how to think, perform, and act with integrity according to the values of that profession. Signature pedagogies reflect and transmit the culture of a discipline, shape the character of its future practice, and form habits in the future practitioners. These pedagogies define the types of knowledge that are valid in a discipline, the methods that should be used to deal with that knowledge, and the hierarchies and sources of authority in the field. However, perhaps most importantly, signature pedagogies preserve the practices, traditions, base knowledge, values, and teaching and learning methods of a profession.

Signature pedagogies are characterized by being pervasive and routine, for dealing with uncertainty, and for engaging the students actively and involving them emotionally. They are pervasive since they are used in most of the educational contexts in which the work of a profession is taught (e.g., the studio model is present in most design programs all around the world). Likewise, these pedagogies span courses and define how the discipline is taught and how the profession is practiced. These pedagogical practices simplify the teaching and learning processes in a profession, which in turn makes it possible to address increasingly sophisticated topics and contents (Shulman, 2005). However, this simplification represents the greatest vulnerability of signature pedagogies; they become a source of rigidity for the
profession by preserving outdated practices and mindsets and “forcing all kinds of learning to fit a limited range of teaching [methods]” (Shulman, 2005, p. 56).

As Shulman (2005) points out, “signature pedagogies are pedagogies of uncertainty” (p. 57). Neither the instructor nor the student knows beforehand the outcome of the process they are following. For instance, in a design studio, the faculty define a project, but it is students’ performance and participation what will determine the outcome of the course regarding learning and design results. This scenario elevates the levels of anxiety in the classroom, yet teaches the students how to deal with uncertainty, which is “one of the most crucial aspects of professionalism” (Shulman, 2005, p. 57). In the following pages the signature pedagogies of industrial design education are presented and analyzed using the three dimensions proposed by Shulman (2005), namely surface, deep, and implicit structures.

**Surface Structure**

The surface structure is defined as the set of concrete attributes that characterize a signature pedagogy. These attributes include the physical, temporal, and material conditions of the learning environment (i.e., the design studio), the teaching and learning processes, and the interactions among faculty, students, and practitioners (Brandt et al., 2011; Shulman, 2005).

**Physical Space and Instructional Resources**

Shulman (2005) claims that signature pedagogies are supported and preserved by the physical space where instruction takes place. In the case of industrial design, most of the
instruction typically happens in the design studio. Physically, the studio is a room with dedicated desk space for each student, which can be used permanently during the academic semester for working on their projects and for having class meetings. In this space, furniture is arranged and rearranged enabling different types of interactions between students, instructors, and designed artifacts (e.g., models, sketches, and virtual designs). Additionally, the typical studio usually features shared spaces and resources, such as books, computers, boards, communal tables, and drafting and modeling tools (Brandt et al., 2011; Shulman, 2005).

In some cases, studios are adjacent to the shop where students can build their models and learn about materials and production processes. Also, it is frequent to find annex rooms where students can perform research activities (e.g., conduct interviews or do experiments), take pictures, exhibit their work, and collect sketches, blueprints, models and prototypes for future reference. A variety of resources also mediates the learning experience provided by industrial design's signature pedagogy. For industrial designers, it is of particular importance to work and discussion of sketches, physical and virtual models, and prototypes. These artifacts are necessary to materialize, communicate, refine, and reflect upon their ideas, configuring what Seymour Papert, founding faculty member of the MIT Media Lab, called “objects-to-think-with” (1980).

For Brandt and colleagues, these artifacts have a double function: “on the one hand students use representations as a means to give their ideas a physical reality and to test them. On the
other hand, instructors use these models as an indication of students’ developing design knowledge” (2011, p. 332). The creation of these artifacts is at the core of the design activity. Through prototyping, design students make their ideas concrete, externalize their thinking process, and exercise metacognitive skills (Davies and Elmer, 2001). In the critique (addressed in the next section), sketches, models, and prototypes are usually accompanied by visual presentations (printed or digital) that synthesize and clarify the design process, core ideas, and status of the project. Another component of design’s signature pedagogy is the sketchbook. This element allows students to document their thought processes visually, collect inspirational materials, present and discuss their ideas in a concrete medium, and leave an audit trail of their design process (Sims & Shreeve, 2012).

Finally, Sims and Shreeve (2012) identify the brief as a critical component of design’s signature pedagogy. The brief—which can be implicit in the syllabus—is the faculty document that defines the design commission; that is, the problem, need, or opportunity to be addressed in the project. The brief offers a set of criteria to evaluate whether or not the design solution meets the needs of the proposed situation. As an instructional resource, the brief “structures learning activities… sets out the parameters for creating a particular product [and] encourages the student to critically evaluate their own work” (Sims & Shreeve, 2012, p. 61).

**Teaching and Learning**

Teaching and learning methods are also critical components of signature pedagogies. According to de la Harpe and Peterson (2008) and Brandt and colleagues (2011), the methods
that are used predominantly in design education are problem-based learning, project-based learning, critique sessions, experimentation, and making. The use of these methods reflects the principle of “learning by doing” (Sims & Shreeve, 2012). However, this learning process does not occur in a vacuum; it occurs within a community—a community of practice as defined by Lave and Wenger (1991)—formed by students, faculty members, and occasional guests. Additionally, teaching practices in design typically address real-world problems, which involve a real setting and community of stakeholders that can affect or can be affected by the design solution developed in the studio. In fact, Brandt and colleagues (2011) consider that addressing real-world problems is part of the signature pedagogy of industrial design.

The nature of problems contributes to the purpose of signature pedagogies; that is, to introduce students (or novices) into the practices and culture of a profession. In industrial design education, the studio serves as a transition space between the academic environment and the professional realm. The studio prepares students for the practical work of the field by addressing real-world problems; following design methodologies used in the practice; partnering with external institutions and sponsors; inviting practitioners to the studio; and having field trips to professional design environments (Brandt et al., 2011). Additionally, Sims and Shreeve (2012) identify the following elements as components of design's signature pedagogies: permanent dialogue and discussion in the studio, intense use of research in the design process, and assessment of projects and students’ learning process through the critique.
Dialogue and Discussion

The dialogue and discussion between students and faculty is a critical component of design’s signature pedagogy (Sims & Shreeve, 2012). This dialogue takes place in the formal context of the critique, but also in more informal and unstructured situations in the studio. Interactions may occur in the form of one-on-one conversations, group meetings, or artifact-oriented discussions. In the latter scenario, models, prototypes, and visual presentations convey ideas and are discussed, analyzed and critiqued. This ongoing dialogue helps students to review their thinking process, approach their project from different perspectives, refine the solutions they are proposing, and construct their identities as future design professionals.

Additionally, these interactions help instructors to assess students’ understanding of the problem and the consistency of their thinking process (Brandt et al., 2011; Sims & Shreeve, 2012). Dialogue also occurs among students—not only between students and faculty—which fosters collaboration and promotes the maturation of ideas by giving and receiving feedback. It is useful to learn how to articulate one's thoughts and build on top of other's ideas. Ultimately, the dialogue and discussion that take place in the design studio provide students with opportunities to develop their creative and critical thinking (Brand et al., 2011).

The Critique

One of the settings in which discussion occurs is the critique, which in turn, is another of the characteristic components of design’s signature pedagogy. The critique—the moment when students present their work to faculty, classmates, and guests—is typically conducted at the
end of the project, usually preceded by less formal desk critiques. Critiques are carried out in the design studio and involve the use of different media to represent concepts and design solutions, ranging from sketches to final prototypes. Usually, the critique starts by the students making a formal presentation of their work, followed by questions from the faculty and closed with comments and feedback from other students and guests (Brandt et al., 2011). The purpose of the critique is to assess students' work, provide feedback on their progress, and stimulate critical reflections. This moment of assessment also offers students the opportunity to practice their argumentative skills and their ability to communicate their thoughts with clarity and precision. For faculty members, the critique also represents a moment to introduce students to the value system of the profession (Brandt et al., 2011, Sims & Shreeve, 2012).

The Research

Typically, a project in an industrial design studio starts by students conducting research about the addressed problem, users, and context. According to Sims and Shreeve, research is a vital component of design education because it offers the students an inquiry-based learning approach, prepares them in developing disciplinary ways of thinking, and “underpins student’s creative practices” (2012, p. 57). The aim and scope of the conducted research will depend on the nature of the project and issues. However, some areas that are typically explored are the problem context, user perspectives, market and product features (including technologies, materials, and finishes), and product form (Sims & Shreeve, 2012). This design
research phase is especially suited to fostering student empathy since it is common to use a variety of methods to explore and understand the experience of users and stakeholders.

**Deep Structure**

The deep structure is defined as the “set of assumptions about how best to impart a certain body of knowledge and know-how” (Shulman, 2005, p. 55). This dimension is comprised of the assertions underlying professional education; subject matter addressed in the instruction; and connections between educational and professional environments (e.g., the practice of professional industrial design in studios and the use of the studio method in industrial design education).

**Underlying Assertions**

One of the more pervasive and powerful ideas underlying industrial design education is that students learn by doing in a social context and by direct experience. This approach to learning is associated with the concepts of apprenticeship and communities of practice. The former refers to the learning that occurs through guided participation in a social activity with companions that support the process (Rogoff, 1990). The latter refers to a group of people with a shared identity, who share knowledge and skills, leading to a distributed learning process (Lave & Wenger, 1991). These approaches to learning are used by industrial design faculty to guide students through the path to becoming professionals (Sims & Shreeve, 2012). Through these approaches, future designers acquire some of the most salient skills that define the industrial design profession, namely dealing with competing priorities, coping
with uncertainty and ambiguity, and managing ill-structured and complex problems (Sims & Shreeve, 2012).

In this process, the faculty are in charge of creating appropriate learning environments and in guiding the students' learning process. They do not provide the "right" response to student projects, but rather they help them in developing their own original solutions. As noted by Sims and Shreeve, "the outcome is unique to the person creating the work, and the teacher is trying to bring this creativity forth from the student, enabling rather than instructing” (2012, p. 59).

Finally, another important principle underlying industrial design education is the assumption that the studio pedagogy has the potential to prepare students for their professional life. This assumption is expressed in the central role that this pedagogy plays in most industrial design programs around the world—in which the studio is virtually omnipresent—and in the resemblance between this pedagogy and the professional industrial design studio. According to the Sims and Shreeve, the studio is “a contributor to signature pedagogies, because it helps to structure learning and teaching and prepares students for professional studio activities” (2012, p. 57).

**Connections With the Profession**

The design studio prepares students for professional life by mirroring the professional design studio, adapting its tools and practices, and adding those from the academic realm. It works
as a bridge between the academic and the professional realms (Sims & Shreeve, 2012) and becomes what Brandt and colleagues (2011) call a “sheltered practice community,” in which the student’s experience is similar to that of the professional studios, under the circumstances and particularities of an academic environment. As Brandt and colleagues point out, the academic studio "take[s] into account the larger disciplinary community of practice and seek[s] to provide a studio bridge, a sheltered practice community, in which students can learn the norms, practices, and tools use of the larger professional community of practice” (2011, p. 346).

This goal is achieved by fostering professional ways of thinking and doing through teaching strategies and learning activities that mirror practice situations. One of these strategies is to challenge students with real-world problems—grounded in the circumstances of professional practice—through a brief that resembles those that they would receive from a real client. Also, this strategy can be implemented by involving real stakeholders in studio projects as participants, clients, and project sponsors. In addressing real-world problems, students are expected to conduct research in their design process, which helps them to develop disciplinary ways of thinking (Sims & Shreeve, 2012). Another strategy to connect industry and academia is to offer students direct experiences and interaction with the professional realm. This goal can be achieved by inviting practitioners to the studio, by taking students to professional studios and industries in which they can “have a sense of how design professionals carried out their ideas” (Brandt et al., 2011, p. 342).
Faculty are responsible for creating the conditions to introduce students into the professional practice. Faculty members can organize the studio in ways that resemble those conditions found in the industry and interact with students in ways that are similar to the interactions between junior designers and design directors in the professional practice. Sims and Shreeve (2012) recommend that faculty members draw upon their personal experience in practice so that they can infuse the studio with that atmosphere.

**Subject Matter**

According to Sims & Shreeve (2012), the knowledge that design education deals with is a “problematic concept,” since it tends to be more procedural—knowing how—than declarative—knowing what. For the authors, this kind of knowledge is more fluid and is comprised of “diverse and sometimes complex skills, processes, understanding about cultural practices, and current esthetic notions” (2012, p. 59). Likewise, this skill set includes "knowing about people, art and design histories, and some theories that illuminate practices” (2012, p. 59).

In industrial design, two of the most important abilities that students are expected to acquire are coping with uncertainty and dealing with ill-structured complex problems. Since the students work to create new solutions for ill-defined (or wicked) problems, the outcomes of their processes are unpredictable and the routes to find solutions are unknown. When designing, students are expected to generate multiple alternatives that initially are imprecise and inconclusive, but as the project evolves these get more defined and refined. By dealing
with this scenario, students learn that design is ambiguous, risky, and requires personal commitment (Cross, 2006).

Understanding this kind of problem and proposing satisfactory design solutions, require that design students have clarity about for whom they design (end users and stakeholders) and the social context that surrounds the addressed problem. As a consequence, students are also expected to acquire and develop a sense of awareness of the audience and the context (Sims & Shreeve, 2012).

**Implicit Structure**

The implicit structure can be defined as the “set of beliefs about professional attitudes, values, and dispositions” (Shulman, 2005, p. 55). This is probably the most difficult dimension to identify in teaching and learning since its manifestations are not explicit and need to be inferred from the concrete aspects of a signature pedagogy. It is comprised by the values and principles of a profession, as well as the hidden curriculum underlying the profession’s education.

**Values and Principles**

One of the skills that industrial design students are expected to acquire is the capacity to deal with competing priorities such as “funding priorities, time pressures, conflicting biases, [and] personal and institutional politics” (Ankiewicz et al., 2006, p. 137). For instance, the designer usually has to mediate between the requirements imposed by the client and the needs
manifested by end users, which may be different. In this case, the designer has to balance these competing priorities and propose solutions that meet the client’s expectations and satisfies the users’ concerns.

As noted by Sims and Shreeve (2012), design students need to develop an awareness of the audience and the context for which they design. This awareness requires from designers an accurate interpretation of the social context and the reality of the project’s stakeholders. According to the authors, the accuracy of these interpretations comes from a thorough study of the context and the capacity of the designer to be sensitive toward the user’s needs, concerns, and circumstances.

Another value that students are expected to acquire is autonomy. This quality is fostered by faculty when they guide students to come up with their own ideas and alternatives, instead of providing definitive responses or courses of action. Likewise, faculty promote the development of a sense of self-criticism by encouraging students to evaluate their work critically and decide for themselves the course of their projects within a set of general constraints.

The sum of these values in the context of industrial design education promotes professionalism. This outcome is part of introducing students to the culture, practices, and values of a profession by using signature pedagogies. Faculty—and society in general—expect students to start behaving professionally as their education progresses. This
expectation is transmitted through the criteria faculty utilize to evaluate students' performance and the behavior that they model to students in their daily interactions.

**Hidden Curriculum**

The hidden curriculum is defined as “the tacit teaching to students of norms, values, and dispositions that goes on simply by their living in and coping with the institutional expectations and routines” (Apple, 2012, p. 40). It is comprised of unstated values, attitudes, and norms that are conveyed through implicit messages that students receive in their learning environment apart of the official curriculum or the school’s explicit mission (Cornbleth, 2003; Dutton, 1987).

Even though this concept has been used to criticize undesirable attributes of educational contexts, in the case of signature pedagogies the hidden curriculum is an effective resource for transmitting desirable values to future professionals. In the case of industrial design education, the studio has been identified as the place and practice in which these tacit messages are conveyed more clearly (Brandt et al., 2011; Carvalho et al., 2009; Ward, 2009; Davies & Elmer, 2001; Dutton, 1987).

For instance, Davies and Elmer (2001) found that the ways design studios are organized and prepared depend on their cultural and institutional contexts. This finding means that the experience students go through in the design studio depend in part on the context in which instruction takes place. Considering that these experiences define how design is practiced by
students (Brandt et al., 2011), it is possible to infer that the environment in which design instruction occurs has an impact on how students' perform as professionals.

A manifestation of this impact is what students and designers judge as “good design” and as “good design practices.” According to Carvalho and colleagues, “designers describe what makes a good design via ‘codes of legitimation’” (2009, p. 484); that is, the dominant construction of achievement and success in a given field or social context (Carvalho et al., 2009). What this means is that the concept of “good design” that students learn and implement as professionals, comes from the dominant view in the field, which is transmitted tacitly in the design studio, its projects, and critiques.

According to Ward (1990), these dominant views are conveyed through different channels such as the use of knowledge in the studio (the way knowledge is produced, validated, and distributed); social interactions that the studio fosters (the roles, hierarchies, and relationships); and a tendency to compete or collaborate with fellow classmates. It is important to note that Ward arrived at these conclusions more than twenty five years ago, so they do not necessarily reflect the current situation in the design studio.

2.3.2. Design Studio Pedagogy

The design studio plays a fundamental role in design’s signature pedagogies, which makes it one of the most salient features of design education. It is the space where most of the teaching and learning take place, it prepares students to make the transition from the
academic environment to the professional realm, and it provides opportunities to develop creative and critical thinking (Shulman, 2005; Sims & Shreeve, 2012). Also, the design studio conveys a particular pedagogy that promotes rich interactions between students, as well as a relationship of apprenticeship between students and faculty members. The studio is a space of negotiation between traditional design practices and localized cultural and institutional contexts. The studio introduces students to the practices and culture of the design profession by mirroring some of the practices of professional studios and it is considered the “backbone” of most of design programs around the world (Shulman, 2005; Rogoff, 1990; Sims & Shreeve, 2012; Salama, 1995).

The studio is described by Shulman as the space where “students assemble around work areas with physical models or virtual designs on computer screens;… [they] are experimenting and collaborating, building things and commenting on each other's work… The focal point of instruction is clearly the designed artifact. The instructor… circulates among the work areas and comments, critiques, challenges, or just observes. Instruction and critique are ubiquitous in this setting, and the formal instructor is not the only source for that pedagogy” (Shulman, 2005, p. 54).

In the design studio, students work intensively on their projects, meet with the faculty to present and discuss their work, and give and receive feedback and interchange ideas and experiences with their peers. These interactions occur in three major moments: during work sessions, desk critiques, and critiques. During work sessions, students make progress on their
design projects and give and receive informal feedback. During desk critiques, instructors and students discuss progress on the projects, challenges, and possible courses of action. During critiques (called design juries by Anthony, 1991), students present the final results of their work to faculty, classmates, and occasional guests.

The learning process that occurs in the design studio is the result of these interactions among students, between the students and faculty, and from the creative activity associated with working on design projects. The project drives this process and plays a central role in the design studio. As Simon argues, the studio is “project-oriented, with each project serving as a vehicle for specific learning objectives. Students undertake design problems of increasing complexity that introduce them incrementally to the knowledge and skills of the discipline” (Simon, 2012, p. 276-77).

The design studio is characterized by the constant and direct interaction between the students and instructor in a relationship that has been equated to that of the master-apprentice of earlier times (Anthony, 1991; Salama, 1995; Crawford, 2013). For Brown and Adler (2008), this system is an example of a social learning environment, in which students learn from the guidance of an established practitioner who comments and critiques their work and from the assistance and feedback they receive from their classmates (Anthony, 1991). From these interactions, Anthony (1991) highlights the importance of the desk critique, the moment when the instructor provides feedback individually to each one of the students at their respective workstations. In Anthony’s criteria, the desk critique “may be seen as a unique
strength of design education, occasionally resulting in lifelong friendships between faculty and students" (Anthony, 1991, p. 12).

However, Weber (1994, in Salama 1995) criticizes this teaching technique due to the emphasis it has on the individual rather than in the group and the little opportunity that it provides to students to learn from comments made to the work of others. This apparent weakness can be compensated for when the instructor offers general remarks to the group after a desk critique session or when students informally exchange their views about their design process.

Methodologically, the design studio is driven by a project (or a similar activity that involves the solution of a problem through design) that engages students in experiential activities. A critical component of the project is the identification and definition of the problem by the student. In some cases, the problem is not given, but a problem space is suggested. In these instances, students conduct different types of research activities to frame the problem and inform potential solutions. Then, students create models, prototypes, visualizations, and simulations to test and refine their design concepts. Also, these tools are used by students to communicate their process and clarify their ideas (Crawford, 2013). The learning processes that occur in the design studio are manifold and are supported by a series of individual and sociocultural theories of learning presented in the following section.
2.3.3. Learning Theories in Design Education

As it was previously stated, the design studio is one of the most important components of design’s signature pedagogy. The studio constitutes a learning environment that imprints on the students a mark that is characteristic of the profession: the design studio is where students become professional designers. This learning experience entails two major processes: the acquisition of skills and knowledge and the introduction to the culture and values of the design profession. These two processes can be explained from two different approaches. The acquisition of skills and knowledge can be understood using an individual theory of learning such as constructivism, and the introduction to the culture and values of the profession can be understood using a couple of sociocultural theories of learning such as apprenticeship and communities of practice. In the following pages, these theories are presented, as well as their connection with the learning phenomena that occurs within the design studio.

**Individual Approaches to Learning**

The acquisition of knowledge and skills in the design studio has been described as a clear manifestation of the constructivist theory of learning. Crawford argues that “many of the tenets of the constructivist model of education may broadly be said to be manifested in the studio method used in American design instruction at the college level as it exists today” (2013, p. 286).

Constructivism’s central idea is that the individual constructs knowledge based on experience and prior knowledge. From a constructivist perspective, knowledge is inherently unstable, is
formed inside the person rather than imposed, and is the product of the individual’s set of beliefs and experiences. As a consequence, knowledge is subjective, personal, and contextually situated (Schunk, 2011). Constructivism assumes that people are active learners and gain knowledge for themselves through interaction with the world and with others. Understanding is acquired through discovery, which is facilitated by meaningful experiences. Social interactions—with teachers, peers, parents, and others—also facilitate this learning process which becomes social and situated. From this perspective, the role of educators is not to deliver knowledge, but to create learning environments that foster the active involvement of learners with content through direct experience and social interactions (Schunk, 2011).

These principles and assumptions from the constructivist theory of learning can be recognized in the learning process that takes place in the design studio. Students are presented with a problematic situation that usually corresponds to a real world issue (contextually situated). Then, they gather information from different sources and disciplines to frame and understand the problem (building their own knowledge). Based on this initial information, they interact with others to share and refine their ideas and design concepts (social interaction). Students materialize these concepts in the form of models, prototypes, and visual representations. These tangible manifestations of their ideas are manipulated, tested, and then refined (direct experience and discovery). Finally, after several iterations, students present their design solution and show a design process that evidences how they build their understanding of the problem through experimentation and social interactions.
Sociocultural Approaches to Learning

The introduction of students to the culture and values of the design profession has been discussed by authors such as Nigel Cross (2006), Meredith Davis (2008, 2016), Carol Brandt and colleagues (2011), and Ellen Sims with Alison Shreeve (2012). They agree in that design students are introduced into the practices and culture of the profession through an apprenticeship system supported by a community of practice. For instance, Cross (2006) states that in traditional design education design practitioners pass their knowledge, skills, and values to aspiring designers, through a system of apprenticeship. In this system, design students tackle small projects and assume the role of professional designers that are guided by more experienced practitioners. Similarly, Davis (2008, 2016) recounts the journey of design students and young designers that, traditionally, entered the profession as apprentices of more experienced designers. In this system, aspiring designers used to start their careers by assuming roles in technical production and support, and eventually earned “the right to control form after demonstrating attention to detail and the ability to execute the creative vision of more experienced practitioners” (2016, paragraph 6).

According to Brandt and colleagues (2011), the learning processes that take place in this apprenticeship system do not occur in a vacuum, but they happen inside a community of practice. In this type of community, apprentices start by undertaking small and peripheral roles, and with time they become more experienced and start to move to more central and influential positions in the community. As noted by Sims and Shreeve (2012), the role of teachers (or masters) is instrumental in the evolution that novices have inside the community.
According to these authors, teachers help their students to become part of these professional communities “through using signature pedagogies relevant to the community of practice” (2012, p. 59).

The concept of apprenticeship was proposed by Barbara Rogoff to refer to situations in which “novices advance their skills and understanding through participation with more skilled partners in culturally organized activities” (Rogoff, 1990, p. 39). As stated by Rogoff (1990), this system usually involves a “master” (or expert), whose skills are more advanced than those of the novices, and other apprentices, who are still learning but have the capacity to offer their support to newer practitioners. “Apprentices learn to think, argue, act, and interact in increasingly knowledgeable ways with people who do something well, by doing it with them as legitimate, peripheral participants” (Lave 1988, in Rogoff, 1990). This concept is also related with Vygotsky’s zone of proximal development, since the novices (or apprentices) operate in tasks beyond their abilities under the guidance and the support of the master (Schunk, 2011).

In the design studio, this model of learning is found in the relationships between faculty (the masters) and students (the apprentices). This model is also seen in the relationship that students establish with each other as members of small groups inside a larger design team. At the small group level, they collaborate with each other in performing the tasks required by the “master,” and at the team level, they share their findings and their experiences so everyone can build on the top of others’ work. The concept of “communities of practice” was
proposed by Jean Lave and Etienne Wenger to refer to “a set of relations among persons, activity, and world, over time” (1991, p. 98). These communities promote shared practices and knowledge by providing “the interpretive support necessary for making sense of its heritage” (1991, p. 98).

Closely related to this concept, the authors also offer the idea of “legitimate peripheral participation” as a description of the interactions and learning processes that occur within a community of practice. In Lave and Wenger’s words, such participation refers to “the particular mode of engagement of a learner who participates in the actual practice of an expert, but only to a limited degree and with limited responsibility for the ultimate product as a whole” (1991, p. 14). In the design studio, legitimate peripheral participation is present in the limited roles that students play in the overarching design process guided by faculty. These roles consist of performing discrete and limited tasks and projects in which level of difficulty and required mastery increase alongside the student’s expertise. The participation of students in the design process occurs within a community of practice. The community is defined by the group of students and designers that share their identity, knowledge, skills, and practices. In this community, participants constantly interact to give and receive support, which leads to a powerful and distributed process of learning.

The support that novices and apprentices receive in a community of practice in the form of scaffolding is aimed at extending “the range of the learner, permit[ing] the attainment of tasks not otherwise possible” (Schunk, 2011, p. 246). Scaffolding refers to situations “in
which the learner gets assistance or support to perform a task beyond his or her own reach if pursued independently when unassisted” (Pea, 2004, p. 430).

In the design studio, scaffolding is present in the set of activities that faculty perform to support the students’ acquisition of knowledge and design skills. Some examples of these activities are: providing information and examples, modeling correct practices, guiding or supervising the student’s tasks, and involving external experts in the design and learning processes. According to Schunk (2011), teachers gradually withdraw the scaffolding as students gain mastery and the capacity to perform independently. Using Vygotsky’s terms, these activities keep students in their zone of proximal development (ZPD). ZPD refers to the group of activities that learners can perform with assistance, located between what they can do by themselves and what they cannot do even with support (Vygotsky, 1978; Pea, 2004; Schunk, 2011). In synthesis, the design studio entails the acquisition of knowledge and skills, and acculturation in design. The former is achieved through a constructivist learning environment in which educators provide the conditions for students to actively build their knowledge through interaction with the project, their classmates, and the external world. The latter is achieved through the social interactions the students have within the design studio (their community of practice), and the learning dynamics that these interactions facilitate.
CHAPTER 3: CONCEPTUAL FRAMEWORK AND RESEARCH QUESTIONS

3.1. Research Paradigm: A Naturalistic Perspective

This study can be classified under the naturalistic paradigm (Groat & Wang, 2002) due to its characteristics, the concepts it addresses, and its underlying assumptions. Groat and Wang propose a tripartite model that clusters different research philosophies or paradigms into three major categories: postpositivism, naturalism, and emancipatory research. The naturalistic paradigm is characterized by conceiving multiple socially-built realities, valuing the interaction between the researcher and the phenomena as a source of insight, and recognizing the researcher’s theoretical positions and values. Also, research done under this paradigm acknowledges the role of interpretation in the process of inquiry and recognizes the importance of the context and its influence on the studied phenomena (Groat & Wang, 2002; Guba, 1981).

Under this paradigm, the concept of generalization and objectivity are questioned and subverted. Proponents of the paradigm consider that generalization is not possible since there is a relationship of interdependence between social or behavioral phenomena and their context. Also, the concept of objectivity is debated on the basis that the investigator becomes part of the studied phenomena while conducting research and that researcher and participants are mutually influenced through their interactions (Guba, 1981). As a consequence, the research guided by this paradigm is also concerned with the interactions between these two factors (phenomena and the natural setting where they occur), as well as with the interactions between the researcher and the participants. These interactions are valued to the extent of
considering the investigators as instruments themselves who are “willingly trading off some objectivity and reliability (in the rationalistic sense) in order to gain greater flexibility and the opportunity to build upon tacit knowledge” (Guba, 1981, p. 79).

At the methodological level, proponents of this research paradigm “prefer to have the theory emerge from the data themselves” (Guba, 1981, p. 78) and advocate for the use of an emergent design that unfolds as the study progresses and the investigators and respondents interact. At the tactical level, this research paradigm has been associated traditionally with qualitative research methods. However, Guba (1981) argues that both approaches, quantitative and qualitative, can be used and can contribute to the production of knowledge under this system of inquiry.

The objective of this study—that is, to identify how educational practices in industrial design education promote the development of student empathy for the users—is aligned with the previous assumptions. Implicitly, the study’s objective recognizes that there are multiple ways to demonstrate empathy, acknowledges the diversity of perspectives and practices in design education, and considers the role of the context in the manifestation of student empathy for users.

Additionally, at the core of the concept of empathy resides the notion that reality can be perceived and conceived in multiple ways. Having empathy for others implies that the observer acknowledges that others have different views, thoughts, and emotions, and, as a
consequence, reacts by attempting to understand these different perspectives and by feeling the emotions elicited by others.

Finally, from my experience as a researcher and as an educator, I have witnessed the richness and depth of information that can be gathered and the lessons that can be learned from the direct interaction with people regarding their views, understanding of the world, ways of learning, and creating relationships.

3.2. Conceptual Framework

A conceptual framework is defined as “a system of concepts, assumptions, expectations, beliefs, and theories that supports and informs your research… [including those] ideas and beliefs that you hold about the phenomena studied” (Maxwell, 2005, p. 39). It can be understood as a map of the territory that is explored by the researcher (Miles & Huberman, 1994), as a preliminary model of the phenomenon and as a tentative theory about it (Maxwell, 2005).

A conceptual framework is characterized by being succinct and holistic. It invites the researcher to be selective regarding the concepts and ideas that are salient and the connections that are more meaningful. This selectivity, however, comes at the cost of disregarding aspects of the studied phenomena. Even though the conceptual framework is based on existing knowledge, it is something that the researcher builds according to his or her
understanding of the situation. As a consequence, the conceptual framework is under permanent construction, revision and evolution (Miles & Huberman, 1994; Maxwell, 2005).

Following the previous considerations, the conceptual framework presented in Figure 6 was created to schematize my understanding of how industrial design students express and develop empathy for users (understood as the groups of stakeholders that are affected by the design solution proposed by the designer) when they are exposed to a human-centered design studio. It synthesizes and proposes connections between salient concepts and theories found in the literature review, identifies the actors who play a role in the studied phenomenon, and defines the factors that influence the development and expression of empathy in this context.

In this framework, the role of design faculty is to set up the learning environment that students experience. This role comprises planning and guiding the design studio, defining the involvement of potential users in the design process, providing feedback to students, and ultimately, encoding and reinforcing human-centered issues in the studio.

The studio, as a signature pedagogy of design education, features the three structures proposed by Shulman (2005): a surface structure that comprises the concrete attributes that characterize the learning experience; a deep structure that includes the assumptions about how to best acquire knowledge and skills; and an implicit structure that consists of the beliefs, attitudes, values, and dispositions in the field and the academic setting. Additionally, the role of users varies according to their level of involvement in the project: it ranges from
merely informing the process through research to co-creating the design solution with the student. This level of involvement depends on how faculty plan projects and how students address problem demands. In this conceptual framework, as well as in human-centered approaches to design, users are considered experts of their own experience who can inform and inspire the design process. Also, in this model, users have needs, aspirations, and expectations are to be met through the design solution.

Finally, the conceptual framework shows that when industrial design students engage in projects with a real context, problem, and group of stakeholders, the outcome is twofold. Students not only create products, services, or experiences that meet users' needs, but they also experience a learning environment that helps them to develop and express empathy for the same users. The process that students follow and the solutions they create constitute evidence of learning. In this research study, this evidence was collected and examined to find how empathy for users was developed and expressed by industrial design students.
Figure 6. Conceptual framework.
3.3. Objectives and Research Questions

As established in the literature review, a human-centered approach to design requires from practitioners an empathic understanding of users to create design solutions that satisfy their needs and circumstances. However, if student empathy is in decline as suggested by Konrath and colleagues, then design education faces the challenge of identifying and refining appropriate methods and educational strategies to promote empathy in a generation that appears to lack the abilities of previous generations. This challenge also represents an opportunity to examine the educational processes that design students experience throughout their formal education and, specifically, those that occur in the design studio where most of the disciplinary learning occurs.

The study examines the educational practices in the design studio that have the potential to promote empathy in industrial design students. Ultimately, the goal of the study is to contribute to the discussion of how to educate a new generation of designers that serves others. With this purpose in mind, the study explored the following research question:

**RQ:** How do teaching and learning practices in the industrial design studio promote the development and expression of student empathy for users?

The exploration of this question involved the examination of research sub-questions focused on the educational practices put in place in the design studio and sub-questions focused on
students’ manifestations of empathy for users. The sub-questions that were investigated are as follows:

**rQ1:** How do faculty reflect concern for the development of student empathy for users in the context of the industrial design studio?

**rQ2:** How do students express their empathy for users in the context of an industrial design studio?
CHAPTER 4: METHODOLOGY

4.1. A Mixed Methods Approach

The study was conducted using a simultaneous mixed methods design driven by its qualitative component (notation: QUAL + quan) as defined by Morse (2002; 2010). This research strategy combines qualitative and quantitative techniques that are used simultaneously, but the former is dominant and drives the research project. The mixed methods research design is used when “some portion of the phenomenon may be measured, and this measurement enhances the qualitative description or interpretation” (Morse, 2002, p. 202). Under a different classification system of mixed methods, this study followed an “embedded design” (Creswell & Plano Clark, 2011), which is described as a strategy in which quantitative (or qualitative) data is collected within a broader qualitative (or quantitative) design to supplement and enhance the overall dominant strategy.

The original design proposed for this study was purely qualitative following a grounded theory approach. However, based on recommendations of the dissertation committee, it was decided that a quantitative component would also be included as part of the study methodology. The decision was made with the purpose of strengthening the trustworthiness of study results by providing evidence of the extent of change in students' levels of empathy. Additionally, adopting a mixed methods research design allowed the combination of both techniques for data collection and for data analysis. The approach provided a quantitative perspective on the qualitative data and a qualitative perspective on the quantitative data. Examples of the combination of methods in the study are the analysis of student discourse...
using descriptive statistics, and the exploration of correlations between students’ level of empathy and the number of times students mentioned users in their presentations.

In an article published in 2007, Johnson, Onwuegbuzie, and Turner presented a synthesis of nineteen different definitions of mixed methods provided by a broad range of authors. As a conclusion of their article, the authors formulated their own inclusive definition which was adopted in the present study, as follows:

“Mixed methods research is an intellectual and practical synthesis based on qualitative and quantitative research; it is the third methodological or research paradigm (along with qualitative and quantitative research). It recognizes the importance of traditional quantitative and qualitative research but also offers a powerful third paradigm choice that often will provide the most informative, complete, balanced, and useful research results” (Johnson, Onwuegbuzie, & Turner, 2007, p. 129).

4.2. Overview of the Research Strategy

As can be seen in Figure 7, which synthesizes the research strategy used in the study, a variety of methods for data collection and analysis from different traditions were combined to investigate the questions defined in the previous section. From a qualitative perspective, the study implemented an ethnographic strategy using techniques such as participant observation, semi-structured interviews, discourse analysis, and document analysis. From a quantitative approach, the study implemented quasi-experimental and correlational strategies,
using techniques such as questionnaires and surveys for data collection, and correlations and analysis of variance (ANOVA) for data analysis. In the following pages, the different components of this research strategy are presented in detail, as well as a description of the site and participants of the study.

4.3. Role of the Researcher

Qualitative research methods have been traditionally associated with the naturalistic paradigm in which the interactions between the researcher and the phenomenon are valued and even encouraged (Groat & Wang, 2002). In contrast, quantitative research has been associated with the positivist/postpositivist paradigm in which these interactions are
minimized by putting distance between the investigator and the object of study for the sake of objectivity (Groat & Wang, 2002; Guba & Lincoln, 1998; Mayes 2001).

This difference in the roles that the researcher is expected to play under each of these paradigms is a matter of ongoing discussion. In the mixed methods literature different positions can be found about the compatibility of quantitative and qualitative research methods and how appropriate it is to combine also research paradigms (Creswell, Plano Clark & Gutmann, 2008). For instance, Hesse-Biber (2010) claimed that the use of mixed methods research has tended to be guided methodologically by positivism and argued that a more balanced orientation would be preferable. Johnson and Onwuegbuzie (2004) advocated for adhering to a pragmatic perspective when conducting mixed methods research, concurring with Creswell, Plano Clark and Gutmann (2008), who recommended that investigators consider the nature of their questions and their research problems for a coherent theoretical perspective. Additionally, Creswell and Plano Clark (2011) suggested the adoption of an umbrella paradigm compatible with the research intention instead of mixing paradigms. In the case of this research study, the driving approach was qualitative and the overarching research paradigm was naturalism. As a consequence, the study valued the interactions between the researcher, the participants, and the studied phenomenon, and the researcher assumed the role of a measurement device.

As discussed by Groat and Wang (2002) and Creswell (2009), the role of the researcher as a measurement device implies that he or she collects data in the natural setting where the
observed phenomenon occurs, he or she interacts with this setting and the people in it, and is the data collection instrument. As a measurement device, the researcher is required to disclose his or her background and other relevant information that could affect the investigator’s reading of the phenomenon with the purpose to detect and acknowledge possible biases. Additionally, in the naturalistic paradigm, the voice of the investigator is that of an active participant, which means that writing in the first person and using personal pronouns is accepted and even encouraged when required.

I am a Colombian industrial designer with a master’s degree in education. I have been interested in the use of design methods and practices in educational contexts since 2004 when I first taught an Art and Design workshop for children for one year in a public library in Bogota, Colombia. However, this interest only became clear when doing my master’s thesis which consisted of the planning, implementation, and evaluation of a 12-week, after-school design workshop in which I investigated the learning outcomes that such an experience had on 9-year-old children.

One of my findings was that some of the students exhibited empathy during the design process, which was compatible with the literature I reviewed at that time. Being aware of the importance of this ability, I became interested in understanding how design education and design-based learning environments could promote empathy, which led me to continue exploring this topic during my doctoral studies. Consequently, I have become aware of the central role that empathy plays in the design process in order to create products, services,
experiences, and systems that respond to the needs, desires, expectations, and aspirations of people. This awareness has motivated me to be not just a researcher, but also an advocate of empathy development through design education. As a consequence, a challenge I had when conducting this study was to separate these two roles to adopt a critical perspective on my actions as a researcher to avoid biasing my observations, analysis, and interpretation. Further in this section, other measures I took to mitigate and avoid biases and to safeguard the quality of this research study are detailed.

4.4. Study Site and Participants

The fieldwork for this study was conducted during one academic semester in the Department of Industrial Design at a major land-grant public research university in the southeastern United States. Three different courses were studied: (1) a basic industrial design studio taken by undergraduate students in their third semester in the Bachelor of Industrial Design; (2) an advanced industrial design studio taken by graduate students in their second semester in the Master of Industrial Design; and (3) a lecture course on human-centered design taken by undergraduate and graduate students in industrial design, including some of the students that were in the graduate studio. These settings were selected to account for the following considerations and assumptions:

- The design studio, as one of the signature pedagogies of industrial design education, has the potential to foster empathy because it is the primary place where students acquire the skills and values of the profession.
• Studying two design studios that differ in many of their characteristics and purposes allowed for contrasting and comparing a wide range of educational practices and circumstances experienced by both groups.

• Studying a lecture course on human-centered design in which undergraduate and graduate students participate allowed for documenting how empathy scores were distributed in a heterogeneous group and how these scores varied over time.

• The length of these learning experiences was enough to allow for prolonged engagement and persistent observation of these settings which favored the trustworthiness of a study conducted under the naturalistic paradigm (Guba, 1981).

• Participants (undergraduate and graduate students and faculty members) were mature enough to respond adequately to interviews that explore their behaviors in the studio.

A total of 60 individuals participated in this study, including 46 undergraduate students, 12 graduate students, and two faculty members. The participants were naturally divided into three groups (there was no randomization in selecting or assigning the participants to these groups), according to the course they were taking or teaching, as follows:

• Group 1: Basic Industrial Design studio
• Group 2: Advanced Industrial Design studio
• Group 3: Human-Centered Design lecture course

The study used different research techniques to collect data from the individuals mentioned above according to group membership. An overview of these techniques and the distribution of the participants per group can be seen in Figure 8. Additionally, a detailed description of
the participants and the courses they were taking or teaching is presented in the following pages.

<table>
<thead>
<tr>
<th>DATA COLLECTION PER GROUP OF PARTICIPANTS</th>
<th>RESEARCH METHODS (QUAL+quan)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Participant Observation</td>
</tr>
<tr>
<td>Group 1 (n=22) Basic Industrial Design Studio</td>
<td></td>
</tr>
<tr>
<td>Group 2 (n=11) Advanced Industrial Design Studio</td>
<td></td>
</tr>
<tr>
<td>Group 3 (n=29) Human Centered Design Course</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 8.* Synthesis of research techniques used with each group.

4.4.1. Group 1: Basic Industrial Design Studio

The Basic Industrial Design studio is a six-credit course that undergraduate students in industrial design take in their fourth semester. Before this studio, students completed a year of design fundamentals with students from other design majors and a semester of basic industrial design. In parallel, students usually take courses in three-dimensional modeling, sketching and ideation, and manufacturing processes.

The objective of this studio is to introduce students to the theories, methods, and language of industrial design through elementary problems in form and function, using various materials
and media. At the end of this studio, it is expected that students reach the following learning objectives stated in the course syllabus:

- Identify the difference between the culture and practice of industrial design and those of art and engineering.
- Design based on their understanding of the relationship between form and function.
- Take human factors into account when designing; be aware of the differences in designing for mass manufacture as opposed to hand-crafting.
- Produce models and sketches that show the development and refinement of their ideas.
- Produce accurate drawings to specify a form for production.

In the semester during which data was collected, students worked on five projects:

1. Design of a condiment organizer for a local restaurant.
2. Design of a kitchen utensil based on the needs of a particular user.
4. Design of a fashion shoe for developed markets, manufactured with African materials and production processes.
5. Design of a product based on students’ ideas and observations throughout the semester.

This group was comprised of the students registered in the BID studio plus their instructor (the teaching assistant did not take part in the study). A total of 22 students (100% of the
class) consented to participate in this investigation. This group had thirteen females and nine males. All except one participant were undergraduate students in industrial design in their sophomore year; the other participant was an undergraduate student in graphic design in his Junior year. Their ages ranged from 18 to 21. The instructor was a senior faculty member with a background in architecture and industrial design. He had several years of experience in the industry and almost two decades in academia; also, he was interested in entrepreneurship, innovation, and the design process.

The BID group was selected on the basis of their relatively limited exposure to human-centered design methods during their undergraduate studies, introductory nature of the studio, and access the instructor provided to the researcher. The members of this group were subjected to participant observation, semi-structured interviews, discourse analysis, survey on students’ academic background, and empathy questionnaire (Interpersonal Reactivity Index).

4.4.2. Group 2: Advanced Industrial Design Studio

The Advanced Industrial Design studio is a six-credit course that graduate students in the Master of Industrial Design (MID) program take in their second or fourth semester depending on the amount of previous design study. Before this studio, second-semester students graduated from a four-year undergraduate program in industrial design or a related design field and took a graduate studio in advanced industrial design. In contrast, fourth-semester students graduated from an undergraduate program in a non-design area and took at
least 30 hours of undergraduate courses in industrial design and a graduate studio in advanced industrial design. In parallel, students taking this studio usually take courses on materials and manufacturing processes and electives.

The objective of this studio is to foster students’ understanding of context and stakeholders by framing insights, exploring concepts, and developing solutions in an iterative process. At the end of this studio, it is expected that students reach the following learning objectives stated in the course syllabus:

• Define an industrial design problem.
• Identify the scope of a problem and the involved stakeholders.
• Identify methods to develop and evaluate design solutions.
• Summarize existing solutions and compare them with user needs.
• Participate in peer critiques.
• Create a written document proposing an approach to develop a design solution.

During the semester when the data was collected, students worked on two projects:

1. Design of a simulator to test sports bras (sponsored project).
2. Writing of a proposal to conduct design research on a workforce-related issue.

This group was comprised of the students registered in the AID studio, plus their instructor (the teaching assistant did not take part in the study). A total of eleven students (100% of the class) consented to participate in this investigation. The group had two females and nine
males. All the students were enrolled in the MID program; six of them had a background in industrial design and were in their first year of grad school (second-semester students), and five of them had diverse backgrounds—that is, Arts, Math, Engineering, and Education—and were in their second year of grad school (fourth-semester students). Their ages ranged from 24 to 45. The instructor was a senior faculty member with a background in industrial engineering and ergonomics. She had a decade of experience consulting, conducting research, and teaching, and was interested in universal design, applied research in product development, and aging population.

The AID group was selected on the basis of the studio focus on applying human-centered design methods in conducting design research, student’s exposure to different academic and professional experiences, and the access that the instructor provided. The members of this group were subjected to participant observation, semi-structured interviews, discourse analysis, survey on students’ academic background, and empathy questionnaire (Interpersonal Reactivity Index).

4.4.3. Group 3: Human Centered Design Course

The Human-Centered Design course is a three-credit lecture class that undergraduate students in industrial design take in their junior or senior years. This course is also taken by graduate students in the MID program as a design elective. Before this studio, undergraduate students have taken one year of design fundamentals, and 2.5 or 3.5 years of basic and intermediate industrial design. In the case of graduate students, their backgrounds vary according to their
program of origin, their experience in the profession, and their year in the MID program. The objective of this course is to introduce students to “the spectrum of human physical and cognitive capabilities as they relate to user interaction with designed products and environments” (Human-Centered Design course syllabus).

During the semester when the data was collected, students had lectures and completed exercises covering the following topics:

1. Biomechanics and musculoskeletal system.
2. Anthropometry in static and dynamic situations.
3. Perception, thinking, information processing, and visual processing.
4. Physiology, musculoskeletal disorders and injury mechanisms.
5. Human factors, principles of Universal Design.
6. Aging and motivation.
7. Human-centered design principles.

This group was comprised of a total of 29 students (83% of the class) registered in the HCD course who gave their consent to participate in this study. This group had fourteen females and fifteen males. Most of the participants (n=22) were undergraduate students in industrial design (junior and senior years), two of them were undergraduate students in other programs, and five of them were enrolled in the MID program (4 of these 5 students also were part of group 2). Their ages ranged from 19 to 45.
The HCD group was selected on the basis of the course focus on how human capabilities relate to user interaction with designed products, the relatively large number of students taking this class (compared to the smaller number of students that take design studios), and the access that the instructor provided. The members of this group were subjected to a survey on students’ academic background, and an empathy questionnaire (Interpersonal Reactivity Index)

4.5. Qualitative Component: An Ethnographic Research Strategy

From a qualitative approach, the study implemented an ethnographic research strategy aimed at identifying educational practices and circumstances associated with the development of student empathy for users and at identifying and characterizing the expressions of students empathy in the industrial design studio. This strategy, originating in cultural anthropology, focuses on describing and interpreting cultural behavior through in-depth engagement with the studied context mediated primarily by thorough observation (Groat & Wang, 2013). Ethnographic research is characterized by a holistic and detailed exploration of the studied phenomena in its natural setting (that is, where it naturally occurs), the focus on the respondent’s viewpoints, and the collection of unstructured data directly by the researcher who acts as a measurement device.

The data collected using this strategy is verbal, visual, and behavioral. These data were collected through the use of multiple research methods but especially through participant observation. Ethnographic research is also characterized by a drive for finding meaning in the
collected data through interpretation and by a prolonged and intense engagement of the researcher in the studied setting. Usually, ethnographic research studies a small number of cases (or even a single case) and allows for changes in the research plan throughout the process due to its open-ended nature (Groat & Wang, 2013; Miles & Huberman, 1994; Creswell, 2009; Guba & Lincoln, 1998).

An ethnographic strategy was used to explore the learning experience that students in groups 1 and 2 had in their respective industrial design studios. The goal was to identify and classify educational practices and circumstances in both settings, especially the strategies that faculty used to address user-related issues. Further, the goal was to determine the aspects of the projects in which students directed their attention and identify and track the expressions of student empathy present in their discourse, their actions, and their creations.

4.5.1. Data Collection

The techniques used to collect data, from a qualitative approach, were: participant observation (registered through note-taking and photography), semi-structured interviews (registered through note-taking and audio recordings), discourse analysis (based on video and audio recordings), and document analysis (based on documents collected from the studios). As can be seen in Figure 9, these techniques were used at different points of the semester in each studio, depending upon the activities and phases of the projects that were being conducted in each of these settings. In the following pages, these different techniques are presented and their implementation is described in the studied settings.
Figure 9. Timeline of data collection using different research methods.

**Participant Observation**

Participant observation, a research method traditionally associated with ethnographic research, refers to the immersion of the researcher in the setting where the phenomenon under study occurs naturally, his interaction with the participants, and his role as observer and information recorder as the phenomenon unfolds. This involvement with the context and participants varies according to the research questions, the studied phenomena, and the researcher’s approach to the investigation (Patton, 1990; Creswell, 2009; Groat & Wang, 2002; Groat & Wang, 2013). The use of this technique in the study allowed close observation of the design studios and interaction with the participants (e.g., asking students informal questions about their process, their design solutions, and their previous experiences). It also presented an opportunity to document students’ design process and products (e.g., taking
pictures of the sessions and the created artifacts), follow specific situations that were considered relevant, and take notes and make reflections on the site.

Figure 9 illustrates how this technique, accompanied by note taking, was utilized throughout the semester. A total of 52 entries, corresponding to an equal number of observed sessions of Groups 1 and 2, were completed in the journal used to record these observations. Additionally, more than a thousand photos were taken to document the observed sessions and student projects. These notes included descriptions of what happened in the studio in every session, descriptions of student projects, and synthesis and reflections about sessions and the data collection process. These notes also included excerpts of conversations with the students, between students and instructor, and the students with each other. Additionally, the notes included passages of student discourse when presenting their projects and the feedback they received from the studio instructor.

The software used to take these notes was Evernote, a cross-platform application designed for note taking, which allows the creation and organization of notes in virtual notebooks, insertion of images and audio recordings, and encryption of notes. This software was selected due to the functionality and flexibility it offers to manage notes, multiple layers of security used to protect the content from unauthorized access, and the possibility to use it on different platforms including mobile devices. This last feature was especially useful when notes were taken in dynamic situations such as desk critiques or informal conversations, in which
discretion and convenience were required. Examples of the notes taken to document observations are presented in Figure 10.

Figure 10. Example of notes taken to document participant observation.

**Semi-Structured Interviews**

Semi-structured interviews refer to face-to-face interviews with participants and involve a few open-ended questions aimed further exploring their experience, views and opinions (Creswell, 2009). The use of this technique at the beginning of the semester revealed information about the instructors’ backgrounds, their understanding of empathy in design education, and the role that this ability was expected to play in the studio. Also, semi-
structured interviews provided information about the level of involvement of users in the projects to be conducted and were instrumental in characterizing the observed courses.

The majority of interviews were conducted at the end of the semester with students from Group 1 (Basic Industrial Design Studio) and Group 2 (Advanced Industrial Design Studio). These interviews revealed more about students’ perceptions of their learning experience, their understanding of users and stakeholders involved in the projects, and their perceptions of the researcher’s presence in the studio. At the end of the semester, instructors were interviewed again to collect their reflections about the studio, explore certain topics in depth (e.g., involvement of the users in the projects, dealing with sensitive topics in the classroom, use of human-centered design methods), and assess the researcher’s role in the studio.

As Figure 9 shows, semi-structured interviews were implemented with the faculty at the beginning and at the end of the semester and with students at the end of the studio. A total of eighteen interviews were conducted with sixteen participants (two faculty members, eight students from Group 1, and six students from Group 2). These interviews were documented with an audio recorder and by taking notes on a laptop and on paper. The decision to take notes on paper came after noticing that a screen in between the interviewer and interviewee created a barrier and hindered the flow of the interview. These interviews were guided by five different protocols, as follows (these protocols can be found in the Appendix section):

1. Interview protocol for instructors (AID and BID), at the beginning of the semester.
2. Interview protocol for instructor of Group 1 (BID), at the end of the semester.
3. Interview protocol for instructor of Group 2 (AID), at the end of the semester.
4. Interview protocol for students of Group 1 (BID), at the end of the semester.
5. Interview protocol for students of Group 2 (AID), at the end of the semester.

**Discourse Analysis**

Discourse analysis refers to the “detailed exploration of political, personal, media or academic ‘talk’ and ‘writing’ about a subject, designed to reveal how knowledge is organized, carried and reproduced in particular ways and through particular institutional practices” (Muncie, 2006, pp. 75). This method aims to find connections between the use of language—the act of communication—and the knowledge, behavior, social practices, or power structures that are embedded in its meaning and structure (Muncie, 2006). The use of this technique allowed the identification of students’ verbal expressions of empathy, which were embedded in their way of defining users and stakeholders involved in their projects. Evidence included the methods students used to learn about users and the context-specific terms they used to address and describe people, and their expressions of concern about the problems experienced by these communities.

As Figure 9 shows, this technique, accompanied by audio and video recordings, was used to analyze student discourse in critiques and project presentations throughout the semester. Data from eight presentation sessions was collected (five project presentations for Group 1, and three project presentations for Group 2), comprising 101 individual presentations by
participants from Group 1, and eleven individual and six group presentations done by participants from Group 2. A total of 21h 15m of video and audio were recorded for further analysis.

Since a text transcript can be searched, coded, and incorporated into a written document, a selection of these presentations and the semi-structured interviews were fully transcribed for a detailed discourse analysis. The software used to transcribe these presentations and interviews was F5 Transcription, an application that assists in converting speech into text transcripts. The software program also allows playback of the recorded audio or video at different speeds (since typing takes more time than speaking), automatic creation of timestamps after each paragraph, and differentiation among speakers through text and color. This tool was selected because of its varied functions, but mainly because of its full compatibility with MAXQDA, the software used to conduct the qualitative data analysis presented later in this section. Figure 11 shows an example of the transcription process.
Document Analysis

Document analysis refers to the “detailed examination of documents produced across a wide range of social practices, taking a variety of forms from the written word to the visual image” (Wharton, 2006, p. 80). It may comprise a content analysis (the quantification of elements or categories within the document), or a textual analysis of the document (the interpretation of the meaning of the document) (Wharton, 2006). The use of document analysis with faculty-generated documents—that is, syllabus, project descriptions and presentation guidelines—allowed identification of the main educational practices used in the studio. Examples of the information collected through this technique were studio learning objectives, projects and activities to be developed in the semester, and criteria used to evaluate student projects and processes. Additionally, the use of this analytic technique with materials created by students
for critiques and presentations such as visual presentations and reports allowed for a better understanding of student projects and design process. Ultimately, the collection and exploration of students’ documents allowed for an identification and categorization of students’ expressions of empathy for users in their written discourse and in the images they used.

As Figure 9 shows, the technique was used to collect and analyze faculty documents and students’ materials at the beginning of the semester and concurrently with each critique. A total of eight faculty documents and 120 students’ materials were collected throughout the semester, including courses’ syllabi (Groups 1, 2, and 3), project descriptions (Groups 1 and 2), presentation guidelines (Groups 1 and 2), IRB applications (Group 2), group presentations (Group 2), and individual presentations (Groups 1 and 2). A total of 890 pages were collected for further content and textual analysis. Examples of collected documents can be seen in Figure 12.
Course Description and Objectives
Introduction to the theories, methods, and language of industrial design; elementary problems in form and function; and transitional implications of hand-crafted and mass-produced objects, in various materials and media. Coursework will reinforce and extend previous knowledge and abilities in preparation for continued work in the curriculum.

Learning Outcomes
Students will be able to express how the culture and practice of ID relates to and differs from that of Art and Engineering. Students will design with an understanding of the relationship between the form of an object and how it functions in a physical, psychological and social sense. Students will design with recognition of the place of human factors in industrial design. Students will be conversant on the issues involved in designing for mass manufacture as opposed to hand-crafting. Students will be able to produce well-crafted 2-D and 3-D sketches showing the development of an idea from initial research through a broad range of concepts to refinements of form and function. Students will be able to produce accurate orthographic drafting with dimensioning to specify a form for production.

Students Will:
- Demonstrate initiative and ability to learn both independently and with peers
- Utilize basic principles of design as critical generators of form
- Begin to understand the designer/client relationship, especially as applied to industrial design
- Appreciate the relevance of design in a professional multi-disciplinary approach to problem solving
- Be introduced to relevant practices, materials, media, software, etc. of industrial design
- Build on knowledge gained from previous studies and/or professional practice
- Apply knowledge from current ID support curriculum to studio coursework
- Define problems to which industrial design may apply
- Identify the scope of such problems and target users or stakeholders
- Organize projects by identifying design stages, durations, benchmarks, and outcomes
- Summarize existing solutions and associated short comings, and compare existing solutions with user needs

Figure 12. Example of collected documents: Student presentation and course syllabus.
4.5.2. Quality Considerations

The criteria for safeguarding the quality and the integrity of research in the qualitative component of the mixed methods study was inherited from the criteria of the naturalistic paradigm. Following Guba’s postulates (1981), the aspects of trustworthiness for this theoretical perspective are presented in the following pages.

**Truth Value (Credibility)**

Truth value refers to cross-checking the sources, methods, results and interpretations to prove the credibility of findings. In this research study, credibility was addressed through several techniques elicited by Guba (1981), such as (1) triangulation of sources and methods; (2) prolonged engagement throughout the entire academic semester; and (3) persistent observation in the context of the study.

**Applicability (Transferability)**

Applicability refers to the extent to which the findings of the study are applicable to other similar contexts. It requires a “thick description” of the study’s context in order to assess how similar it is to other contexts. In this research study, transferability was addressed through these techniques (also presented by Guba, 1981), such as: (1) conducting theoretical sampling of the participants, (2) collecting descriptive data through interviews, observations, and artifacts, and (3) providing detailed descriptions of the observed design studios, design experience, participants’ behaviors, and role that faculty played.
**Consistency (Dependability)**

Consistency refers to the dependability of study results in terms of traceability; that is, the possibility to track variations in the studied phenomenon across the research process (Guba, 1981). The dependability in this study was addressed through: (1) the overlapping of methods (e.g., participant observation and semi-structured interviews), and (2) the establishing of an “audit trail” through an organized and systematized documentation of the process.

**Neutrality (Confirmability)**

Neutrality refers to the possibility of confirming study results and interpretations across methods, sources and investigators, and of being aware of the researcher’s assumptions and biases (Guba, 1981). In this research study, confirmability was addressed through some of the previously mentioned techniques (triangulation and the establishment of an audit trail), plus the practice of reflexivity; that is, the researcher’s self-revision of his thoughts and assumptions regarding the study and documentation on the notes taken about the role of the researcher.

4.6. Quantitative Component: Quasi-Experimental and Correlational Strategies

From a quantitative approach, this study implemented *quasi-experimental* and *correlational* strategies aimed at establishing a baseline measure of empathy in students, determining the impact on student empathy levels of the three different approaches to design instruction that students were exposed to, and finding relationships between these same levels with other variables collected and quantified during the study. These strategies, usually associated with
the positivistic paradigm, were used to supplement the dominant qualitative approach of this study in order to have a better understanding of the expression and development of empathy in industrial design students and to enhance the way this phenomenon is described and interpreted. The use of these strategies offered a numerical notion of the student empathy levels and a quantitative perspective on the qualitative data that was collected and analyzed.

4.6.1. Quasi-Experimental Strategy

Experimental and quasi-experimental research is characterized by establishing cause-and-effect relationships among observed variables, simplifying researchable phenomena in dependent and independent variables, and relying on measurable data and measurement devices. Under such research strategies, a clear unit of assignment is defined and accompanied by the use of control or comparison groups. Additionally, quasi-experimental research is characterized by the lack of randomization in selecting and/or assigning participants to the observed groups (treatment and control) because of practical or ethical reasons (Groat & Wang, 2013). Given the nature of this research setting, it was possible to perform a quasi-experiment instead of an experiment. In this case, participants could not be randomly selected because all of the participants were students enrolled in one or more of the three courses and could not be randomly assigned because these courses are not interchangeable in the curriculum. Also, since all of the participants received design instruction, it was not possible to test a comparable control group without instruction. In order to mitigate the effects of this situation, a pre-test was used to establish a baseline
against which the post-test results were compared after the administration of the treatment
(i.e., design instruction). This strategy was used with the following objectives in mind:
1. Establishing a baseline measurement of empathy in the industrial design students that
participated in this study.
2. Comparing the effects on student empathy levels of two studios with different approaches
(Basic Industrial Design and Advanced Industrial Design).
3. Comparing the effects on student empathy levels of two different types of courses that
address human-centered design (i.e., lecture-based course and design studio).

**Quasi-Experimental Design**

In order to accomplish these goals, two quasi-experiments with a non-equivalent groups
design (NEGD) were conducted. This type of design is usually used in educational
environments in which randomization is not possible and groups must be kept intact. For this
reason, it is impossible to guarantee that the groups are equivalent to those in which
participants were randomly selected and/or randomly assigned, and thus, affects the design’s
internal validity of the research design. In order to mitigate this “selection threat,” it is
suggested that a pre-test be conducted to evaluate how similar the groups are (Trochim,
2006a). The design of the conducted quasi-experiments is as follows:

1. Measure the effect of experiencing a human-centered design studio—as Group 2 did—on
the empathy scores of the participants.
**Null hypothesis:** Experiencing a design studio with a human-centered approach does not have any statistically significant effect on the participants’ empathy scores (H0: Epre = Epost, where E stands for mean empathy scores measured before and after design instruction).

**Alternative hypothesis:** Experiencing a design studio with a human-centered approach has a statistically significant effect on participants’ empathy scores (H1: Epre ≠ Epost, where E stands for mean empathy scores measured before and after design instruction).

**Treatment (Independent variable):** Experience a design studio with a human-centered approach.

**Outcome (Dependent variable):** Scores on empathy questionnaire (Interpersonal Reactivity Index).

**Treatment group:** Group 2 (Advanced Industrial Design studio which had a human-centered approach).

**Control group:** Group 1 (Basic Industrial Design studio which did not have a human-centered approach).

**Statistical design:** Quasi-experimental design (no random assignment or selection of participants) featuring a non-equivalent (pre-test and post-test) control-group design (Creswell, 2009, p. 160), with the following notation:

Group 2 (AID) 0—— X——0

Group 1 (BID) 0———0
2. Measure the effect of experiencing a *lecture-based course on human-centered design*—as Group 3 did—on the empathy scores of the participants.

**Null hypothesis:** Experiencing a lecture-based course on human-centered design does not have any statistically significant effect on the participants’ empathy scores (H0: Epre = Epost, where E stands for mean empathy scores measured before (pre) and after (post) design instruction).

**Alternative hypothesis:** Experiencing a lecture-based course on human-centered design has a statistically significant effect on participants’ empathy scores (H1: Epre ≠ Epost, where E stands for mean empathy scores measured before and after design instruction).

**Treatment (Independent variable):** Experience a lecture-based course on human-centered design.

**Outcome (Dependent variable):** Scores on empathy questionnaire (Interpersonal Reactivity Index).

**Treatment group:** Group 3 (Human-Centered Design course).

**Control group:** Group 2 (Advanced Industrial Design studio).

**Statistical design:** Quasi-experimental design (no random assignment or selection of participants) featuring a non-equivalent (pre-test and post-test) control-group design (Creswell, 2009, p. 160), with the following notation:

Group 3 (HCD) 0——X——0

Group 2 (AID) 0———0
Data Collection: Interpersonal Reactivity Index

An empathy questionnaire was administered at the beginning of the semester (pre-test) and at the end (post-test) to all the participants (Groups 1, 2 and 3) with the purpose of measuring changes in students’ level of empathy throughout the semester, comparing these changes among the observed groups, and accounting for individual differences in this trait by establishing a baseline measure. The administered questionnaire was a selection of items from the Interpersonal Reactivity Index (IRI), developed by Mark Davis (1980, 1983), which has a multi-dimensional approach (i.e., addresses both the cognitive and affective components of empathy), comprises twenty-eight questions distributed in four categories (Perspective Taking, Empathic Concern, Personal Distress, and Fantasy), and features a 5-point Likert-like scale that ranges from “Does not describe me well” to “Describes me very well.”

The selected items (fourteen in total, which can be found in the Appendix) were taken from the perspective-taking and empathic concern dimensions. These dimensions are the most relevant in the process of approaching, understanding, and establishing an empathic relationship with users and stakeholders in the design process. The Interpersonal Reactivity Index (IRI) was selected from a group of possible questionnaires on the basis of its approach to empathy as an emotional and cognitive phenomenon (whereas the others present one approach or the other), the adequacy of its internal reliability ($\alpha$: 0.71 - 0.77), its reliability over time ($r$: 0.62 - 0.71 in 60 to 75 days), and its extended use for more than 35 years.
(Davis, 1980, 1983). A table that compares different questionnaires to measure empathy can be seen in Figure 13.

<table>
<thead>
<tr>
<th>TEST</th>
<th>RELIABILITY</th>
<th>EVIDENCES OF VALIDITY</th>
</tr>
</thead>
</table>
| IRI - 1980 (Davis) | \( \alpha: 0.71 - 0.77^3 \) (“Adequate”) | Intercorrelations:  
- Within IRI subscales.  
- IRI and other psychological measures.  
- IRI x EM / IRI x QMEE / IRI x TEQ. |
|                    | \( r: 0.62 - 0.71^3 \) 60-75 days |                                                           |
| EM - 1969 (Hogan)  | \( \alpha: 0.52 - 0.77^4 \) (“Acceptable”) | Intercorrelations:  
- EM and social acuity measures.  
- EM and other psychological measures.  
- EM and existing personality measures. |
|                    | \( r: 0.74 - 0.81^4 \) 60 days |                                                           |
| QMEE - 1972 (Mehrabian & Epstein) | \( \alpha: 0.84^5 \) (“Good”) | Intercorrelations:  
- Inverse correlation: QMEE scores and measures of aggressiveness.  
- Direct correlation: QMEE scores and measures of helping behavior. |
|                    | Not provided |                                                           |
| TEQ - 2009 (Spreng et al.) | \( \alpha: 0.87^6 \) (“Good”) | Intercorrelations between TEQ and IRI.  
- Broad spectrum of empathy-related constructs (face validity).  
- Correlation with two behavioral measures of empathy (not self-reported). |
|                    | \( r: 0.81^6 \) 66 days |                                                           |

Figure 13. Comparison between different empathy questionnaires.
1. Internal reliability (or internal consistency) is measured using Cronbach’s alpha (\( \alpha \)); 2. Reliability over time (or test-retest reliability) is measured through the correlation of the results obtained in the test and retest (\( r \)); Sources: 3. Davis (1983), 4. Hogan (1969), 5. Mehrabian & Epstein (1972), 6. Spreng et al. (2009).

4.6.2. Correlational Strategy

Correlational research is characterized by establishing associations between variables, exploring patterns that occur in natural settings (as opposed to experimental research that tends to isolate variables in a controlled environment), and using correlational statistics that numerically describe relationships between two variables. According to Groat and Wang (2013) correlational research relies on variables that can be measured (e.g., measurable
aspects of human behavior) which are classified as *categorical* (variables sorted into discrete categories, e.g., hair color), *ordinal* (variables sorted into ordered categories, e.g., age range), and *interval* (variables sorted into categories separated by the exact same measurable distance, e.g., temperature). This strategy was used to study the relationship among student empathy scores (measured through the previously described empathy questionnaire) and other variables extracted from “quantitized” qualitative techniques (e.g., the number of times students mentioned the user in their presentations). By finding relationships between variables present in qualitative and quantitative data, this correlational strategy served as a bridge between types of data and provided insights that could not have been found by using a single approach.

**Data Collection: Academic and Extracurricular Background Survey**

As Groat and Wang (2013) highlight, correlational research uses data collection techniques that are compatible with other research strategies. In the case of this study, correlational research was used mostly to analyze data collected though ethnographic research (i.e., students’ documents and discourse) and quasi-experimental research (i.e., student empathy scores). This analysis can be found in the Data Analyses section of this report.

From an exclusively correlational research approach, the only instrument used for data collection was a survey questionnaire that was administered to all the participants (Groups 1, 2 and 3). The purpose of this survey was to determine participants’ academic backgrounds (since not all the participants majored in industrial design), their previous and current
exposure to human-centered design, classes they were taking during the observed semester, and their involvement in extracurricular activities. The survey was completed by participants at the beginning of the semester. However, no second survey was administered at the end, so it is not possible to determine if some classes that were initially reported were dropped during the semester. This academic and extracurricular background survey questionnaire can be found in the Appendix section.

**Quality Considerations**

The criteria to safeguard the quality and the integrity of research in the quantitative component of this mixed methods study corresponds to some of the criteria proposed for the positivistic paradigm is summarized by Groat and Wang (2002) as follows:

**Internal Validity**, the truthful representation of the object of study by the construct, was addressed by using a questionnaire in which validity has been proved by finding a positive correlation between the IRI’s results with other psychological measures of empathy and with the results of other empathy questionnaires: the EM, by Hogan (1969); the QMEE, by Mehrabian & Epstein (1972), and the TEQ, by Spreng and colleagues (2009).

**External Validity**, the applicability or generalizability of the results of a study, was addressed by acknowledging that the proposed research strategies were not suited nor intended to produce generalizable results. However, as mentioned before, these results were
intended to be transferred and applied to similar contexts, which was mediated by a detailed
description during the researched setting and participants.

**Reliability**, the consistency of the results under the same conditions of measurement was
addressed by administering the empathy questionnaire to three different groups at two
different occasions of the semester under the same conditions.

**Objectivity**, the reduction and mitigation of possible biases was addressed by using a
standardized instrument (the Interpersonal Reactivity Index) under the same set of conditions
that minimized the interactions between researcher and participants and protected the
confidentiality of the responses.

4.7. Mixed Data Analyses

The data analysis strategy used in this study was guided by the model for mixed methods
data analysis proposed by Onwuegbuzie and Teddlie (2003). The model proposed is intended
to combine qualitative and quantitative data through a multi-stage process in which data is
(1) reduced, (2) displayed, (3) transformed, (4) correlated, (5) consolidated, (6) compared,
and (7) integrated. Data correlation, consolidation, and comparison are interchangeable
techniques that are used depending on the purpose of the study.

Data reduction consists of simplifying, organizing, and giving structure to collected data for
its further analysis (Onwuegbuzie & Teddlie, 2003). In this study, qualitative data was
subjected to thematic analysis (coding and memoing) and quantitative data was subjected to descriptive statistics and analysis of variance (ANOVA).

Data display consists of synthesizing the information into visual representations and simplified “gestalts or easily understood configurations” (Miles & Huberman, 1994, p. 11). In this study, qualitative and quantitative data were synthesized using the matrices, tables, graphs, and charts presented in the Findings section.

Data transformation consists of “quantitizing” qualitative data and/or “qualitizing” quantitative data (Onwuegbuzie & Teddlie, 2003). The term “quantitizing” was proposed by Tashakkori and Teddlie (1998) and refers to converting qualitative data into numerical codes that can be represented statistically. Likewise, the term “qualitizing” was proposed by the same authors and refers to converting numerical data into narrative data that can be analyzed qualitatively. In this study, part of the collected qualitative data, such as student discourse and the images they used in their presentations, were “quantitized” and subjected to descriptive statistics to identify underlying patterns.

Data correlation consists of finding the degree of relationship between sets of two variables extracted from the quantitative data and/or the “quantitized” qualitative data (Onwuegbuzie & Teddlie, 2003; Crano & Brewer, 1973). In this study, “quantitized” qualitative data, such as the number of students’ references to users per presentation, was correlated with student empathy scores.
Data consolidation consists of consolidating qualitative and quantitative data into a combined data set. In this study, instead of consolidating data, “quantitized” qualitative data and purely quantitative data were correlated. According to Onwuegbuzie and Teddlie (2003), data correlation, consolidation, and comparison are interchangeable stages of the mixed methods data analysis that are used depending on the purpose of the study.

Data comparison consists of comparing sets of qualitative and quantitative data with the purpose of triangulating findings (Onwuegbuzie & Teddlie, 2003). In this study, data sets collected from each project and each studio were compared with each other to identify educational practices that were effective in promoting student empathy for users.

Data integration consists of combining qualitative and quantitative data into a coherent whole with the goal to make interpretations and draw inferences (Onwuegbuzie & Teddlie, 2003). In this study, qualitative and quantitative data were integrated as the description of findings was drafted in the writing of this document.

In the following pages, the methods and techniques used as part of this mixed methods data analysis strategy are presented and discussed in detail.

4.7.1. Qualitative Data Analyses

Qualitative data in this study consisted of documents collected from participants (e.g., course syllabus, students’ slides), field notes taken during participant observation sessions (i.e.,
studio sessions), audio recordings from interviews, and audio and video recordings from students’ presentations. Figure 14 synthesizes the data analysis process followed in the study.

![Diagram of data analysis process]

*Figure 14. Representation of the processes of collecting and analyzing data.*

To analyze these sets of unstructured data different procedures were followed. Initially, the almost 1100 pieces of collected data were digitalized, organized, classified, and renamed according to the following rational nomenclature:

\[
\text{Type-of-Data\_Participant\_Date\_Recorded-Event.File-Format}
\]

For instance, the file containing the audio recording of an interview held with the participant coded as BID_02 at the end of the semester, on April 30, 2015, was renamed as “Interview\_BID\_02\_150430\_End-of-Semester.m4a.” To keep track of this vast amount of
data, each piece of information was recorded in a master database shown in Figure 15. This database included the following fields:

- Names of the files containing each piece of data.
- Research methods used to collect each data point (e.g., interviews, observation).
- Category or type of data point (e.g., audio recording, video recording, field notes).
- Date of collection and event in which data was collected.
- Group of participants from whom the data was collected.
- Participant from which the data was collected.

Figure 15. Screenshot of database used to organize and keep track of collected data.

Once data was organized, it was prepared for coding and further analysis. This preparation implied transcribing a selection of audio and video recordings and cleaning from the notes.
names or other references that could potentially disclose the identity of participants. Also, the sizes of photos and videos were reduced so that they could be handled with ease by most personal computers and all the data points were imported into MAXQDA, the software used to support the qualitative and mixed methods data analysis.

From Group 1 (Basic Industrial Design studio), a selection of 24 presentations (eight from each of the three analyzed projects) and all ten interviews were fully transcribed. From Group 2 (Advanced Industrial Design studio), all 17 presentations and eight interviews were also fully transcribed. The criteria for selecting the presentations to transcribe in Group 1 were the significance of the project regarding the presence of a variety of educational practices and the participation of the participant in semi-structured interviews. As a consequence, presentations that were selected were those from projects 1, 3, and 5 (design of a condiment organizer, design of a shoe for African children, and design of a product based on students’ insights), and from the eight participants that agreed to be interviewed at the end of the semester.

Regarding the software used to support the analysis of qualitative data, MAXQDA was selected after testing other options such as NVivo and Atlas.ti. The rationale for selecting this tool over the others was that the emphasis of MAXQDA is the analysis of mixed methods data (not just qualitative data). This program is also superior in handling and coding images and PDF files, formats in which students’ presentations were captured. Figure 16 shows a screenshot of the coding process of text and an image in MAXQDA.
Before proceeding further, it is important to define the concept of coding in qualitative data analysis. For the purposes of this section, the definition proposed by Charmaz was adopted: “coding means that we attach labels to segments of data that depict what each segment is about. Coding distills data, sorts them, and gives us a handle for making comparisons with other segments of data” (Charmaz, 2006, p. 3). An initial phase of coding was completed after organizing and preparing data for analysis. This initial phase of coding was intended to identify general teaching and learning practices and potential sources and categories of students’ expressions of empathy for users. In this phase, categories used to code the data emerged from the data themselves. Initial codes were selected, sorted and organized to direct the second phase of coding, in which a focused coding strategy was used. Charmaz defines this type of coding as “using the most significant and/or frequent earlier codes to sift through
large amounts of data” (2006, p. 57). To keep these codes constantly present throughout the data analysis process, they were written in adhesive notes that were posted on the researcher’s workspace as a constant reminder of the categories that were being used to classify the analyzed data. Figure 17 shows the wall facing the researcher’s desk in which the mentioned adhesive notes were posted.

![Figure 17. Adhesive notes used to keep track of codes used to analyze qualitative data.](image)

The initial and focused coding processes were accompanied by the writing of memos (or memoing). These memos included preliminary analytic notes, codes definition, questions regarding the process or the data, tentative categories of analysis, and other ideas that occurred during the process of coding. These memos were used to reflect on the process and
as a basis for writing findings. The coding and memoing process worked relatively well for
the analysis of participants’ written and spoken discourse. However, the analysis of students’
images required an additional layer of interpretation. In these data points, ideas were not
explicitly expressed in words, but implicitly suggested by pictures, models, and prototypes.
To analyze and interpret these data, the following two-phase strategy was implemented:

First, all the images used by students to represent the user and context in their projects were
subjected to visual content analysis (Leewen & Jewitt, 2004) to observe general patterns in
how students depicted potential users. This type of analysis consisted of identifying, coding,
and tabulating specific elements that appeared in the pictures provided by students, such as
context, categories of users, and actions performed by users.

Second, a selection of representative images of users identified in the previous phase was
subjected to visual semiotics analysis to observe, in individual images, how students
perceived, understood, and showed empathy for users (van Leeuwen, 2004). This type of
analysis consisted of coding denotative and connotative elements in the images. To analyze
diagrams that combined text and images, the text was analyzed with the same coding strategy
used to study participants’ discourse and the images were analyzed using a visual semiotics
approach.

The outcomes of these analyses were “quantitizing” (transformed into quantitative data) and
synthesized into visual representations using tools such as Adobe InDesign to create tables
and matrices, Adobe Illustrator to create diagrams and networks, and Tableau to create graphs and charts. These visual representations were used to present and discuss findings, compare the data collected from each project and each studio, and identify trends, patterns, and interesting pieces of data.

These salient data points were analyzed more in depth, searching for specific educational practices that were put in place in the studied settings, and for clear evidence of student empathy for users. Even though these pieces of evidence were not numerous, they provided rich information used to build a theoretical argument regarding the promotion of student empathy for users in the context of industrial design education.

4.7.2. Quantitative Data Analyses

In this study, quantitative data consisted of student scores in the Interpersonal Reactivity Index questionnaire, students’ answers to a survey intended to determine their academic background, and “quantitized” qualitative data such as the number of students’ references to users in their presentations.

To analyze student empathy scores in the IRI questionnaire, a combination of data display and analysis of variance (ANOVA) were used. Initially, student scores were displayed using box plots to visually identify the differences in pre-test and post-test per group of participants. Box plots were selected as a technique of visualization because they effectively
convey crucial information such as the values distribution, the mean and median values, and the range of values.

This visualization technique, when initially implemented, showed two outliers that skewed the scores distribution of their respective groups. The paper questionnaires that corresponded to these outliers were re-examined and it was found that, in one case, a student inverted the 5-point Likert-type scale, and in the other case, a student’s pre- and post-tests had been completed by two different people. As a consequence, these scores were eliminated from the analyzed data set.

After conducting this visual analysis of scores, data were subjected to a two-way ANOVA (Onwuegbuzie & Leech, 2006). This test was used to determine the significance of the difference in scores between the pre- and post-test and between the three tested groups (Basic Industrial Design studio, Advanced Industrial Design studio, and Human-Centered Design course).

To analyze the academic background survey and the “quantitized” qualitative data, basic descriptive statistics were used. These analyses provided a summary of the academic background of students in each group, and a synthesis of identified codes and categories in qualitative data subjected to thematic analysis. These summaries included the distribution of values (frequency of values for each variable), their central tendency (the mean and median values), and their dispersion (the range of analyzed values).
Additionally, students’ IRI scores and a selection of “quantized” qualitative data were analyzed from a correlational approach. Through the calculation of the Pearson Product Moment Correlation (PPMC), or Pearson’s correlation, the degree of relationship between IRI scores and individual variables extracted from “quantitized” data was determined (Crano & Brewer, 1973). The results of these quantitative analyses are presented in the findings section, in which they were used to expand the understanding provided by qualitative methods. Also, these quantitative findings provide evidence of the extent of changes in students' levels of empathy and strengthen the trustworthiness of this study.
CHAPTER 5: FINDINGS AND DISCUSSION

This chapter reports the findings of the research study by major units of analysis. A unit of analysis is the major entity that is analyzed in a study, which can be comprised of individuals, groups, artifacts, geographical units, or social interactions (Trochim, 2006b). As shown in Figure 18, in this study two major units of analysis were studied: (1) faculty’s educational practices; and (2) students’ expressions of empathy. These units of analysis were derived from the research question and sub-questions presented in Chapter 3, as follows:

**RQ:** How do teaching and learning practices in the industrial design studio promote the development and expression of student empathy for users?

**rQ1:** How do faculty reflect concern for the development of student empathy for users in the context of an industrial design studio?

**rQ2:** How do students express their empathy for users in the context of an industrial design studio?

*Figure 18. Organization of findings.*
It was necessary to operationalize a definition of the three major concepts discussed in the findings: empathy, educational practices, and expressions of empathy. These definitions determined the boundaries within which these concepts were used in this study.

**Empathy**

As mentioned in the literature review, the concept of empathy has been defined under many different approaches. However, based on definitions of this ability applied to the context of industrial design education, the concept of empathy referred in the findings is defined as follows:

Empathy, refers to the cognitive and affective phenomenon in which an observer (i.e., an industrial design student) is exposed in some fashion to a target (i.e., a potential user or project stakeholder). After this exposure, the observer responds by imagining and understanding the target’s situation (perspective-taking) and/or by having feelings of warmth, compassion, or concern for the target (empathic concern).

This definition involves two of the four dimensions of empathy identified by Davis (1980), namely perspective-taking and empathic concern. Perspective-taking (PT) refers to “the deliberate attempt to imagine the internal state of another person” (Davis, 2006, p. 450). It is considered a clear manifestation of empathy by several authors who classify it either as a process or as a cognitive outcome of the empathic response (Davis, 2006; Daily, 2010; Batson et al., 1997; Elliot et al., 2011). Empathic concern (EC) refers to “[an] other-oriented
emotion elicited by and congruent with the perceived welfare of someone in need” (Batson, 2011, p. 11). It comprises “feelings of warmth, compassion, and concern for others” (Davis, 1980, p. 85).

**Educational Practices**

Another concept that needs to be operationalized is that of educational practices. In this study, educational practices refer to the forms of teaching and learning that were implemented by faculty in the observed settings. These practices were analyzed to identify those that reflected faculty’s concern for the development of student empathy for users. In particular, the educational practices that the study focuses on are those that Shulman defines as signature pedagogies. Signature pedagogies are “the characteristic forms of teaching and learning… that organize the fundamental ways in which future practitioners are educated for their new professions” (Shulman, 2005, p. 52).

Sims and Shreeve (2012) identified a number of these signature pedagogies in design education (presented in more detail in the literature review section), which were used in this study as categories of analysis to classify the educational practices that were observed and documented. These categories are defined as follows:

- **The design studio** refers to the learning environment where students worked on their design projects, interacted with each other, and met with the faculty.
- **The brief** refers to the problem, need, or opportunity that was presented to students for them to address in their design projects.
• **The research** refers to the methods and techniques that were presented or suggested to students for them to learn more about the problem, user, and context.

• **The dialogue and critique** refer to the interactions that faculty had with students to provide them feedback on their work and the methods and criteria used for this purpose. This category includes informal conversations, desk-critiques, and formal critiques in which students’ processes and products were evaluated.

**Expressions of Empathy**

In this study, “expressions of empathy” refer to the verbal, graphical, and operational manifestations of student empathy for users. These categories to classify how empathy is manifested were derived from Sanders’ model for understanding the experience of people based on what they say, do, and make (Sanders & Dandavate, 1999). The three categories are defined as follows:

• **Verbal expressions** (what students say) refer to manifestations of empathy present in student discourse elicited through interviews, conversations in the studio, project presentations, and interactions with users and stakeholders.

• **Graphical expressions** (what students make) refer to manifestations of empathy present in the visual materials that students prepared to support their ideas in presentations and critiques. Special attention was given to the images that students used to depict users and stakeholders.

• **Operational expressions** (what students do) refer to manifestations of empathy present in the research activities undertaken by students in understanding users,
paying special attention to those activities that allowed for interaction between students and users.

5.1. Faculty's Educational Practices

This section describes teaching and learning practices as implemented by faculty in the observed studios. Based on the data analysis, it identifies practices that reflected faculty concern for the development of student empathy for users. These practices are organized and presented according to categories previously introduced: the design studio brief, research, and dialogue and critique.

5.1.1. The Design Studio

As mentioned in the literature review, the design studio is considered the “backbone” of most design programs around the world and constitutes the learning environment that prepares students to transition from the academic environment to the professional realm (Shulman, 2005; Sims & Shreeve, 2012).

In this section, detailed descriptions of each of the observed studios covers the logistical and physical characteristics of the studios, as well as their curricular and pedagogical aspects such as learning objectives, evaluation criteria, and teaching and learning practices.
5.1.1.1. Basic Industrial Design Studio (BID)

The semester offering of the Basic Industrial Design studio focused on introducing undergraduate industrial design students to “the theories, methods, and language of industrial design, elementary problems in form and function, and transitional implications of hand-crafted and mass-produced objects” (BID syllabus, Spring 2015).

Figure 19. Students working on the design of a kitchen utensil in the Basic Industrial Design studio.

This undergraduate awarded six credits for instruction distributed in three sessions per week (Monday, Wednesday, and Friday). The studio enrolled 22 sophomore students, each of whom had a permanent desk assigned throughout the semester. Spaces were used to work, keep models and prototypes, and interact with classmates and the studio instructor. Also,
students had access to two shared computers with digitizing tablets, which allowed them to sketch and draw directly on the display surface. Additionally, the studio space was located very close to the design library and across the street from the materials laboratory, where students had access to equipment and machinery for working with wood, plastics, metal, and glass. Figure 19 shows a regular work session in the studio.

Typical academic design studios use multiple types of interactions. However, in this studio, furniture was too heavy to be rearranged frequently, so the studio had the same configuration for all the activities throughout the semester (see the classroom layout in Figure 21). This lack of flexibility prevented students from changing places during the semester, which promoted deeper interactions with a particular group of classmates than with others. The program compensated for difficulty in rearranging the furniture in the studio through adjacent multi-functional spaces: students had access to two smaller rooms for meetings, building models, and working individually (see Figure 20). However, the scarcity of space and the lack of flexibility in the studio were adverse factors for conducting controlled observations, experiments, or product testing with target users, which reduced the opportunities for user-student interactions and the occurrence of empathic episodes in this context (i.e., the exposition of design students to potential users that triggers empathic responses).
Place in the Curriculum

Students registered for the studio had previously taken a year of design fundamentals with other design majors in the first semester, one semester of basic industrial design, two introductory courses on design thinking, and one course on ideation (visual generation and exploration of ideas through drawing). They had also taken a general course on academic writing, a course on mathematics, elective courses in the humanities and natural sciences, and one course on digital design techniques. Concurrent with the Basic Industrial Design studio, students took three-credit courses on tridimensional modeling, manufacturing processes, and ideation.
In an interview with Professor Williams (pseudonym assigned to BID instructor), he asserted that one of his goals was to guide students in incorporating in their projects the knowledge and skills acquired in these different courses. For him, the studio offered students an opportunity to connect and practice what they learned in the first year and what they were learning during the observed semester: “the studio is where all comes together. They learn lots of things in their support courses, but the studio is where it starts to make sense to them.”

Learning Objectives and Outcomes

The learning objectives for this studio were extensive. The syllabus mentioned twenty-four, the guideline for projects presentation added another nine, and Professor Williams mentioned seven additional objectives in an interview conducted at the beginning of the semester. Most of these objectives dealt with the students’ comprehension of the design process, use of basic design practices and concepts, and development of specific skills in a variety of domains.

The following categories group the objectives referred above:

1. Recognition of particular aspects of the culture and practice of design.
2. Adoption and implementation of a systematic design process.
3. Use of 2-D and 3-D techniques for ideation, prototyping, and representation.
4. Presentation and communication of ideas, processes, and design solutions.
5. Discovery of users' needs through direct and indirect research.
6. Basic knowledge of materials and manufacturing processes.
7. Development of strategies to learn and work under different circumstances.
8. Management of time and resources in a design project.
The large number of learning objectives addressed in the Basic Industrial Design studio indicates the general nature of the course, in which, according to the syllabus, students were introduced to “theories, methods, and language of industrial design.” Aspiring to achieve such a large number of learning objectives in a single course represents challenges for teaching and evaluating students’ work and raises questions regarding the extent to which these many objectives were met.

**Evaluation Criteria**

Similar to the learning objectives presented above, the evaluation criteria for this studio included a vast number of items (the syllabus included eighteen). These criteria were comprised of the skills, attitudes, and behaviors that students were expected to show and develop throughout the studio. Figure 21 presents a synthesis of these success criteria.

In an interview held with Professor Williams, he discussed in depth some of these criteria, giving special attention to those that involved student’s interaction with potential users and stakeholders. According to Professor Williams, one of the aspects that define students’ success and his success as a teacher is the level of interaction that students have with the community outside of the studio. For him, the value of these explorations resides in that they provide students the opportunity to experience situations and scenarios from the viewpoint of others. In his words, “when I sent [students] to the restaurant to find out information about the condiment holder, this is not so much about condiment organization, it’s about going into
a new culture, it’s about stepping into a new environment and seeing the way it is seen by people who live there.”

<table>
<thead>
<tr>
<th>SKILLS</th>
<th>ATTITUDES</th>
<th>BEHAVIORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Respond to critiques</td>
<td>• Commitment to excellence</td>
<td>• Attendance</td>
</tr>
<tr>
<td>• Communicate in 2D and 3D media</td>
<td>• Sensitivity to design problems</td>
<td></td>
</tr>
<tr>
<td>• Use of design vocabulary</td>
<td>• Awareness to cultural and environmental factors</td>
<td>• Participation in the studio</td>
</tr>
<tr>
<td>• Deal with uncertainty</td>
<td>• Self-awareness and self-motivation</td>
<td>• Generation of varied and alternative design solutions</td>
</tr>
<tr>
<td>• Work individually and in teams</td>
<td>• Avoidance of preconceptions</td>
<td>• Completion of assignments</td>
</tr>
<tr>
<td></td>
<td>• Exploration beyond the obvious</td>
<td>• Quality and documentation of work</td>
</tr>
<tr>
<td></td>
<td>• Humor, play, and fun</td>
<td>• Improvement, development, and refinement of ideas</td>
</tr>
</tbody>
</table>

*Figure 21. Synthesis of success criteria for the Basic Industrial Design studio (Source: BID syllabus).*

However, the level of interaction between students and potential users and stakeholders are just a component of a successful design process in this studio. As Professor Williams pointed out in the interview introduced above, a project’s success also depends on how students address the needs and concerns of users. For him, a student “is moving in the right direction” when he or she proposes a design solution that addresses the user’s needs and concerns, but “misses the boat” when he or she disregards the user’s input and proposes a solution based only on his or her own preferences and preconceptions.

Additionally, Professor Williams highlighted other aspects of a successful design solution, such as usability, practicality, functionality, and product-environment fit. For him, a successful design solution produced in the studio should show a balance between form and function and should not be designed exclusively on the basis of aesthetic factors. Professor
Williams explained that to achieve said balance students should consider how the object is intended to be used by people and how the object is supposed to fit into its environment.

**Teaching and Learning Practices**

The Basic Industrial Design studio featured teaching and learning methods based on the learning by doing that characterizes the studio pedagogy. In this studio, students worked on five design projects, were exposed to critique sessions at the end of each project, and had ongoing interaction with the instructor, teaching assistant, classmates, and members of the community.

Usually, in a design studio students work on two or three projects during the semester. However, in the case of this studio, students worked on five different projects. In an interview held with Professor Williams at the end of the semester, he explained that the purpose of having this many projects was to offer students more opportunities to get familiar with and internalize the design process. Also, he mentioned that this number of projects offered students a diversity of topics to explore and communities to discover. The five projects in which students worked were as follows:

1. Design of a condiment organizer for a local restaurant.
2. Design of a kitchen utensil based on the needs of a particular user.
4. Design of a fashion shoe for markets in industrialized countries manufactured with African materials and production processes.

5. Design of a product based on students’ ideas and observations throughout the semester.

The development of these projects was guided by the instructor who alternated many types of interactions with students. The first type of interaction was the full-class meeting, in which Professor Williams gave general instructions and foregrounded important issues embedded in the project definition (for instance, at the beginning of the project or after the critique). The second type of interaction was the small-group meeting, in which students discussed the progress on their projects with a group of three or four classmates (usually those seated nearby), and then raised concerns and questions for consideration by the rest of the class and the instructor. The third type of interaction was the one-on-one meeting (or desk critiques), in which Professor Williams and the teaching assistant met individually with each student to check progress on the project, answer questions, and suggest possible courses of action.

At the end of each project, students made individual presentations to describe the processes they followed, justify their decisions, and introduce the design solution to the proposed challenge. Students structured their presentations following guidelines provided by the instructor at the beginning of the semester. These guidelines included problem identification, state of the art, project goals, collected information, ideation process, analysis and selection of alternatives, design development and prototyping, final design solution, testimonials from potential users, and conclusions. In an interview with Professor Williams, he argued that this
outline reinforces a design process and supports their presentation of a design solution. For him, this presentation outline is “a constant reminder from the very beginning of what one would need to have towards the end, so it structures their activity and tells them what to do… it is a process organizer.”

After each presentation, students answered questions from the instructor, teaching assistant, classmates, and occasional guests. In some cases, students received immediate feedback from the instructor, but in most cases, he sent his comments and assessment via email. The use of this channel of communication for providing feedback presented a limitation for this study since comments were not accessible.

5.1.1.2. Advanced Industrial Design Studio (AID)

The iteration of the Advanced Industrial Design studio that was observed focused on introducing graduate students in industrial design to design research by “focusing on understanding context and stakeholders, framing insights, and exploring concepts as an iterative process in solution development” (AID syllabus).

In this graduate studio, students met three times per week (Tuesday, Wednesday, and Thursday) in sessions of different length that represented a total of nine and a half hours a week. The studio was taken by 11 graduate students, each of whom had a permanent desk assigned throughout the master’s program. These spaces were used to work individually and
in groups, keep models and prototypes, and meet with the studio instructor. Figure 22 shows a regular work session at the studio.

*Figure 22. Photo of students working in groups on the design of a simulator to test sports bras at the Advanced Industrial Design studio.*

The space where the Advanced Industrial Design studio took place offered students access to multiple and valuable resources. In the studio, students had dedicated space to work, digital projectors, mobile whiteboards, and four shared computers with a Cintiq tablet/screen that students used for sketching. As can be seen in Figure 23, this studio space was connected to the instructor’s office and adjacent to the school’s ergonomics laboratory.

This proximity allowed for an ongoing access to the instructor—even when the studio was not in session—and to resources available in the ergonomics laboratory. Some of these resources
consisted of equipment to collect biomechanical data, suits to simulate diverse physical conditions, and audio and video recording devices. Also, the laboratory offered students a space to conduct large group meetings, user observations, product evaluations, and process assessments.

Additionally, the studio space was conveniently located across the street from the design library and very close to the school’s materials laboratory, where students had access to equipment and machinery for working with wood, plastics, metal, and glass.

*Figure 23. General layout of the Advanced Industrial Design studio.*
Place in the Curriculum

The master’s program and the Advanced Industrial Design studio offer two tracks to complete the degree requirements. Track II is a two-year program intended for students with an undergraduate degree in industrial design (or related field). Track III is a three-year program intended for students with an undergraduate degree in fields other than industrial design.

Track II students enrolled in this studio had previously taken a six-credit graduate industrial design studio and three-credit courses in materials and processes and design methods. Track III students, on the other hand, had previously taken these same courses plus an earlier year of undergraduate industrial design classes (two senior studios in industrial design, two courses on ideation, a course on materials, a course on digital techniques of representation, and two electives). Concurrently with the Advanced Industrial Design studio, students took graduate courses on manufacturing processes and two electives on architecture and design.

In an interview held with Professor Miller (pseudonym assigned to the instructor of this studio) at the beginning of the semester, she stated that the Advanced Industrial Design studio focused on design research and built on the skills and knowledge acquired in undergraduate studios where the focus was design development. According to Professor Miller, the goal for students in this studio was to generate knowledge based on the development of new products.
Learning Objectives

The learning objectives for this studio were identified from the syllabus and an interview conducted with Professor Miller. These objectives reflected the focus of the studio on design research by covering issues such as planning and conducting research in design; identifying a researchable problem and the users and stakeholders associated with it; and selecting and developing methods for data collection and analyses in the context of the selected problem.

In an interview, Professor Miller expressed her intention to familiarize students with design research by presenting it terms similar to those used in the typical design process but with a difference in the tools and techniques utilized. She highlighted that even if students did not intend to become design researchers, learning about research would enrich and inform their practice as designers. An important component of introducing students to design research was, as stated by Professor Miller, to present them with a selection of methods for data collection and analysis that they could use in the studio and later in their professional practice.

Two of the research skills that Professor Miller emphasized as crucial for students to acquire and develop in the Advanced Industrial Design studio were the abilities to conduct interviews and observe people’s behavior. For her, developing a deep understanding of people helps students to inform and inspire their design process.
These skills reflected another important learning objective highlighted by Professor Miller later in the interview: the focus of this studio on human-centered design. It was crucial that students realized that any design project has multiple users and stakeholders who need to be considered in the design process. This human-centeredness was also expressed in Professor Miller’s interest for students learning about the human body “and the way it acts, the way it moves, and how do you simulate it.”

Additionally, the syllabus included objectives related to the evaluation and assessment of design solutions based on the satisfaction of user needs. Learning objectives suggested a connection between the Advanced Industrial Design studio and the ergonomics laboratory discussed above. This laboratory, to which students had access, was directed by Professor Miller and its goals included the evaluation of products, processes, and places based on how people interacted with and reacted to these.

**Evaluation Criteria**

According to the syllabus, the final grade of this studio was comprised of three major components, namely, the first project (bra testing device, which represented 60% of the grade), the second project (research proposal, which represented 30% of the grade), and participation and professional conduct (10% of the grade).

The first project was evaluated based on the design process, the final product, the presentation, and the project narrative. Additionally, this project’s evaluation also included
peer-assessment and self-assessment components. The criteria to evaluate the design process included aspects such as the identification and definition of the problem and target audience, the research from secondary sources (i.e., review of patents, market, and literature), and the consideration of human factors and ergonomics. Also, the process’ evaluation criteria included aspects of process exploration and documentation. Even though these criteria did not contain research from primary sources (i.e., interviews, observations, experiments), this type of research was reflected in the learning outcomes for this studio and was continually encouraged by the instructor.

The criteria to evaluate the final product included how the proposed solution solved the critical problems that were identified, coherence of the design with the process that was followed by the students, and level of resolution of aspects of human factors and ergonomics. Also, these criteria included aspects of manufacturing such as proposed materials, production processes, and costs. The presentation was evaluated based on a rubric that included elements related to the content and delivery of the presentation and the visual and written materials that supported it. The project narrative was evaluated using a different rubric that included items such as discussed content and ideas, supporting evidence, followed methods, organization, and mechanics. Finally, the self- and peer-assessment of the first project was focused on the level of contribution of each member to the team effort.

In an interview held with Professor Miller at the beginning of the semester, she extended these criteria and highlighted the importance of “soft skills” to address human-centered
projects such as the ones developed in this studio. She argued that students were expected to use “people-first language,” and “put themselves in the position of [participants]” so that they could collect data successfully. Including these “soft skills” in the evaluation criteria suggests a concern from the instructor for the development of student empathy for users and participants. The following sections identify and discuss other instances in which these concerns were expressed in the project brief, research, and dialogue and critique.

It is important to highlight that the evaluation criteria of the first project included items addressing user-related issues such as the identification and definition of the problem and target audience and the consideration of human factors and aspects of ergonomics in student projects. The criteria addressing user-related issues were consistent with the studio’s learning outcomes that read “Identify the scope of the problem, target users or stakeholders” and “Compare existing solutions with user needs.” The alignment of these items in the project’s evaluation criteria and the studio’s learning outcomes suggests that reinforcing user-related issues to students was a priority for Professor Miller. In an interview, she added that two of the major lessons that she expected her students to learn in the studio were “to be user-centered” and “realize that there is a user” in any design project that they were to develop, which are abilities required from a designer to be able to approach, interact, and empathize with potential users and stakeholders.

By contrast, the evaluation criteria of the second project (design research proposal addressing a workforce-related problem) did not address user-related issues explicitly. These criteria
included aspects such as the significance of the selected problem, impact of the proposed solution, synthesis of information, student’s approach to solution development, and presentation style. According to Professor Miller, “this [second] project was about practicing a skill set: proposal development skill set,” which was aligned with one of the studio’s learning objectives that read “Create a written proposal and presentation to document the approach to solution development.” The skill-building purpose of the second project was made explicit to students during this project’s critique, when Professor Miller explained the work that students were expected to do during the summer in preparation for their thesis:

“In the summer, find those areas [of interest], find those compelling stories. You guys know how to tell the story. You know how to zero in in a project, you know how to find something that has a reasonable scope, and you can put methods for things you want to do. That’s one of the reasons I had you do this other project [Project 2], so that you can think about what does it take to propose research, and to do something that is researchable.”

**Teaching and Learning Practices**

The Advanced Industrial Design studio featured teaching and learning methods based on learning by doing. In this studio, students worked on two design research projects, were exposed to critique sessions at the middle and end of each project, and worked in teams and individually. Also, they had the opportunity to collect data from interviews and observations with participants and interact permanently with the instructor, teaching assistant, and the sponsor of one of the projects.
The first project consisted in the design of a device to test sports bras informed and inspired by empirical research. The second project consisted in the formulation of a design research proposal intended to address a problem in the workforce. The first project had two variations, explained later in this section, in which students had the opportunity to decide if they wanted to work on the sponsored version of the project or an unfunded version. The second project offered students the opportunity to identify a problem in the workforce that they intended to address in their design research proposals.

The second project was introduced four weeks after the first project was launched and students were asked to work on them simultaneously. However, students gave more time and attention to the first project (design of a device to test sports bras) probably because it involved an external client, represented more than half of the grading of the studio, and required to go through an extensive phase of prototyping and testing that was not required in the second project.

The development of these projects was guided by Professor Miller who alternated her interactions with students. The most frequent type of interaction was the small-group meeting, in which students met to work and discuss the course of their projects while Professor Miller had individual conversations with each group. These interactions were supported by occasional full-class meetings, in which Professor Miller gave general instructions and remarks about the projects and introduced design research techniques such as literature reviews, interviews, or observations.
A less frequent type of interaction in this studio was one-on-one meetings, in which Professor Miller met individually with each student to discuss their progress on the second project (research proposal for a problem in the workforce), answer questions, and suggest possible courses of action. The researcher did not have access to these individual meetings because they were planned as advising sessions in which other topics related to students’ progress were discussed. Consequently, the content of these meetings is not reported in this study.

For the first project (design of a device to test sports bras), students were asked to do two formal presentations in front of representatives of the project sponsor. In the first presentation, each of the three groups discussed their approaches to the problem, major insights they found in the research stage, and direction of the work. In the second presentation, students introduced the design solutions they developed based on their research findings and design process. After each presentation, students answered questions from the instructor and the sponsor, whom also gave them their comments and feedback.

A couple of days before presenting to the project sponsor, students had the opportunity to rehearse in front of the instructor and classmates, which allowed them to practice their design pitch and uncover areas that needed further work. In an interview, Professor Miller argued that the purpose of these practice sessions was helping students to improve their skills and discourse in a safe and constructive environment. Also, she added that “practice only makes
permanent... [but only] perfect practice makes perfect. So I want them to practice doing it right. And to give them multiple opportunities to learn what they could be doing wrong. ”

For the second project, students were asked to present a design research proposal at the end of the semester. In these presentations, students justified the workforce problem they addressed and outlined the design research proposal they developed to study this issue. Also, they described the process they followed, the insights they found doing preliminary research, and the potential beneficiaries of their work. After this last presentation, which was also the last session of the studio, Professor Miller asked some questions for clarification and made some final remarks to wrap up the project and the studio.

5.1.2. The Brief

The brief is a written description of the problem, need, or opportunity to be addressed in a design project (Sims & Shreeve, 2012). In the observed studios, the brief was an integral part of the curriculum and covered aspects such as the definition of the problem; process, methods, and activities; resources; and a set of criteria for measuring the success of the solutions designed by the students.

This section discusses the aspects of briefs used in both studios that suggest faculty’s concern for the development of student empathy for users. Findings are based on field notes, content analysis of documents provided by faculty (i.e., syllabi, project briefs, and presentation
guidelines), and the discourse analysis conducted on the transcriptions of interviews with faculty and students.

5.1.2.1. The Brief in AID

Project 1 consisted in the design of a device for “capturing and simulating breast and torso motion during athletic activity” (AID Syllabus, Spring 2015) intended to test the level of support provided by sports bras. A company that designs and manufactures sports clothing sponsored this project. However, Professor Miller gave students the option to work on a variation of this project with similar requirements but without ties to a corporate sponsor. All students agreed to work on the sponsored version of this project.

Project 1 required from students to working in teams to identify current methods of assessing the performance of sports bras, relevant motions of torso and breast to be simulated, and methods to capture and analyze the simulated movements. Also, this project required students to understand the anatomy of the breast and body mechanics when exposed to athletic activity and to address the variability in women’s bodies in the device they designed. Most importantly, the project required students to understand the relation between the measures obtained by the simulator they were to design and the qualitative assessment provided by sports bras users.

The brief of Project 1 required students to follow a design process that relied heavily on research of primary and secondary sources and on physical experimentation with materials,
and technologies to simulate and record body motion. The process was divided into four stages: (1) background research—reviewing existing literature (literature review), existing solutions to similar problems (market and patents review), and available materials and technologies; (2) primary user research—understanding the user experience based on empirical methods such as observations and interviews; (3) ideation—generating a variety of design concepts to address the proposed challenge through brainstorming sessions and the use of sketches; and (4) prototyping—developing functional prototypes through several iterations of trial and refinement.

Project 2 consisted in the development of a design research proposal to investigate and solve a workforce related problem. In this project, students worked individually and had the opportunity to select the problem to be addressed according to their preferences, previous experiences, or access to the problem’s setting. According to Professor Miller, this project gave students the opportunity “to explore something [they] might cherish,” that is, a problem close to them or to people they cared about.

The second project required students to “create a proposal and presentation to document your approach to solution development” covering the following aspects: (1) definition of the problem and identification of potential beneficiaries of a solution (target users and stakeholders); (2) review of existing solutions and their shortcomings in relation to the needs of users; (3) findings of a pilot study conducted by students to explore the selected problem (e.g., observation of the problem in context); (4) proposed methods to investigate and solve
the selected problem; and (5) plan of work and budget should the research proposal were to be implemented.

The brief of Project 2 was flexible regarding the specific process that students were expected to follow. It listed the items that the final presentation should include, and it asked students to conduct a pilot study to learn more about the problem, context, and users. However, students were free to define the problem to investigate as well as the scope, methods, and settings of the pilot study as long as they met the evaluation criteria presented in the description of the AID studio, as follows:

1. Significance of the problem.
2. Scope of impact of proposed solution.
4. Approach to solution development.
5. Initial ideation.
6. Proposal fitting reasonably within the your capabilities, resources, and network.
7. Budget (well defined, reasonable)
8. Presentation and documentation
9. Responses to peers and guest critics.

In Project 1, students faced the challenge of understanding the experiences and difficulties that women wearing sports bras had while practicing athletic activities. This problem was apparently more challenging for this group of students considering that most of them were
men who had never experienced the situation for which they had to design. However, this challenge also represented an opportunity for students to empathize and move beyond their comfort zone to accomplish the project objectives. In an interview with Professor Miller, she stated that the problem she posed to students in Project 1 promoted their empathy for users by making them feel uncomfortable and by pushing them to put themselves in the situation of women wearing sports bras and that of women they interviewed and observed as part of their research:

“I think empathy can be gained in many ways... I am trying to teach about empathy by asking [students] to create something new and to try something new. To be in an uncomfortable position. I keep putting them in positions where they are uncomfortable, so they will understand what it’s like to be uncomfortable... They’re creating the simulator [to test sports bras] by learning to ask where does it hurt. I want them to learn where to put sensors by understanding what the breast is like [and] how it’s going to change [during athletic activities].”

It is interesting to note that even though Professor Miller highlighted the importance of making students feel uncomfortable as a strategy to promote their empathy for sports bra users, in interviews held with students at the end of the semester, most of them reported feeling comfortable with the topic and the methodology of the studio:

“Because I come from an art background, we have to draw. It’s not uncommon to draw in class a naked woman just sitting in the middle of the room for two and a half hours... it’s anatomy, everybody’s got it, I don’t really care.”
“[The topic] didn’t scare me at all. I’m a mature person... I designed a lingerie store and it was started and ran by all women, so I had to go and meet them... I had to have that language and feel comfortably in talking to them, and not be like some giggling frat boy.”

“At first I wasn’t happy [with the topic]. It was very similar to the last project that I did... You just you go, find the people who are using [the product], you ask them questions, and then you find out the problems... it was just another design project.”

It is possible that students were uncomfortable, but in the interviews they projected a favorable image of themselves by posing as mature adults who were at ease with working on a project that dealt with the female anatomy. For instance, two of the interviewed male students that stated that they felt comfortable with the topic hesitated when they had to use the word “breast” in their oral presentations. This observation is not conclusive regarding their level of comfort with the topic and project but suggests that there was some degree of incongruence between the actions they reported (i.e., not feeling discomfort) and the actions that were documented through direct observation (i.e., hesitating when referring to the participant’s breasts).

Also, it is also possible that some students did not feel awkward because they did not have direct interaction with the women their group observed and interviewed. As students worked in teams in this project (three groups), they organized the work so that each team member would deal mostly with a couple of specific components of the project. For instance, in one of the groups observed, one of the students was in charge of creating the visual presentations
and conducting research on secondary sources (review of literature, market, and patents),
while the other two members were in charge of planning and conducting research with
participants. In another group, not all the members were present in each observation and they
compensated for that lack of direct experience by analyzing women’s body motions using
computer-generated animations. In general, by working in teams, some students avoided
going out of their comfort zone by focusing on familiar aspects of the project. Distributing
tasks according to the strengths of each participant was positive in terms of work efficiency,
but was not as effective in terms of meeting the faculty objective that students work in
unfamiliar territory.

Another aspect of the brief that seemed to reduce the opportunities for students to empathize
with users was the project’s focus on the physical dimensions of the experience of sports bras
users. Guiding questions posed by the project brief were related to the physical experience of
wearing a sports bras. These questions included aspects such as the range of motion in
women’s torsos, techniques to record the movement of torso and breast, anatomical aspects
of the breast to be considered in the design of the simulator, and variability in women’s
physical characteristics that needed to be addressed by the simulator. Consequently, the
observations and interviews that students conducted documented issues of physical
discomfort in participants wearing sports bras, measured the motion of participants’ upper
body, and explored variations in the motion of participants practicing different kinds of
athletic activities. Even though the project dealt with an intimate topic, the approach that
most of the students had was positivistic by distancing themselves from the “object of study,”
that is, the women they observed and interviewed. Ultimately, the project objective was not to design a sports bra—which would have required students to explore a broader range of aspects of the user experience, but a device to test these bras for categorizing them according to the level of support they provided for different types of athletic activities. This avoided the social aspects of clothing design as part of the assignment.

By contrast, Project 2—preparing a design research proposal to investigate and solve a workforce related problem—was posed in more personal terms for students than Project 1. The second project brief focused on the impact that students’ work could have on the quality of life of people in the workforce and invited them to design for a population, a problem, or a topic that students cherished. The syllabus introduced Project 2 in the following terms:

“You have the capacity to change people’s lives for better or worse. This project is an opportunity to explore something you might cherish. I believe that inspiration can come out of understanding... One way to understanding of problems, of people and context is through design research. But research takes planning and that’s what this project is about. Planning a design research project to promote understanding so that you are positioned to design something you cherish.”

Also, the introduction of Project 2 invited students to “do good” by improving the conditions of people in the workplace through design. The introduction emphasized aspects of inclusiveness by motivating students to improve conditions for people of all ages and all levels of ability:
“If you could make people’s lives better at work wouldn’t that seem like a good thing? If you want to do good, you don’t have to fly to the ends of the earth—you can do good by making things better for people at work. Better so they don’t get hurt, so they can keep doing a job as they get older or as their capabilities shift. Better so that work can be done by more people—folks some discount as unemployable.”

There is a stark contrast between the syllabus introduction provided for Project 1 (very rational and focused on the goals for the simulator students designed) and the introduction provided for Project 2 (more emotional and focused on the impact and the relevance of students’ work). Likewise, the focus of the project brief was different in both cases. In Project 1, the brief focused on discussing specific aspects of the project: timing, budget, deliverables, research methods, and processes. In Project 2 a large part of the brief was dedicated to showing students the significance of their work and discussing the components of the research proposal.

The more personal nature of the brief in Project 2 led most of the students to select topics and problems that were closer to their own circumstances and the people they cared about. Seven students—out of eleven—selected problems that occurred in settings in which their friends, family members, or themselves had worked. For instance, one of the students focused on reducing the injuries caused by the misuse of welding masks inspired by the experiences of his father working as a mechanic. Another student focused on addressing back injuries suffered by people working in wood shops inspired by his own experience working and owning one of these shops. Another student focused on reducing the burns suffered by cooks
in restaurants inspired by the experience of her stepson who studied culinary arts. In sum, the brief in Project 2 defined a set of objectives and principles intended to motivate students to get closer and more engaged with people than they did in Project 1.

Apparently, the brief of Project 2 offered a more favorable scenario for students to experience and develop empathy for potential users. However, the conditions that Project 2 brief presented to students were very flexible and the learning experience that they went through varied from student to student. The development of Project 2 relied heavily on students’ autonomy, personal interests, and ability to manage two major projects at the same time.

As a consequence, the degree to which a scenario seemed favorable for expressions of empathy in Project 2 was determined largely by the student. Time management in developing the project was also under student control, unlike Project 1 in which faculty defined the schedule of deliverables. For instance, in an interview held with students one week before the final presentation of Project 1, two students reported that they were not sure about the problem or population that they were going to address in their research proposals. Another couple of students reported that they did not conduct a pilot study but that they relied on their previous experiences observing and talking with workers about the settings they addressed in their proposals. By contrast, in this same round of interviews, a student reported that she had conducted two sessions of contextual observation and several interviews to inform her work on this project. The difference in experiences recounted by students suggests differences in the processes they followed and the methods they used to learn about potential users and
stakeholders. Consequently, the learning experience that each student had in Project 2 was different as well as the opportunities that they had to empathize with people addressed in their proposals. It may be that these path differences on Project 2 represented differences in student attention to users, however, it is not possible to separate such findings from the influence of time management.

In synthesis, the data collected and analyzed suggest that the project briefs provided to students in the Advanced Industrial Design studio created sets of conditions that were favorable for the expression and development of student empathy for users. The brief in Project 1 provided a robust structure (i.e., timing, budget, deliverables, research methods, and processes) for students to explore the experiences of users of sports bras. Students were required to do research in a topic unfamiliar for most of them, given the fact that most of them were men who could not experience firsthand the problems associated with wearing sports bras. By contrast, the brief in Project 2 aimed to motivate students at the personal and emotional levels by making them aware of the impact of their work on other people’s lives. However, the learning experience provided by this project relied on students’ autonomy and self-management more than on a robust structure as Project 1 provided. As a consequence, the learning and research processes that students had in Project 2 were inconsistent, in that opportunities for student empathy depended more on students’ approach to the project than on the conditions stated in the brief.
5.1.2.2. The Brief in BID

“[The first project] is not so much about condiment organization, it’s about going into a new culture, it’s about stepping into a new environment and seeing the way it is seen by people who live there… until the student can live in that environment, and see things the way those intimate users see them, [until] then he is designing from the wrong culture.”
–Professor Williams, instructor at the Basic Industrial Design studio.

The quote above, extracted from an interview with Professor Williams, exemplifies and synthesizes his approach to formulating the problems that students addressed in the Basic Industrial Design studio. For him, the brief guided and structured activities and conversations with students, with the ultimate purpose of teaching them different aspects of industrial design. The adoption of other people’s perspectives was among these objectives.

In the case of the previous quote, Professor Williams argued that posing the problem of designing a condiment organizer (Project 1) would persuade students to leave the studio and see with new eyes a familiar place. He expected that in doing this, students would enter into other people’s reality and culture, challenge their preconceptions about users, and design on the bases of direct interaction with different people and settings. In making this argument in an interview, Professor Williams provided as an example the case of a student who described the impact in her project as having a direct experience in the design context. Professor Williams recounted how visiting the restaurant and talking to the wait staff changed the
student’s mind and preconceived ideas about the dynamics of the place, as well as the
product requirements for a condiment organizer in that setting.

This argument made by Professor Williams in an interview at the beginning of the semester
seemed consistent with two items included in the studio’s evaluation criteria provided in the
syllabus that read “cultural and environmental awareness and responsibility” and “avoidance
of preconceptions.” However, just these two items were related to people and potential users
among all evaluation criteria. As mentioned in the description of the BID studio presented
before, the remaining sixteen items covered other aspects of the projects, which suggests that
issues related to users, culture, and preconceptions received the same attention in students’
evaluations as given to other topics. Unfortunately, due to the lack of access to the feedback
and assessment that Professor Williams provided to students, it is only possible to speculate
about the weight that user-related issues had on final evaluations.

The two user-related items in the evaluation criteria discussed above were also seen in the
brief that Professor Williams presented to students in Project 3. In this project, students were
asked to design a shoe for children in Africa that could be manufactured by local
communities with readily available materials. This project was motivated by the request of a
couple of retirees who traveled to a Sub-Saharan African country and found that children
walked barefoot and were exposed to injuries, infections, and diseases. As a consequence,
this couple sponsored the design of a low-cost shoe that could be manufactured by
communities in Africa and invited Professor Williams and his students to participate in this
initiative. Even though Professor Williams did not frame the general problem addressed in this third project, he adopted it as a challenge to design for a setting and a group of users that was strange to students and to which they had no access. For this purpose, Professor Williams influenced the definition of the design task with the purpose of introducing students progressively to this complex issue.

Initially, Professor Williams broke down the problem into smaller and more approachable issues for the students, such as the protection of the foot, documentation of manual manufacturing processes, and exploration of materials readily available in certain African regions and countries. As students became more familiar with the problem, Professor Williams introduced more specific user-related issues through questions posed during desk critiques that he conducted throughout the project. For instance, when students proposed fastening mechanisms that were common in mass-produced shoes, Professor Williams raised questions about the familiarity of those mechanisms among the target users. Additionally, he asked students to avoid making assumptions and to base their decisions on information they could collect through online research and their interactions with the project sponsor.

The use of these methods to conduct user research raises questions about the accuracy of the information that students received and, therefore, their perceptions of users of the shoes they designed. Online research has several limitations when it is used by untrained researchers, as was the case with this group of sophomores. The major problem was the low reliability of the information found by students at this level of their education. Even though they could have
found information that was accurate, in students’ presentations there was no evidence that the sources they consulted were reliable and authoritative, as they did not provide any references to their sources. Also, gathering information from the project sponsors had several limitations that students expressed in interviews conducted at the end of the semester. When they were asked about the process of collecting information from the project sponsors, all of the interviewed students mentioned that it was a challenge. They argued that the sponsors’ experience in Africa was very limited and that their answers were imprecise. Difficulties in accessing reliable and precise information about the context and users suggest that conducting reliable user research was beyond the scope of this studio. According to the syllabus, it was expected that students would identify potential users and refine design problems based on an assessment of users’ needs, however, they lacked access to information that would guide many of their design decisions.

In Project 5, students were asked to observe their context and everyday experiences to identify and document issues that might frame design challenges in their own lives or other people’s lives. Based on these observations, students were to formulate their own brief and design a product to solve one of the issues they observed during the semester. For this purpose, on the first day of the studio, Professor Williams asked students to carry a notebook in which they were to write down problems they identified through their observations. Also, they were required to write down or sketch possible solutions to these issues, which were shared with the group on a weekly basis. Before Project 4 ended, students were asked to select one of the observed issues to be addressed in Project 5, based on how interesting the
problem was, the feedback they received from their classmates, and their personal preferences.

Professor Williams considered this last project a “dessert” in which students worked on something aligned to their interests, preferences, and personal experiences. In his words, “I would like for the final project to be something that [students] get an internal joy from. Something that they generate, that they are happy to do, that would be satisfying to them individually.” For the purpose of this study, the fact that students could select their own topic based on their observations was an opportunity to find evidence of how the empathy for users integrated in Project 1 and 3 was applied in Project 5, in which the project brief did not constraint students’ selection of users or context.

Even though it was not stated in the project brief, the structure of Project 5 was open to addressing Professor Williams’ objective of mitigating students’ preconceptions. By asking students to observe and question everyday activities looking for problems and pain points, Professor Williams gave students the opportunity to appreciate their daily lives from a new perspective and to consider routine activities from the standpoint of others. However, the brief in Project 5 did not require students to interact with other people to collect information regarding the problems they observed, nor did require students to test their design solutions with potential users. Additionally, students had fewer than three weeks to complete this project at the end of the semester when projects for other classes were also due. Consequently, just a few students took Project 5 as an opportunity to explore other people’s
experience (e.g., access to healthy food for people living in food deserts) and most based their projects on issues found in their own context or in their own communities (e.g., reduce the number of tools that designers carry with them everyday).

Project 5 had the potential to demonstrate empathy, as encouraged in previous projects. As author Roman Krznaric (2014) argues, prejudice, preconceptions, and stereotyping prevent people from appreciating another’s humanity and erodes any possibility of empathy. By not asking students to provide evidence of their interactions with people and potential users to inform their insights, this project fell short in pushing students to go beyond their comfort zone; it allowed students to avoid conditions that encouraged empathy for others. As a consequence, a possible modification to this project brief would be to ask students to observe and document problems found in other people’s lives rather than on their own, still allowing for personal interpretations of problem components.

As shown in the interview excerpt, Professor Williams’ understanding of this project reflected an intention to please students and close the semester with an enjoyable project that acknowledged their preferences. The tension between addressing student’s preconceptions and acknowledging their preferences is explained by Professor Williams as an attempt to keep them engaged and motivated by giving them the power over the project: “Students will engage in this type of challenge more completely because it’s their idea from the beginning to end. It’s a challenge that they discovered... it pushes them to explore, to seek answers, to try different things, and it’s an issue of personal pride as well.” This tension can be seen also in
the other two projects that were analyzed in the BID studio. In Project 1, students were allowed to stay in their comfort zone by situating the project in a local restaurant, but they were pushed to confront their preconceptions about other people by the requirement to make observations and ask questions to servers and patrons. In Project 3, they were pushed beyond their known reality by situating the project in Sub-Saharan Africa, but they were allowed to use methods of inquiry that were familiar to them and avoided personal contact with users, such as online research. The difference in approaches to dealing with users and context presented above in the three analyzed projects suggests a search for a balanced project brief in which students address the authentic experiences of others and challenge their own assumptions and preconceptions.

The attempt to keep students engaged by posing them projects based on their own preferences raises questions about the assumptions implicit these projects regarding their motivation. Are students more engaged when they deal with problems that affect them directly rather than when they deal with problems that affect other people? Do students transfer what they learn from observing and solving their own problems to instances in which they have to observe and solve problems for others? Do they use these experiences with other to challenge their own assumptions? What are the implications of these assumptions in instances in which students work with classmates whose life experiences and background is radically different from their own? Do students go through a full research and design process when the frame of reference is reduced to their own experiences? These are questions that require further research in the context of industrial design education to inform and improve
how projects are formulated and structured if empathy for users is one of the learning objectives pursued in a studio at the sophomore level.

In synthesis, the collected and analyzed data suggest that three strategies were utilized in the Basic Industrial Design studio that had the potential to promote student empathy for users: First, using the brief to structure activities and conversations with students that invited them to consider and adopt the perspective of users and stakeholders; second, introducing the problem progressively as a sequence of smaller and manageable issues that allowed students to learn sequentially from realities different from their own; and third, proposing problems that balance the use of students’ prior knowledge with the exploration of new realities that challenge their preconceptions.

However, data suggest that some aspects of the projects undertaken in this studio also posed some obstacles to the manifestation and expression of student empathy in the studio. In particular, these obstacles were: the lack of access to users and context in Project 3; reliance on secondary sources of information such as online research; observation of personal experiences in identifying problems to address in Project 5; the few references to users and user-related issues in the course objectives and evaluation criteria.

5.1.3. The Research

Student research in the observed industrial design studios consisted of the exploration of the problem, users, and context through different methods and techniques with the purpose of
informing and inspiring the design processes. In the five projects documented herein, different types of research activities were conducted by students throughout the development of each project. This phase of the design process was especially well suited for promoting empathy, since it required students to explore and understand the experience of users and stakeholders using a variety of methods of inquiry.

This section discusses the research activities proposed by the instructors of both studios that suggest their concern for promoting student empathy for users. Findings are based on field notes, content analysis of documents provided by faculty (i.e., syllabi, project briefs, and presentation guidelines), and discourse analysis conducted on the transcriptions of interviews with faculty and students.

5.1.3.1. The Research in AID

“Empathy is about understanding what somebody is going through, and having respect for it, and understanding the challenges that they’re meeting... I think empathy can be gained through knowledge. I think it can be gained by understanding context.”

“When you’re asking to somebody private questions, if you role-play, if you rehearse, if you think through, if you plan... to me that’s about developing empathy for creating a good environment in order to run somebody through a user-centered design research project.”
“So, just developing the models, developing the motions, understanding where to put the sensors, understanding how to ask those questions, I think it makes [students] more empathetic to a person who is an end-user of a bra, to the person who is going to be using their simulator.”

–Professor Miller, instructor at the Advanced Industrial Design studio.

These quotes, extracted from an interview with Professor Miller, summarize her position regarding the promotion of student empathy for users through design research projects in the Advanced Industrial Design studio. For her, student empathy was by advancing the knowledge and understanding of people and context. She argued that by planning and conducting research activities, students in her studio were faced with the challenge of creating a user-centered environment for research participants, which in turn developed student empathy for participants. Likewise, she claimed that by asking students to design a device to test sports bras, they engaged in design and research activities—such as developing models, measuring body motions, defining sensor positions, and preparing questions for participants—that increased their empathy for users of sports bras and the device they designed.

As stated in the syllabus, the subject matter of this studio was design research; that is, the use of research methods and practices aimed at informing and inspiring the process of designing products, services, experiences, environments, and systems. Consequently, research activities in the Advanced Industrial Design studio were of paramount importance. According to the
syllabus, the studio focused on “understanding context and stakeholders” through research from primary and secondary sources. Recognizing that some of her students were more interested in the practice of industrial design than in design research, Professor Miller argued that she wanted to getting them engaged by showing that “design research is just like [industrial] design,” since both involved a structured process, a balance between creativity and curiosity, a user-centered approach, and consideration of multiple stakeholders. Also, she expected to engage students by showing them the value of design research for their practice: “[students] can learn something about themselves and they can learn something about their own process, even if they don’t become design researchers they can be informed by it.”

In Project 1, the design of a device to test sports bras, the syllabus asked students to conduct research from primary and secondary sources using methods such as ethnographic observations, semi-structured interviews, and brainstorming—for research on primary sources, and reviews of literature, patents, materials, and the market (i.e., existing solutions in the market). The stated objectives of using these methods to investigate primary sources were to observe and understand users and context, and to “identify alternative design directions” (AID Syllabus). By contrast, the stated goals of using the aforementioned methods to investigate secondary sources were to identify problems and opportunities and recognize potential settings for field work. In this project, students interacted mainly with sports bras users, who participated in research activities to inform the design of the device. Even though the end-users of the device were bra designers, the interaction of students with them was very limited partially due to the difficulty in accessing this group of stakeholders,
but mainly because the focus of the project was on translating the experience of sports bras users for the testing device designed by students.

In directing this project, one of the aspects that reflected the intention of Professor Miller to promote student empathy was the exhaustive preparation work she asked students to do before collecting data from participants (i.e., sports bras users). Following Professor Miller’s comparison between the practice of industrial design and design research, students were asked to design the experience that they presented to participants during data collection through a series of activities that adopted the perspective of such participants. In particular, Professor Miller asked students to prepare an IRB application describing in detail the data collection activities that they were planning, she gave them time to rehearse and refine their interactions with participants and she supervised the elaboration of students’ research plans.

According to the Office for Human Research Protections (OHRP, an office within the United States Department of Health and Human Services), an Institutional Review Board—IRB—is a mechanism to protect human subjects involved in research activities. In research institutions, IRB takes the form of a committee that approves, monitors, and reviews research studies that involve human subjects based on the ethical principles of “respect for persons, beneficence, and justice” (OHRP, 1993). Even though students were not officially required to submit their research plan to the IRB committee, Professor Miller asked them to prepare their applications with the double purpose of thinking through the details of the research activities they were going to implement with participants and dealing with this procedure in
preparation for their master’s thesis. Professor Miller was emphatic in asking students to put in place measures to protect themselves and their participants from potential risks associated with the research activities they were planning to conduct. These research activities ranged from documenting the distance that the nipples of running women moved in a stride to asking pregnant women as for the reasons why they preferred to use sports bras even when they were not practicing athletic activities.

In the second week of classes, Professor Miller made a presentation to students covering the basics of an IRB application, addressing topics such as the need for this requirement in research studies involving human subjects, ethical implications of collecting data from people, and the components of IRB application that they needed to submit. For three weeks, students worked on planning their research activities and preparing their IRB application with the supervision and guidance of Professor Miller. In a conversation held on the fifth week of classes, one student reported a major obstacle he found in the studio up to that moment was filling the IRB application, not because it was difficult or confusing, but because it was long, tedious and too detailed. However, in an interview at the end of the semester, the same student reported that even though he initially felt that completing the application was unnecessary, once in the field and in the presence of the participants, he understood the value of that preparation work.

The relevance of this discussion regarding preparation of the IRB application lies in the role that such an assignment played in the research conducted by students in the studio and in the
significance that this task had in terms of promoting student empathy for participants by Professor Miller. The IRB application constituted a detailed blueprint of the research activities conducted by students in the studio, including a detailed description of the research procedures from the perspective of the participants (including all the interactions between the subjects and the researcher); list of potential risks for participants and measures to minimize them; and appendix with all materials presented to participants. An example of the language used by a group of students to describe their research procedures is presented as follows:

“Participants will be asked to run on a treadmill under three distinct conditions in order to collect data on how their bodies and breasts move under these conditions. This will facilitate the construction of a functional prototype in studio to represent the torso and breast motion of unrestrained and restrained breasts. Using a semi-structured interview following the observation, researchers will ask the participant questions about their experience with existing market sports bras to identify areas that need to be addressed (such as strap chaffing) for data collection on the simulator.”

In sum, preparing the IRB application made students adopt a participant-centered approach to the research activities they planned and conducted in the studio. It put students in the position of the people they observed and interviewed so that the procedures and questions they applied considered the participants’ perspective and preserved their dignity, autonomy, safety, and equality. The learning outcome of preparing the IRB application—that is, students adopting the participants’ perspective—seemed to justify the efforts and time devoted by Professor Miller to this assignment regarding the development of student empathy.
However, the fact that students empathized with participants while planning research activities was no guarantee that they would behave appropriately and empathically during the actual collection of data. Consequently, Professor Miller also devoted a considerable amount of time and effort in preparing students for their interactions with participants in the field. In particular, she had small-group meetings with all three groups of students for four studio sessions to support them in preparing the implementation of their research plan. Professor Miller’s support consisted in reviewing with the students their protocols for observations and interviews, watching them practice recruiting and interviewing participants, and providing detailed feedback to each group and general feedback to the whole class. In an interview, Professor Miller stated that the purpose of the research preparation was to help students in overcoming their barriers, perfecting their practices, and becoming sensitive to people:

“Me asking [students] to project plan, to think about what they say, to think about what they want to ask, to share that with me, to have me review it, that is all driving me helping them develop a sensitivity to what they are doing, because it is purposeful. So by the time they’re interacting with somebody, somebody’s things that would be barriers, won’t be because it’s second nature.”

“I don’t want [students] fumbling through things. I think you learn by doing... Practice only makes permanent. Perfect practice makes perfect. So I want them to practice doing it right. And to give them multiple opportunities to learn what they could be doing that’s wrong. So that they become sensitive... because if you’re doing user-centered design, and you don’t have those sensitivities, people are not going to open-up to you and you’re not going to find out the truth.”
According to her statements and the time and effort she invested in supporting students’ research preparation, the development of student sensitivity to people and empathy for participants were a high priority for Professor Miller. This interpretation is reinforced by 81 references to users and participants in the studio syllabus, surpassed only by 91 references to research-related topics. Additionally, when Professor Miller was asked about her definition of success in the AID studio, she referred to the development of students’ “soft-skills” such as empathy:

“There are tremendous amount of soft-skills that [students] have to learn in order to be successful in data collection [such as] them learning to use the right words, using people-first language, [and] them learning how to put themselves in the position of the person they are interviewing on this very sensitive topic so that they can get people to open up to them.”

Despite the fact that the development of student empathy for participants was paramount in the Advanced Industrial Design studio, it is necessary to mention that not all groups had the same level of interaction with participants and not all students were equally engaged in the interactions with participants that their groups had. As mentioned before, students were divided among three teams that addressed the projects from different approaches. Team 1 (comprised of three male students) focused on the use of sports bras by women who practiced long distance running. Team 2 (comprised of three male students and a female student) focused on the use of sports bras by pregnant women. Team 3 (comprised also of three male students and a female student) focused on the use of sports bras by women who
practiced activities that implied complex motions such as yoga, kickboxing, and salsa dancing.

Team 1 conducted two data collection sessions with six participants. In these sessions, participants’ upper-body and breasts movement were observed and recorded while they ran on a treadmill. Also, they were asked to wear a hypoallergenic body paint on their arms to determine the areas of the breast that were affected by friction with the arms. Finally, participants were interviewed about their experiences and difficulties wearing sports bras. The variety and typology of research activities conducted by Team 1 suggested that their interaction with participants was intense and provided rich insights informing the design of the sports bras testing device. In an interview with a member of Team 1, he claimed that the data collection strategy was useful for understanding breast movement and for learning about “recruiting and communicating with various people in a way that was professional” and about “people’s willingness to talk about certain things, their perspectives, the way that they share, [and] what they think.” However, he also reported that not all team members were equally engaged in the data collection activities and that one of them took charge of the electronic presentation while the other two members were in charge of research and design. Therefore, students’ exposure to human-centered research methods was uneven.

Similarly, students in Team 2 reported having interviewed and observed six women in different stages of pregnancy, who were recorded doing different kinds of activities (i.e., at home, at work, and exercising) to determine the types and range of movements that they
were physically able to perform. According to the group’s IRB application, the purpose of the interview was to learn more about their experience wearing sports bras during pregnancy and to identify problems and opportunities that might inform the design of the device to test sports bras. Team 2 also reported interviewing a bra fitter to learn from her experience advising pregnant women in the selection of a bra according to their stage of pregnancy and body type. In the case of this group, interviewed students reported that all group members were similarly involved in the research activities, which was corroborated in an observed data collection session.

By contrast, students in Team 3 reported having interviewed and observed only three women in different athletic activities that involved complex motions (i.e., yoga, kickboxing, and salsa dancing) in order to “uncover problems associated with bra use during athletic activities requiring extreme ranges of motion and to document torso and upper extremity body posture” (Team 3, IRB application). Whereas members of Team 1 and 2 reported having recruited their participants using different sources and media for this purpose, a member of Team 3 stated in an interview that all three participants were people that members of the group already knew. Additionally, the same student reported that during the data collection sessions the team member who was acquainted with the participant was the one who led the interview, while the rest of the group observed and recorded:

“Generally, we let the contact of the group talk to [the participant], because they’re obviously the person that they have the most comfort with, and we acknowledged that
it’s a sensitive topic for some people, so obviously you want to talk to somebody who you are comfortable with for the most part... It was a very casual kind of encounter with them.”

The few people who were interviewed and observed by Team 3 suggested that the members of this group had fewer opportunities to interact and empathize with participants than their counterparts in Team 1 and 2. However, the familiarity between members from Team 3 with individual participants suggested a higher level of interaction and communication between them and, in turn, increased opportunities for empathy to occur. Unfortunately, since data collection sessions were not part of this study, there is no additional data to support or reject this interpretation.

In summary, the intent of Professor Miller’s first project was intended to promote student empathy through a thorough process of research planning that required student adoption of the participants’ perspective so that the research procedures preserved participants’ dignity, autonomy, safety, and equality. Likewise, Professor Miller expressed her concern for the development of student empathy by devoting a considerable amount of time and effort to help students in preparing their interactions with participants in the field. However, not all students were equally engaged in research activities that involved external participants. The number of participants interviewed and observed varied, as well as the roles that team members played during data collection sessions. This phenomenon suggests that not all students had the same types of opportunities to empathize with participants.
Project 2 consisted of the development of a design research proposal to investigate and solve a workforce-related problem. According to the syllabus, the purpose of this project was “to promote understanding [on the selected workforce-related problem] so that you are positioned to design something you cherish.” Compared to Project 1, this project was different in that its focus was on planning rather than conducting design research. As a consequence, the syllabus was not specific regarding the types of research activities that students were to perform. On the contrary, the syllabus required from students to determine the research strategy that they would use to study and propose solutions to the workforce-related problem that they selected. The syllabus just specified that students were expected to conduct a pilot study to understand the selected issue, but it was part of the students’ challenge to define the research methods they would implement in this pilot study.

As mentioned in the section discussing the brief, not all the students conducted a pilot study but some relied on personal experiences and the experiences of people close to them to inform their design research proposal. The group of students who allegedly conducted a pilot study reported in their final presentation having used methods such as literature, patents, and market reviews; participant and non-participant observations; semi-structured and informal interviews; and user journey maps—a visualization tool used to find insights by identifying users’ steps through a determined experience.

Unfortunately, the data collected by students in the research processes for this project was too limited to draw meaningful conclusions, due to the limited time that students and the
instructor devoted to the project. Interactions between the instructor and students discussing Project 2 occurred in one-on-one meetings at the instructor’s office to which the researcher did not have access.

5.1.3.2. The Research in BID

“Empathy is essential. Students don’t have a project unless they go out and talk to people who are expressing a need… unless students engage in that kind of information gathering, they don’t really have a legitimate design project yet.”

“[Empathy] is really the point of all of these excursions [into the users’ world]. It’s going out to become another person, to put yourself in the shoes of another person. To live the experiences of another person. And each of those people is a teacher for [students]. So the students need to be malleable.”

–Professor Williams, instructor at the Basic Industrial Design studio.

The quotes above, extracted from an interview with Professor Williams, summarize his position regarding the importance of research in promoting student empathy for users. For him, research in a design project served the dual purpose of making students see the problem they were addressing from the perspective of users and giving legitimacy to the solutions students proposed based on their research findings. Also, Professor Williams indicated that he used research with primary sources in the studio as a strategy to improve students’ engagement and commitment in their work. In this respect, Professor Williams claimed that students who had contact with the community and interactions with potential users tended to be more engaged than if they did not have direct interaction. He added that students were
expected to show respect and empathy for the people with whom they interacted as he was discussing the skills that students needed to learn to do research in the context of a design project:

“[Students] need to understand that no matter what their interviewee does, or says, they themselves need to show utmost respect to that individual. They need to try to understand the point of view of their interviewee. They’re depending on the person that they interview to help orient them, so the student needs to do everything possible to allow the interviewee to position the student, to see through this particular window, to see the things from the point of view of the one being interviewed. So that requires humility on our part, that requires fellow feeling on our part, empathy on our part.”

In the three projects undertaken in the Basic Industrial Design studio that were analyzed in this study, students performed the research activities presented below to inform and inspire their design processes.

In Project 1, the design of a condiment organizer, the project brief asked students to search for information about condiment organizers on the internet, observe restaurant staff cleaning and serving tables, and ask servers, managers, and patrons about their experience handling and organizing condiments. Even though Professor Williams expressed that one of the goals of this assignment was to promote students’ ability to take the perspective of people working in restaurants, in interviews conducted with students they expressed difficulties and confusion regarding the purpose of this assignment. Some students reported that they felt the problem of designing a condiment organizer was too small to justify extensive research,
others reported that the purpose of visiting restaurants was not clear at the beginning of the project, and others reported that it was hard to find major problems regarding condiment organization in the settings they observed:

“The whole time it felt like the whole reason I was going [to the restaurant] was off the point, and [I thought] ‘this is not really a big enough deal to even be asking them’, so it didn’t feel very productive going there and asking them [about condiment organization].”

“For the first project, [research] felt excessive, because we had to keep going back, and going back, and going back [to the restaurant]... I wish I had understood the point in the beginning. I wish that I had thought out more precisely what I was looking for each time I went.”

“[Waiters] weren’t supposed to ever look like anything is troubling them because that was part of the atmosphere there, so it was hard to spot things when I was observing them... because they couldn’t show that they were unhappy about something.”

Students’ reactions to the research activities suggested that they perceived few opportunities for significant research or meaningful insights in the problem of condiment organization in a restaurant setting. Consequently, students’ reactions raise questions about the efficacy of the research activities that they carried out in Project 1 and whether they really considered the perspectives of restaurant staff. Likewise, this situation raises questions about how engaging was the problem posed to students and the potential for promoting their empathy for users.
In Project 3, the design of a shoe for African children, Professor Williams asked students to compensate for the lack of access to users and context by doing online research and submitting questions to the project sponsor who, allegedly, had contacts in Mozambique who could answer students’ questions. Questions submitted by students addressed different topics such as availability of materials, availability of means of production, living conditions of target communities, and characteristics of the context. The online research students did in Project 3 explored topics such as the living conditions in Sub-Saharan Africa, materials available in these countries, local production processes, and existing solutions to the problem of children exposure to diseases and injuries by walking barefoot. Regarding the questions submitted to the project sponsor, students reported in several interviews that they received vague and confusing responses that were not helpful to inform the design of the shoes they designed. Regarding the online research that most of students used to inform their design processes, it was stated before that the reliability and accuracy of information collected through this method is often questionable when used by inexperienced researchers and unlikely to provide firsthand experience by children in Africa. Additionally, Professor Williams argued in an interview that information that students collected exclusively through online research created an unrealistic image of users: “if you’re just designing for the person you’re reading about on the internet, you’re designing for a fantasy... these are not real people.”

It is understandable that the lack of access to the context and potential users in this project left few options for students to conduct user-centered research; however, they could have
approached this problem differently so that the information they collected was more reliable. For instance, they could have contacted and interviewed immigrant families that came from Sub-Saharan Africa, contacted people living in those areas through social media (which students use with proficiency), or reading ethnographic reports written by seasoned anthropologists. One of the students attributed his decisions regarding the research activities he conducted to the scarcity of time to develop this project:

“It never felt that we had enough time to do anything than ‘google’ stuff. So that’s pretty much what I did. I mean, I didn’t just ‘google’ the name of my product and then just clicked on the first three links… I follow the trails and went in depth to get a general knowledge of the issues I was dealing with.”

It is important to note that the fragment presented above is not representative of all the students in the Basic Industrial Design studio but it shows an extreme case of a student who relied mostly on online research. By contrast, another student reported that interacting with users and stakeholders in a real-world setting throughout the semester was very helpful to develop her ideas and develop her communication skills:

“Being able to get that one-on-one interaction with a client or an audience, is something that I have found pretty helpful because we were able to communicate to people our ideas… When speaking with other people outside of our field, we would have to come up with a way to clearly communicate what we are talking about… and that would definitely get you out of your comfort zone to get testimonials and feedback to help improve your design.”
Additionally, in Project 3, Professor Williams asked students to wear the shoes they designed to test how they would feel on the feet of their intended users and then, based on this experience, make refinements to the original design. Literally, the instructor asked students to walk into other people’s shoes (the popular definition of empathy) to inform their design processes. In an interview at the end of the semester, one of the students recounted his experience testing the first iteration of the shoes he designed showing his intention to experience by himself what the target users would feel and think when wearing the shoes:

“I built a pair of the shoes and took them out for a test. I walked around on different kinds of surfaces and filmed myself using the product and just seeing what it might be like to have this experience on your feet, and trying to find where the faults were... I wish I could give another pair to another person who could use them in a different kind of context and go on to have a long walk with it, that wasn’t strenuous but I just wanted to do as rapidly as possible, find out where the major failings points were for the shoe.”

In Project 5, the design of a product based on students’ insights, research methods consisted of students taking notes about problems they observed in their environment. In the studio session in which Professor Williams introduced this project, he asked students to look for problems that they experienced on a daily basis, whether they were major problems, minor annoyances, or situations that were not evidently problematic. Also, he asked students to look for problems that people around them experienced, paying special attention to “people who have difficulties accomplishing a task.” Along with the notes that students took, Professor
Williams asked them to write or sketch a solution to the problems they encountered, which students presented in the studio on a weekly basis.

As mentioned before, just a few students selected a problem based on other people’s experience. Most of the students selected issues found in their own context and in their own community. From a research perspective, asking students to identify problems in their daily lives meant that the range of issues that they documented was limited to their own experiences even if the problems they found occurred to other people. In other words, the universe of problems that students could observe and select was restricted to the routine of a college student in industrial design. As a consequence, projects that addressed issues related to student life were common in the last assignment, as can be seen in the following examples of problem descriptions extracted from students’ presentations:

“College students flood to beaches and other popular locations such as Las Vegas, Bahamas, and Panama City. [However,] it is very difficult to think of and plan the aspects of a spring break trip. No app or website currently does this.”

“Designers tend to carry an assortment of tools to help them create wherever they go. Yet, often times, it may be a hassle having to carry so many tools or forget something and have to borrow from someone else. Why not have a tool that incorporates the most commonly used items?”

“Since a lot of us want to study abroad this summer, or traveling during the summer, one of my parents’ concerns was that I was going to get mugged or pickpocketed... so I decided that I wanted to work on something like that for my project.”
The limited range of experiences that students observed to inspire their work on Project 5 raises questions regarding the range of people with whom they could empathize in developing this assignment. If students looked for problems in their daily lives, then the people suffering these problems were likely individuals in their same situation or members of their community. Consequently, 47% (n=9) of student projects were targeted to college students, 32% (n=6) were inspired by problems that affected students' friends and family, and just 21% (n=4) of the projects addressed problems that affected individuals or communities that students would not normally find in their daily routines. The natural consequence of students addressing their own problems or those of people close to them is that empathy was unlikely to extend to people whose experiences were specifically different from their own. In terms of empathy promotion, an improved version of this assignment would be not just to ask students to observe and document other people's problems—as suggested in the previous section that discusses the brief—but to situate the observations students were to conduct in settings or situations unfamiliar to them, to gain perspective beyond their own.

Regardless of the limitations that these projects represented for student empathy development, research was an important component of the Basic Industrial Design studio. According to Professor Williams, research activities allowed students to contrast their preconceptions with reality, identify the network of people involved in the problem setting, and recognize the variety of requirements and expectations that users and stakeholders had regarding the product categories that students approached in this studio. The importance of research was reinforced throughout the semester. At the beginning of each project, students
received instructions in how to conduct contextual observations (e.g., in the restaurant, a kitchen, a college dorm) and how to ask questions of people in these environments (e.g., servers and managers, friends, family members). In the middle of the projects, students were required to give a presentation about their preliminary findings and the direction of their work. And at the end of the projects, the presentation guidelines suggested students to include findings from their research, a synthesis of existing solutions, and testimonials from potential users.

Even though the research was an essential component of every project analyzed for this study, the studio syllabus barely mentioned it. In three pages of syllabus (1342 words), the word “research” appeared only once as part of a learning objective that read: “Students will be able to produce well-crafted 2-D and 3-D sketches showing the development of an idea from initial research through a broad range of concepts to refinements of form and function.” Additionally, the syllabus implied that research activities were to be conducted by students to identify and assess user needs in a learning objective that read: “[Students will] refine design problems through a structured user needs assessment.” Except for the two sentences above, research was absent from the syllabus.

A possible explanation for this phenomenon is that the studio focused on introducing students to the practices and form-making methods of industrial design and the syllabus referred to research in generic terms as a design method. A different explanation is that the studio attempted to cover a large number of topics and, as a consequence, research received as much
attention as the rest of the subjects included in the syllabus but many skills were in competition for student attention. Another possible explanation is that the syllabus was not intended to address the details of each project, deferring to project briefs for the research activities associated with each project. Unfortunately, this phenomenon was not discussed in the interviews held with Professor Williams and, as a consequence, it is only possible to speculate as to the reasons why such an important component of the studio was barely referred to in the syllabus.

In summary, research activities were considered instrumental by Professor Williams in the development of all the projects analyzed in the Basic Industrial Design studio. However, student accounts and presentations suggested that research activities in the BID studio were conducted with different levels of proficiency and at different levels of depth; while some students used these activities as opportunities to step into the users’ world, there were also students who perceived these activities as mere requirements of the project, thus their level of engagement was limited. The difference in approaches to research activities in the studio implied a difference in opportunities for student empathy to develop. In Project 1, one of the objectives of research activities was to invite students to adopt the perspective of people working in restaurants. However, data suggested that students were not as engaged as expected with the topic (condiment organization in a restaurant setting) and had issues in recognizing the value of the research activities that they were asked to perform. In Project 3, the topic had the potential to promote student empathy for African children exposed to diseases and injuries by walking barefoot. However, according to the data analysis, the
research activities that students conducted (e.g., online research and submitting questions to the project sponsor) were only partially successful in providing reliable information on the problem, context, and users. Additionally, the lack of direct user-student interaction raised questions regarding the extent to which students could effectively empathize with people they learned about from secondary online sources. In Project 5, the problem-observation method proposed to students showed its limitations in the range of people that students ended up observing. As data shows, just a few projects dealt with problems faced by individuals that students would not normally encounter in their daily routine, while the majority of projects were aimed at solving problems that affected the students themselves and other people close to them. Additionally, the faculty authorship of the project brief and the uneven engagement in research activities suggested that students had limited opportunities to frame problems before working on Project 5. Assignments focused on artifacts (e.g., condiment organizers, kitchen utensils, shoes) rather than problems (e.g., service and health). It is important to highlight that the promotion of student empathy for users was not part of the learning objectives of this studio. As a consequence, the difficulties in promoting student empathy should not be assumed as a measure of the level of success of this course.

5.1.4. The Dialogue and Critique

Dialogue and critique in the observed studios consisted of the interactions between and students to provide feedback on work, including the methods and criteria used for evaluation. This category includes informal conversations, one-on-one desk-critiques, and formal critiques in which students’ processes and products were evaluated. In the analysis of this
category, special attention was given to instances in which faculty reinforced user-related issues and concepts of human-centered design.

This section discusses the interactions that faculty had with students in both studios that suggested their concern for promoting student empathy for users. These findings are based on field notes, content analysis of documents provided by faculty (i.e., syllabi, project briefs, and presentation guidelines), and discourse analysis conducted on the transcriptions of interviews with faculty and students. It is important to note that the dialogue between faculty and students was documented in field notes that summarized content. For this reason, the examples of conversations presented in this section are not verbatim, but they reflect the overall exchange between faculty and students.

5.1.4.1. The Dialogue and Critique in AID

The dialogue and critique in the Advanced Industrial Design studio were characterized by different modes of interaction between Professor Miller and her students. In total, six types of interactions were identified in the studio sessions: (1) lecture, (2) full-class discussions, (3) small-group discussions, (4) one-on-one discussions, (5) students’ presentations, and (6) critique.

During lectures, Professor Miller addressed the full class in launching projects, introducing concepts, or discussing topics of general interest (e.g., how to complete an IRB application). This type of instruction was usually accompanied by full-class discussions in which
Professor Miller and all the students addressed a range of issues. These interactions occurred at the beginning of the semester when the group discussed and identified possible approaches to address the design of the device to test sports bras.

The most common mode of interaction in the AID studio was the **small-group discussion** in which Professor Miller and each group of students addressed their progress on Project 1, raised questions and problems, and defined courses of action. The small-group discussion occurred weekly when Professor Miller moved between groups to check on student projects. **In one-on-one discussions**, Professor Miller and individual students discussed aspects related to Project 2 (which was conducted individually). As mentioned before, one-on-one conversations were not recorded in this study and, as a consequence, the specifics of these discussions is not reported.

Throughout the semester, students gave three **presentations** to share progress on projects, design processes they used, and outcomes of these processes (i.e., the device to test sports bras in Project 1 and the research proposal addressing a workforce-related problem in Project 2). In Project 1, presentations focused on presenting students’ work to the project sponsor with whom students discussed specific aspects of the project, addressing mutual questions, and identifying technical concerns of the design. As a consequence, presentations in Project 1 looked more like a client-designer meeting than a traditional design **critique** in which faculty assess students' work, stimulate critical reflections, and reinforce central concepts and values of the design profession (Brandt et al., 2011, Sims & Shreeve, 2012). Professor Miller provided critique-style feedback for Project 1 during studio sessions in small-group meetings.
and full-class discussions, especially when students rehearsed the presentations they had planned for the sponsor a week in advance of such encounters. By contrast in Project 2, the critique was intertwined with students’ presentations. In this second critique, Professor Miller followed the evaluation criteria stated in the syllabus to provide feedback, formulate questions, and assess students’ work. Students and instructor discussed topics such as the significance of the problem, scope of the proposed solution, data collection methods, approach to the solution, and the budget proposed by students.

Through the different types of interactions presented above, Professor Miller reinforced in students the importance of considering the perspective of users and project participants throughout the studio. Early in the semester, during a small-group discussion, members of Team 3 recounted their experience interviewing and observing three users of sports bras who practiced complex-motion activities (i.e., yoga, kickboxing, and salsa dancing). Professor Miller recognized the value of the information that students collected but emphasized that, as they were early in the project, they also needed to consider the perspective of other key users. In particular, she asked them to collect information from potential users of the device they were developing such as bra designers, bra fitters, and users of simulators (e.g., technicians, designers, engineers).

In a similar conversation with members of Team 2, Professor Miller asked them about the group of potential participants that they were planning to interview and observe. They identified key users for their project such as pregnant women, users of simulators, and
technicians. Similar to what she had suggested to members of Team 3, Professor Miller asked this group of students to expand their scope and consider interviewing bra designers and people working at maternity stores. Additionally, she recommended using a design research technique called “a day in the life” which consists of following and documenting a day in the life of a key user (e.g., a pregnant woman) to appreciate and understand the daily experience of that person.

As illustrated on several occasions in these conversations, Professor Miller reinforced the importance of considering the perspective of users and stakeholders by asking students to expand the range of potential participants and use research methods intended to document and understand their experience. This situation suggested that when students were complacent with their understanding of users and stakeholders, and they were at a point in their projects when they still needed to expand their comprehension of the problem, then the role of the design instructor was to make them aware of the limitations of their approaches and suggest courses of action that would provide a broader and more empathic perspective.

Conversations also highlighted the importance of an ongoing dialogue in the studio between faculty and students to detect and address the described shortfalls in user research in a timely manner. Also, these conversations suggested the need for different modes of interaction between faculty and students to promote student empathy for users. If the interactions in the studio had been limited to lectures or full-class discussions, then Professor Miller would have been unaware of students’ complacency in their attitude toward the problem and students
would not missed opportunities to refine their research process to capture the perspectives of a wider population. In short, by holding frequent small-group meetings Professor Miller learned about the status of student projects and provided guidance so that students were aware of a broad range of users and stakeholders whose perspectives and experiences needed to be considered.

However, despite the richness of communication that small-group meetings support, they also fall short in the relatively low number of students that an instructor can reach in a studio session and in the inefficiency in covering the same topics or making the same remarks with each group of students. For instance, the conversations previously referred to took place during a session in which Professor Miller made similar comments and recommendations to the three groups of students in the studio. In the small-group meeting that she had with the three groups, Professor Miller addressed common issues such as the range of participants that students were expected to interview and observe, research methods that students could use for this phase of the project, and strategies that they could implement to find and recruit participants. Apparently, Professor Miller could have covered these topics through other methods such as lectures or full-class discussions to make more efficient use of the studio time, although the small group format tended to demand greater individual attention from students. The exclusive use of seemingly “efficient” methods would also have limited Professor Miller’s awareness of the status of student projects, her capacity to advise their selection of potential participants, and the range of students’ opportunities for interacting and empathizing with diverse users and stakeholders.
The discussion does not suggest that lectures or full-class discussions were discarded by Professor Miller as opportunities to reinforce user-centered issues and promote student empathy. For instance, in the studio session immediately after the conversations previously reported, Professor Miller gave a lecture on collecting “first-person data” and completing an IRB application. According to field notes taken during that lecture, Professor Miller emphasized the importance of doing pilot work to test research methods and instruments before exposing participants to them. Also, she asked students to consult with her before each session of data collection so that they could review together the procedures, language, and instruments students were planning to use with participants.

Additionally, when presenting the IRB application process, Professor Miller highlighted that the purpose of such procedure in the AID studio was protecting participants from physical, psychological, and social risks associated with activities conducted by researchers. She added that it was necessary to identify and prepare measures to mitigate such risks, especially because of the sensitivity of some individuals to the research topic (i.e., participants’ experiences with sports’ bras and motion of the breasts when practicing athletic activities). Professor Miller communicated to students that one of her concerns with Project 1 was that they or the participants would feel uncomfortable with the types of questions or activities in their data collection process. Regarding this concern, in the field notes it reads:

“[Professor Miller] highlights how sensitive this topic is, and gives recommendations on how to deal with participants in order to protect them and protect the
As exemplified in the content of the lecture, in several instances Professor Miller expressed her concern for the safety and comfort of participants and students by reinforcing the need to test, refine, and practice research procedures and by making students aware of the sensitivity of the research topic for some individuals. These situations suggested that Professor Miller made an attempt to promote student empathy for participants by modeling an empathic behavior for them—such as expressing concern for others, engaging them in an empathic discussion, and inviting them to consider how fellow students and participants perceived the topic of the studio. Several authors (Baron-Cohen & Wheelwright, 2004; Wiggins & McTighe, 2005; Howe, 2013) have claimed that behaviors such as the ones described before are clear manifestations of empathy and constitute effective strategies to promote this ability in educational settings. By exhibiting these behaviors during the lecture on collecting first-person data and completing an IRB application, Professor Miller showed her ability to empathize and her concern for promoting student empathy. Additionally, this situation showed instances in which lectures and full-class discussions were leveraged as opportunities to foster both empathic concern and perspective-taking in students.

Professor Miller also used presentations and critiques, especially in Project 2, to redirect student attention to user-related issues. For instance, in the case of a student who presented a proposal to study postural problems caused by the design of jewelers’ workbenches,
Professor Miller redirected student’s attention to a potential user problem that he had overlooked. In discussing his proposal, the student presented an image of a “clean and organized workbench” as an example of a problem-free workspace (see Figure 24). However, in the critique, Professor Miller pointed out the presence of a large pill bottle on the working surface presented by the student and stated that objects like this were indications of problems faced by users:

“In one of your photos, a picture of somebody’s workbench, on the left side, there was a huge bottle of ibuprofen within easy range. Obviously this person suffers of pain and discomfort. If I were you, I would have highlighted that emphatically... those are the kinds of things that, when you’re in somebody’s space, you have to look for... look for things that people have done to fix their environment, those are indications that there is a design opportunity.”
Professor Miller’s comment was intended to raise student sensitivity to users’ problems. She invited students to be observant of the users’ environment in the search for signals that indicated problems and discomfort, such as the pill bottle seen in the picture above, makeshift adaptations, and signs of excessive use. By asking students to search for these elements in the user’s environment, Professor Miller invited them to have a critical approach when they were engaged in design research activities and to imagine themselves in the user’s situation in understanding the reasons that motivated such changes and adaptations.
In the case of another student who presented a proposal to study injuries suffered by janitors and cleaners, Professor Miller praised his attitude toward a janitorial worker that he observed and interviewed for the project. Professor Miller acknowledged that the student had paid attention to the interviewee and had shown respect when asking questions regarding the janitor’s practices that were risky or unsafe. As opposed to the comment that Professor Miller made to the student that overlooked the pill bottle in his analysis, she offered a compliment to reinforce the student’s respectful attitude and behavior:

“I can tell that you were taking in what the woman was saying, and questioning it, and being respectful and not overly probative... I meant that in a complimentary way, because working with people, and asking them questions sometimes is difficult. Some people are very cautious. I have noticed that for certain types of individuals it takes a long time to develop their trust... I think that you managed that well.”

As exposed in these comments, Professor Miller used the critique to reinforce student attention to user-related issues that were either neglected—as in the case of the overlooked pill bottle—or address by students. In particular, Professor Miller referred to alternate perspectives when students looked for insights into the users’ world. They had considered their own point view before making inferences regarding their environment and experiences. Also, Professor Miller referred to the sensitivity that students were expected to demonstrate when interacting with participants, so that treatment was not just respectful but also conducive to producing meaningful insights. Professor Miller’s comments suggested that a strategy to promote student sensitivity and consideration of user-related issues is to offer
positive and negative reinforcement in the critique. It is important to notice that the two comments previously presented were some of the few that Professor Miller provided regarding these kinds of issues. Most of the comments and questions raised in the critique of Project 2 addressed managerial aspects of the research proposal that students presented, such as the timeline, budget, team, and resources. As mentioned in the section discussing the research, the purpose of Project 2 was training students in planning skills that were required for their master’s thesis.

In conclusion, as the examples from the Advanced Industrial Design studio illustrate, different types of faculty-student interactions were used to raise students’ awareness regarding user-related issues and promote empathy-related behaviors and skills. Behaviors promoted through the dialogue and critique in the AID studio were: identifying all users and stakeholders involved in a problem; considering and acknowledging their different perspectives; caring for the welfare of participants; being respectful with potential users and representing their voice with dignity; expressing concern for users and stakeholders and being sensitive to issues affecting them.

On the other hand, the strategies used by Professor Miller to promote student empathy through the dialogue and critique were as follows: alternating modes of faculty-student interaction; proposing the use of empathic research methods (e.g., “a day in the life”); suggesting preferred courses of action that would provide an empathic understanding of users and stakeholders; modeling empathic behaviors; redirecting student attention toward user-
related issues; engaging students in empathic discussions; and using positive and negative reinforcements to promote empathic attitudes and behaviors in students.

5.1.4.2. The Dialogue and Critique in BID

The structure of the dialogue and critique in the Basic Industrial Design studio was similar to the one featured in the AID studio in that the BID studio alternated different types of interaction between students and instructor. The same modes of interaction that were described for the AID studio were also present in the BID studio; these modes were: (1) lecture, (2) full-class discussions, (3) small-group discussions, (4) one-on-one discussions, (5) students’ presentations, and (6) critique. The type of interaction that was most frequently used in this studio was the small-group discussion. However, given that students worked individually, the purpose and dynamics of discussions at the BID studio were different from the AID studio in that students were grouped for sharing their work, not for working together.

In half of the documented studio sessions, students were asked to share their progress with classmates seated nearby in what Professor Williams called “clusters.” One of the purposes of discussions in these “clusters” was for students to share their weekly observations for Project 5 (design of a product based on students’ insights): individual students presented their observations and their classmates provided feedback regarding problem insights and potential solutions. Also, small-group discussions served to address specific topics defined at the beginning of the session by Professor Williams. Additionally, students shared their sketches, 3-D models, and presentations before the final critique, and gave and received feedback.
For instance, in a small-group discussion at the middle of the semester, students shared their progress on Project 3 (design of a shoe for African children) addressing issues such as the availability of materials in areas where the shoes were planned to be produced, time and effort required to sew a pair of shoes, and design of the template to produce the shoe. Also, in that conversation, students addressed user-related issues such as the protection that shoes offered children from insects and weather conditions, stability and heel support, and needs of the diverse group of users that should be addressed by the shoe design. More importantly, one of the issues that was raised in that conversation was the ability of local communities in African villages to manufacture the shoe—which was one of the requirements in the brief.

When the project was launched, the sponsor suggested that students could propose the use of discarded car tires as the material for the sole since they were already in use for that purpose. However, as seen in Figure 25, students attempted to cut soles from car tires and reported in a small-group conversation that it was an almost impossible task. Students’ expressed their concern for the ability of people in rural villages to make shoes with this material given the lack of access to power tools and the physical strength required to cut the tire by hand.
Figure 25. Student struggling while cutting a shoe sole from a discarded car tire.

This conversation shows that in Project 3, students may have not empathized as much with the users of the shoes—i.e., African children, but empathized more with communities in manufacturing the shoe by hand. The small-group discussion offered an outlet for students to share their experiences and frustrations in making shoes by hand and to express their concerns regarding the process that artisanal shoe manufacturer was expected to complete. This conversation highlights that even though students did not have direct access to the experience of African children—the target user of the shoe they designed in Project 3—they had access to the experience and difficulties of the manufacturer by going through the
process of building several versions of the shoe by hand. In interviews held with students at the end of the semester, half of them expressed that one of the takeaways of Project 3 was learning how to sew and recounted the challenges of building functional shoe models. This suggests that by going through an intense prototyping process, students related to the experiences and difficulties of the manufacturer, for whom they expressed feelings of empathic concern. In short, prototyping allowed students not just to imagine the situation of manufacturers but also to actually experience part of the challenges of making shoes by hand. Small-group discussions allowed them to express their frustration and their feelings of empathic concern for artisanal shoe manufacturers.

It is important to note that discussions in “clusters” were not spontaneous but guided by Professor Williams, who in each session established the purpose of the conversation, topics that students were expected to cover, and types of feedback that students were expected to provide. At the beginning of the semester, when Professor Williams, introduced the methodology of the studio, he outlined the structure of the interactions among students in small-group discussions, modeled the type of feedback that was expected from students by providing some examples, and emphasized to students the importance of paying attention to each other during small-group meetings by asking students to “respond to what people are saying.” A field note taken near the end of the semester documents a personal reflection regarding the role of student dialogue and feedback in the studio and in promoting student empathy. The note reads as follows:
“[During the observed conversation, students] made few references to the user and user-related issues. However, what most called my attention, was to realize that empathy in this context may happen not only between designer and user, but between classmates, when they are invited to critique each other’s work... [In the BID studio] balanced feedback is provided both by faculty and students. I am not sure if it has to do with the American culture, the University, or the [program], but in my experience here, feedback always highlights positive aspects of projects, and points out the aspects that can be improved... I would like to explore further this behavior and [determine] if it can be considered as evidence of empathy between classmates.”

Even though the study of student empathy for fellow classmates is beyond the scope of the dissertation, the reflection presented before raised questions regarding the role of student-to-student dialogue in promoting their empathy for users and stakeholders. How does students sharing their work affect the development of empathy for users? How can faculty follow students’ progress and promote student empathy for users through small-group discussions? What difference does it make, in terms of empathy promotion, for students to interact in small-group discussions versus not working together?

Answering these questions with certainty requires additional research, however, it is possible to propose a tentative response based on the study’s framework. According to Howe (2013), an effective strategy to promote empathy is having empathic discussions, that is, talking about other’s behavior, thoughts, and feelings. Howe argues that by engaging in conversations about these issues, the subject thinks about what another person might be thinking, feeling, or experiencing, which can lead to empathy. In small-group discussions in
the design studio, students often converse about the experiences, behavior, thoughts, and feelings of users and stakeholders aiming at discovering insights that inform and inspire the design process. For instance, in the AID studio, the team that addressed the use of sports bras by pregnant women documented the participants’ experiences going through daily activities to build a user journey map. This map is a tool for visualizing the experience of individuals engaged in an activity. It analyzes the tasks, thoughts, emotions, motivations, and barriers that people encounter so that designers can identify insights and opportunities to improve the user’s experience. Building such a map requires that the team has discussions and reach consensus regarding the target user, which may lead to student empathy development.

Another important component of interaction between faculty and students in the BID studio was the critique. In the BID studio, each of the three projects ended with a critique session in which students presented the process they followed and the design solution they developed, answered questions and comments from the audience (classmates and sponsor in Project 3), and received some feedback from Professor Williams. However, most of the instructor’s comments were given through email rather than out loud during the critique. Even though this communication was not collected for the study, Professor Williams made a few comments and provided some feedback during critiques, which suggested the content of the emails he sent to students. The comments made by Professor Williams that were documented consisted of questions and expressions of concern and admiration for particular aspects of student projects. The topics that were most frequently addressed were aspects of functionality and the aesthetics of the design solution proposed by students, properties of the materials and
mechanisms they used, and issues of visual communication in the slides. Also, Professor Williams addressed the congruence between the product and the context and some aspects of manufacturing. Some questions were posed regarding user-related issues, but this topic was secondary in the discussions held during critiques. Given the lack of access to detailed feedback, it is not possible to describe the extent to which user-related issues were among the comments sent via email.

For the critique, students were required to prepare an electronic presentation that showed the process and design solution. In Project 3 students presented the models and prototypes they made throughout the development of the shoe for African children. During presentations, students followed the outline provided by Professor Williams, including: title slide; problem identification; existing state of the art; goals; information gathered; ideation; analysis of alternatives; design development; final design; product in context; testimonials from users; and a conclusion. In an interview conducted at the beginning of the semester, Professor Williams described this outline as a “process organizer” that guided student’s work and helped them to develop their own ideas and structure their presentations. It is important to note that in the outline, user-related issues were only considered as testimonials at the end of the presentation and were not explicitly stated on other sections. If the outline was considered a “process organizer,” and user-related issues were included at the end of the presentation in the form of testimonials, it can be inferred that the design process in the BID studio was focused on other issues, such as the identification of the problem, development of design solution, and the use of images and models in telling a compelling story. This interpretation is
supported by Figure 27, which visualizes the most frequently used words in the outline. The size of the font is determined by the number of times each word was found in the document. The difference in size of the word “users”, “product”, and “problem” suggests the order of priorities that students were expected to adopt for presentations and critiques.

In conclusion, small-group discussions guided by Professor Williams allowed for the emergence of expressions of empathy such as the concerns raised by some students regarding the difficulties that local shoe manufacturers might have if they proposed the use of discarded car tires as the material for the shoe sole. This situation also showed that prototyping in Project 3 (i.e., creating shoe models by hand) allowed students to experience the challenges face by artisanal shoe manufacturers, which promoted student empathy for local

*Figure 26. Word cloud of the BID studio’s outline for project presentations.*
manufacturers. Even though student feedback was an integral part of small-group discussions, it is uncertain to what extent giving and receiving feedback promoted (or not) student empathy for users. Based on the study framework, small-group meetings appeared to encourage empathic discussions about users and stakeholders, however, there was little evidence showing that type of empathic discussion in the BID studio. This suggests that without emphasis on user-related issues in the project brief and reinforcement by faculty in guiding these discussions, students focus no more on empathy for users than on other aspects of projects. Regarding the critique, given that the researcher had access to just a fraction of the comments and feedback provided to students, it is not possible to determine if this aspect of the studio was used to reinforce user-related issues. However, a thematic analysis of the studio’s outline for project presentations suggests that user-related issues were not a priority in students presentations, which leaves little space for the critique to be considered as an aspect used to promote student empathy for users in the BID studio.

5.2. Student's Expressions of Empathy for Users

This section presents an analysis of students’ responses to the educational practices that they experienced in the observed studios (i.e., the studio, brief, research, and dialogue and critique presented before). Special attention was given to student discourse (how students referred to users and user-related issues), use of images (how students depicted users), and application of research methods in the studio (how students learned from and interacted with users).
In this section, responses from students in a human-centered design studio (AID) were compared to responses of students in an introductory studio (BID) to identify how different teaching practices might have promoted the development and expression of student empathy for users. This section reports quantitative and qualitative data for a wide angle on students’ responses. Illustrated, detailed descriptions of particular cases portray how empathy was expressed in the observed studios. Students’ responses are organized and presented according to the categories previously introduced: verbal, graphical, and operational manifestations.

5.2.1. Variations in Empathy Measures

As referred in Chapter 4: Methodology, an empathy questionnaire was administered to students at the beginning (pre-test) and the end of the semester (post-test) in order to (1) establish a baseline measurement of empathy in the industrial design students that participated in this study (AID, BID, and HCD); (2) compare the effects on student empathy levels of two studios with different approaches (BID and AID studios); and (3) compare the effects on student empathy levels of two different types of courses that addressed human-centered design (AID studio and HCD lecture-based course).

The questionnaire administered to students consisted of 14 items extracted from two components of the Interpersonal Reactivity Index (IRI) proposed by Mark Davis (1983): empathic concern (EC)—“tendency to experience feelings of warmth, compassion, and concern for other people” (p. 117), and perspective-taking (PT)—“tendency to adopt the
point of view of other people in everyday life” (p. 117). Student scores were analyzed using a combination of data display and analysis of variance (ANOVA).

With the purpose of establishing a baseline measurement of student empathy, the questionnaire described before was applied at the beginning of the semester (week 2 of classes) to all students in the three groups (AID, BID, HCD). Baseline scores (or pre-test scores) were used for finding numerical relations between empathy levels (i.e., EC and PT scores) and “quantitized” qualitative data (e.g., number of references to users in student discourse). In order to compare the effects on student empathy levels of the BID and AID studios and the HCD lecture course, two analyses were conducted to test the following hypotheses:

1. Experiencing a design studio with a human-centered approach (AID) has a statistically significant effect on participants’ empathy scores (H1: Epre ≠ Epost, where E stands for mean empathy scores measured before and after design instruction).

2. Experiencing a lecture-based course on human-centered design (HCD) has a statistically significant effect on participants’ empathy scores (H1: Epre ≠ Epost, where E stands for mean empathy scores measured before and after design instruction).

These hypotheses were tested applying the IRI questionnaire at the end of the semester (last week of classes) and the pre- and post-test scores were analyzed using two-way analysis of
variance (ANOVA). Figures 28 and 29 visualize in box plots student scores in pre- and post-test per group of participants. In terms of empathic concern (Figure 27), students in the BID studio had a mean score of 2.78 in pre-test and 2.56 in post-test; students in the AID studio had a mean score of 2.43 in pre-test and 2.74 in post-test; and students in the HCD lecture course had a mean score of 2.79 in pre-test and post-test.

![Box plots of student scores in pre- and post-test](image.png)

*Figure 27. Empathic Concern: Distribution of scores in pre-test and post-test.*

In terms of perspective-taking (Figure 28), students in the BID studio had a mean score of 2.64 in pre-test and 2.82 in post-test; students in the AID studio had a mean score of 2.63 in pre-test and 2.77 in post-test; and students in the HCD course had a mean score of 3.11 in pre-test and 3.06 in post-test.
To test the hypotheses presented before and determine the statistical significance of the changes in empathy levels shown in Figures 28 and 29, four two-way ANOVA tests were conducted as shown on Figure 29.

Tests 1 and 2 examined the effects of experiencing a human-centered design studio (i.e., AID) on empathic concern (Test 1) and perspective-taking (Test 2), by comparing pre- and post-test scores of AID students with those of BID. Tests 3 and 4 examined the effects of experiencing a lecture-based course on human-centered design (i.e., HCD) on empathic concern (Test 3) and perspective-taking (Test 4), by comparing pre- and post-test scores of
AID students with those of HCD. The overarching purpose of conducting these four tests was to account for effects on empathy scores caused by instruction method—AID studio vs. HCD lecture-based course, and focus of the course—AID studio vs. BID studio. The results of these four tests can be seen in Appendix G: Two-Way ANOVA Tables.

<table>
<thead>
<tr>
<th>HYPOTHESES</th>
<th>EMPATHIC CONCERN (EC)</th>
<th>PERSPECTIVE TAKING (PT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Experiencing a design studio with a human-centered approach (AID) has a statistically significant effect on participants’ empathy scores.</td>
<td><strong>TWO-WAY ANOVA # 1</strong>&lt;br&gt;Response Empathic Concern</td>
<td><strong>TWO-WAY ANOVA # 2</strong>&lt;br&gt;Response Perspective Taking</td>
</tr>
<tr>
<td>1. Experiencing a design studio with a human-centered approach (AID) has a statistically significant effect on participants’ empathy scores.</td>
<td>Factor #1 Group (AID, BID)</td>
<td>Factor #1 Group (AID, BID)</td>
</tr>
<tr>
<td>1. Experiencing a design studio with a human-centered approach (AID) has a statistically significant effect on participants’ empathy scores.</td>
<td>Factor #2 Test (Pre, Post)</td>
<td>Factor #2 Test (Pre, Post)</td>
</tr>
<tr>
<td>2. Experiencing a lecture-based course on human-centered design (HCD) has a statistically significant effect on participants’ empathy scores.</td>
<td><strong>TWO-WAY ANOVA # 3</strong>&lt;br&gt;Response Empathic Concern</td>
<td><strong>TWO-WAY ANOVA # 4</strong>&lt;br&gt;Response Perspective Taking</td>
</tr>
<tr>
<td>2. Experiencing a lecture-based course on human-centered design (HCD) has a statistically significant effect on participants’ empathy scores.</td>
<td>Factor #1 Group (AID, HCD)</td>
<td>Factor #1 Group (AID, HCD)</td>
</tr>
<tr>
<td>2. Experiencing a lecture-based course on human-centered design (HCD) has a statistically significant effect on participants’ empathy scores.</td>
<td>Factor #2 Test (Pre, Post)</td>
<td>Factor #2 Test (Pre, Post)</td>
</tr>
</tbody>
</table>

**Figure 29.** Use of two-way ANOVA to test hypotheses.

There was no statistically significant interaction between the effects of experiencing a human-centered design studio (AID x BID, Pre-Test x Post-Test) on both empathy measures (EC and PT). There was also no statistically significant effect of experiencing a human-centered design course (AID x HCD, Pre-Test x Post-Test) on EC scores.

However, there was a statistically significant interaction between the effects of experiencing a lecture-based course on human-centered design (AID x HCD, Pre-Test x Post-Test) on PT scores \( F (1, 50) = 8.94, p<0.005 \). Simple main effects analysis showed that pre-test scores were significantly lower in the AID studio than in the HCD course \( p = 0.015 \), but there were no significant differences between post-test scores in these two groups \( p = 0.091 \).
These results suggest that when students were exposed to similar content (human-centered design) in different learning environments (studio vs. lecture-based course), the gains in perspective-taking (PT) were significantly greater in the studio than in the lecture-based course (HCD).

It is important to note that, for practical reasons, the use of ANOVA to test the hypotheses mentioned before violated some of the assumptions of this statistical test, as follows:

- Participants were not randomly selected because the observed courses were part of the core curriculum of the industrial design program, therefore students did not have the option of taking them or not, depending on whether or not they were selected for the study.
- Participants were not randomly assigned to a group since courses were not interchangeable (students could not register in AID instead of BID, or in HCD instead of AID).
- The groups of students were not independent from each other; some students in the AID studio took the HCD course on the same semester of the observation. As a consequence, scores of students that took both courses were counted only for the AID studio to control for possible effects of exposure to both courses on empathy scores.

Additionally, the quasi-experimental component of this study was limited by the fact that the groups of students were not equivalent in number of participants, gender distribution, and prior academic experiences. No measures were taken to control for external conditions that
could have affected student empathy scores out of the observed studios, such as other courses that they were taken simultaneously, extra-curricular activities, or personal experiences.

Another factor that was not controlled was the exposure of students to stressful situations like the ones they experienced at the end of the semester when the post-test was conducted, such as preparing final presentations, studying for final exams, and exhaustion. According to several studies (e.g. Bellini, Baime, and Shea, 2002; Shanafelt et al., 2005; McFarland, Kirkwood, and Maki, 2014; Todd et al., 2015), empathy levels are negatively affected by experiencing stressful situations, which “increase reliance on one’s own egocentric perspective when reasoning about the mental states of others” (Todd et al., 2015, p. 374). As a consequence, post-test scores could have been higher as a consequence of design instruction, but the stress they experienced could have been a confounding factor.

For the causes stated before, findings in variations of empathy scores cannot be generalizable and are not conclusive. Most importantly, given the limitations in design and application of the quasi-experimental component of the study and the lack of statistical significance shown by the ANOVA tests, changes in empathy scores presented in Figures 28 and 29 are inconclusive. More research is needed—with larger samples, equivalent groups and more control measures—to determine the extent to which empathy scores change when students are exposed to human-centered design instruction in a studio environment or in a lecture-based course.
5.2.2. Verbal Expressions: Describing Users

Verbal expressions of student empathy for users (what students say) refer to students' written and oral language that communicated the thoughts and feelings elicited by the experience and circumstances of users and stakeholders to whom students were exposed directly or indirectly. Verbal manifestations of student empathy for users were identified through discourse analysis of instances in which users were acknowledged or characterized. This analysis consisted of deconstruction and coding of students' language used in interviews, conversations in the studio, project presentations, and project documentation. The identification of students' verbal expressions of empathy was based on the assumption that language used by students is a reflection of what they think of and feel for users and stakeholders. Consequently, analyzing student discourse has the potential to unveil instances in which students took on the user's perspective (PT) or expressed feelings of warmth, compassion, or concern for users (EC).

The identification of verbal expressions of empathy was based on the analysis of 164 documents consisting of transcriptions of student interviews and oral presentations, IRB applications, and electronic presentations prepared by students from both groups (AID and BID studios). Student discourse was coded using the following categories:

1. User identification: a category used to classify students' references according to type of user (e.g., restaurant staff, African children, pregnant woman, etc.). This category was useful to identify the terms that students used to refer to users and infer the level of familiarity with
them—addressing a user by first name indicates a closer level of familiarity than addressing
users with generic terms (e.g., people, users, “they”).

2. User definition: a category used to classify students' references to users according to the
characteristics (e.g., age, gender, role, level of physical ability). This category was useful in
identifying the users' characteristics that students focused on and in inferring students'
understanding of users and stakeholders.

3. User's concerns and preferences: a category used to classify students' references to
problems, concerns and preferences manifested explicitly by users and stakeholders (e.g.,
“she [the user] said that it was the most perfect bra that she ever had”). This category was
useful in determining students' concern and understanding of situations addressed by users
and stakeholders.

4. User's problems and insights: a category used to classify students' references to problems
and insights (e.g., “we found that women don't like, in certain bras, the seams and stitches”).
This category was useful in determining students' concern and understanding of users'
situations based on their own observations.

**How Frequently Students Referred to Users?**

Data collected from AID and BID studios were not equivalent because of the difference in
number of students in each group (BID: 22, AID: 11), number of presentations done in each
studio (BID: 5, AID: 2), and the fact that students presented in groups in the AID studio and
individually in the BID studio. For this reason, the approach selected to compare how
frequently students in both groups referred to users and user-related issues was to record the
time they devoted in their oral presentations to each topic.

Figure 30. Percentage of time used by students (AID and BID studios) discussing each
topic on their presentations.

Figure 30 visualizes the percentage of time used by students (AID and BID studios)
discussing various topics in their presentations, such as the design problem, aspects of project
management, use of models and prototypes, research activities conducted or planned, and
user-related issues. This figure shows that AID students devoted more than half of the
presentation time discussing user-related issues, whereas BID students devoted less than 10%
of their presentation time discussing these issues. Consequently, data suggest that the use of spoken language by AID students reflected their interest in user-related issues (e.g., discussing the experience of women wearing sports bras), which is consistent with the focus of the studio on developing design research skills from a human-centered approach.

**How Did Students Refer to Users?**

Student discourse was analyzed to determine the terms or expressions used to refer to users and stakeholders. These terms were classified and organized according to their level of familiarity with users under the assumption that familiarity and similarity between individuals is key to develop empathy. According to Preston and DeWaal (2001), empathy increases with familiarity (when the empathizer has been previously exposed to the target of empathy) and similarity (when the empathizer perceives an overlap between herself or himself and the target of empathy). Also, Preston and DeWaal argue: “the greater the familiarity or similarity, the richer the subject's representation of the object” (2001, p. 35).

In short, this means that when students have rich representations of users and stakeholders, it is an indication of greater familiarity or similarity. As a consequence, the use of general expressions to refer to users (e.g., “people”) reflects a basic representation of users by students, a perception of distance between users and students, and therefore, fewer opportunities to develop empathy. By contrast, the use of specific expressions to refer to users (e.g., “Maria”) reflects the opposite situation: perceptions of having a close relation with users, deeper understanding, and therefore more opportunities to develop empathy.
Figure 31 visualizes terms used by students to refer to users organized according to level of specificity (from generic to specific) as an indication of students’ level of familiarity with users. Examples of terms on the left side of the spectrum identified in both studios were generic references to users (e.g., people, men/women, public) and generic references to users’ roles (e.g., user, employee, management). Examples of terms on specific side of the spectrum identified on both studios were the use of first names to refer to users, references to family members (e.g., “my sister…”), and references to users with specific roles (e.g., bra fitter, bra designer, yoga instructor). In the BID studio the most common references to users was “people,” whereas in the AID studio it was “participant.”
Figure 31. Visualization of terms used to refer to users organized according to their level of specificity (from generic to specific expressions).
By comparing the distribution of references to users by AID students and BID students, Figure 31 shows that AID students tended to use terms across the spectrum (from generic to specific), whereas BID students tended to use more generic expressions. The explanation of this phenomenon could be that as students in the AID studio spent more time working on the same project throughout the semester and focused their work on understanding the experience of specific groups of people (e.g., sports’ bras users), they had opportunities to build richer representations of such people and develop familiarity and empathy. By contrast, BID students’ time in the semester was divided into five projects with five different groups of users and stakeholders. As a consequence, the opportunities for building richer representations and develop familiarity and empathy with these groups of users were fewer. What this implies for the promotion of empathy in design education is that longer projects allow for the construction of richer representations of users by students, increased familiarity with them, and greater opportunities for empathy to emerge.

**Examples of Students’ Verbal Expressions of Empathy**

In the study, verbal expressions of student empathy for users were analyzed in context and contrasted with other sources of evidence such as images and field notes. To exemplify the range of students’ verbal expressions of empathy evidenced in the study, this section contrasts two opposite cases in which empathy expression varied from very low to very high.

Student 1 was part of the group of AID students who in Project 1 addressed long distance runners to understand their experience in wearing sports bras. As part of their research, the
group wanted to identify areas where there was friction between the bra and arms while running. For this purpose, students applied body paint to participants’ arms, asked them to run on the treadmill, and then identified rub spots from arms and bra. This procedure can be seen in Figure 32. In an interview at the end of the semester, Student 1 responded as follows when asked about this way to present the research topic to participants:

“I explained ahead of time what the phases [of the data collection session] were going to be, and then as we were doing things, [I explained] ‘at this point, I need to paint the underside of your arm, so I’m going to have a brush, and this paint might be a little bit cold’… as trying to think of myself as being clinical in doing this research. I had to make contact with them, but I always did it in a quick way where it didn’t seem bothersome to me or them.”

Student 2 was enrolled in the BID studio and his presentations throughout the semester focused on discussing aspects of product form and function disassociated of users. For Project 5, the design of a product based on observations and insights, Student 2 designed a
computer case intended to address issues of overheating as seen in Figure 32. He used engineering software to calculate the heat dissipation provided by his design and created professional-looking 3-D models and renders to present his project. At the beginning of the presentation he introduced his project as follows:

“In my project I’m looking to find the solution to PCs that are overheating and also gain some aesthetic value to them... [My design] has proper open ventilation, has access to the main components, and is still touchable on the sides, this in case you want to move it around your desk you don’t burn your hand... the most important thing is that this case, even though it has a really new look and style, still fits a lot of industry standards for size components”

Even though Students 1 and 2 in these examples were part of different studios and addressed different kinds of projects, the contrast between their discourse is indicative of two very different approaches to addressing user-related issues and two different representations of users. On the one hand, Student 1 expressed concern for the physical and psychological comfort of the participant that he was observing as part of his research. He also expressed his consideration for the participant’s perspective at the moment of presenting research procedures. On the other hand, Student 2 referred briefly to the user just to clarify that he or she would not get hurt when coming in contact with the sculptural computer case he designed. His discourse focused on the technical features and aesthetic properties of his design, but disregarded the interaction of the object with the user and context.
These examples also show two different paradigms in design that still coexist in most industrial design programs: the object-centered approach, intended to “produce an artifact or environment that solves a problem” (Davis, 2008, p. 71), and the systems-based approach intended to “address friction in the relationships among communities, conventions, and contexts” (Davis, 2008, p. 72). The sculptural case designed by Student 2 shows an interest for producing beautiful forms and manipulating high technology. However, the disregard expressed for users and user-related issues shows a disconnection with the complex system in which the product would live if it were produced. By contrast, the thorough study that Student 1 and his group did to inform their process shows an interest in addressing the complex system of elements involved in the device they were designing. These cases raise questions regarding the promotion of empathy under the paradigms mentioned before. Can an object-centered studio or project create the conditions for the development of student empathy for users? Or does the focus on the object shadows user-related issues that need to be considered for empathy to emerge? Is a system-based approach more effective for exposing students to user-related issues and promote their empathy for users and stakeholders? These are interesting and complex questions that require further research and reflection to be answered.

**What Does Students’ Use of Language Say About Their Ability to Empathize?**

One of the objectives in conducting a mixed methods study is to compare and contrast “quantitized” qualitative data with pure quantitative data. In this section, students’ references to users in their discourse were quantified to look for numerical relations with other
measures. In particular, the number of references to users by students in the BID studio were compared with their baseline empathy scores. This comparison was not performed for students in the AID studio because the bulk of the discourse collected was in group presentation sessions, in which each student addressed a different aspect of the project. Consequently, there were students in the AID studio whose recorded discourse addressed only user-related issues and other students who never mentioned the topic.

BID student empathy scores and number of references to users were analyzed with the Pearson product-moment correlation coefficient (or Pearson’s r) to determine the numeric relation between these measures. Figure 33 shows that there was no correlation between the number of references to users by students and perspective-taking scores. However, references to users and empathic concern scores were strongly correlated. This correlation can be better seen in Figure 34, which shows the relation between students’ references to users and students’ baseline empathy scores (Empathic Concern and Perspective Taking).

<table>
<thead>
<tr>
<th>Missing values removal: Pairwise deletion</th>
<th>Empathic Concern (EC)</th>
<th>Perspective Taking (PT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-Test</td>
<td>Post-Test</td>
</tr>
<tr>
<td>R</td>
<td>0.81183</td>
<td>0.75436</td>
</tr>
<tr>
<td>R Standard Error</td>
<td>0.01794</td>
<td>0.03078</td>
</tr>
<tr>
<td>t</td>
<td>6.06057</td>
<td>4.29961</td>
</tr>
<tr>
<td>p-value</td>
<td>0.0000079</td>
<td>0.00039</td>
</tr>
<tr>
<td>HO (5%)</td>
<td>Rejected</td>
<td>Rejected</td>
</tr>
<tr>
<td>Relationship</td>
<td>Strong</td>
<td>Strong</td>
</tr>
</tbody>
</table>

*Figure 33. Correlations coefficients matrix between students’ references to users and students’ baseline empathy scores (Empathic Concern and Perspective Taking).*
In conclusion, students’ use of language is a manifestation of their understanding of users and stakeholders. Specificity in language used to discuss users and user-related issues is associated with students’ mental representations of and familiarity with users and stakeholders. Since empathy increases with familiarity and similarity, students’ use of language that shows proximity between them and users reflects greater opportunities for empathy to occur. On the other hand, the analysis of student discourse is enriched when it is complemented with other types of data, such as student use of images (i.e., graphical expressions) or student use of research methods (i.e., operational expressions). More research needs to be done to determine how design approaches (i.e., object-centered or system-based) intervene in design students’ development of empathy for users. Additionally, according to data collected from the BID studio, there is a positive and strong relation between the frequency in which students refer to users and their empathic concern (EC) scores, which
needs to be validated through more research with larger samples and participants with a wider spectrum of educational level.

5.2.3. Graphical Expressions: Depicting Users

Graphical expressions of student empathy for users (what students make) refer to students' use of images in documents and presentations to depict users and communicated their thoughts and feelings regarding users and stakeholders. Graphical expressions of student empathy for users were identified through visual content analysis (i.e., identifying and coding the content of the images used by students, what the image shows), and semiotic analysis of images (i.e., identifying and coding denotative and connotative elements in the images, what the image communicates). This analysis was based on the assumption that images used by students to depict users are a reflection of their understanding and emotional connection with them. Therefore, the students' process of selecting each image presented to an audience elicited thoughts and feelings creating opportunities for students to empathize with users and stakeholders.

The identification of graphical expressions of empathy was based on the analysis of 1894 images extracted from the visual presentations created by students from both groups (AID and BID studios) for the projects in this study. These images were coded using the following categories:

1. Depiction of people (binary category): a category used to differentiate images depicting people from those that depicted other elements (e.g., products, spaces, sketches, precedents).
The group of images depicting people was classified according to the next four categories whereas the group of images that depicted other elements was not further analyzed.

2. **Image content**: a category used to classify images depicting people according to the primary content that they portray. For instance, average users, users facing difficulties, or users testing products.

3. **Depicted user**: a category used to classify images according to the type of user they present. For instance, restaurant staff, users of sports bras, African children, or students.

4. **Image source**: a category used to classify images according to its source. For instance, images found online, images taken by the student or stock images. This category was important to assess the level of familiarity between students and users.

5. **Distance**: a category used to classify images according to the distance between the subject (student/photographer) and the object (depicted user). This category was important to understanding the level of physical proximity between students and users and to infering the purpose of the image by determining its focus. This category was inspired by Barthes’ concept of “photogenia,” which implies the interpretation of the meaning of images through the analysis of stylistic aspects of images such as “framing, distance, lighting, focus, speed” (Barthes in van Leeuwen, 2004).

**How Frequently Students Depicted Users?**

All images presented by students in their project presentations were extracted and classified according to whether or not they depicted users. Figure 35 visualizes the percentage of images used by students of both studios to depict users on their presentations. This figure
shows that more than half of the images used by students in the AID studio depicted users, whereas less than a fifth of images used by students in the BID studio depicted users. Consequently, data suggested that AID students went through the process of selecting and creating images depicting users more frequently than BID students, providing more opportunities for AID students to express empathy for users through the use of images.

**Figure 35.** Percentage of images used by students (AID and BID studios) to depict users on their presentations.

**How Did Students Depict Users?**

Students’ images were classified according to whether or not users and stakeholders were depicted. The group of images that showed users was further analyzed to determine their content and intent. Figure 36 compares the content of images depicting users presented by AID and BID students. AID students used most of the images to present average users (e.g.,
sports bras users), the design process they followed (in which students themselves were depicted), users facing problems (e.g., woman showing discomfort with her bra), and images from research activities students conducted (e.g., participants being observed while running). BID students used most to the images to present the process of testing products (in which students themselves were depicted), average users (e.g., restaurant customers), and users facing problems (e.g., foot of children affected by diseases related to walking barefoot).

In both groups the pattern of use of images was similar: images showing students working or testing products as documentation of their work; images showing average users and stakeholders as a means to familiarize the audience with the people addressed by students; and images of users facing problems used to discuss the problems and difficulties addressed in student projects. In terms of empathy, it is revealing that students in both groups used most of the images to depict themselves working or testing products. These images were not intended to connect the audience with users or emphasize the problem addressed by student projects. In other words, these images were not used to reflect on users and, therefore they were not determined as significant in developing or externalizing empathy. In order to assess the potential for empathy offered by the rest of the images, other categories had to be evaluated, as well as the context in which images were presented.
Figure 36. Content of images used by students to depict users.

**How Did Students Collect User Images?**

As mentioned in the previous section, students’ familiarity with users is key for empathy to emerge. To establish student familiarity with users depicted in images, the origin of images that students used was analyzed. The origin of images that students presented to depict users
(Figure 37) reveals students’ effort taken to depict users and physical proximity between students and users. Photographs taken by students establish that they had a direct experience with users, that is, they were more familiar with users than in cases in which images’ origin was the internet or a third party source.

As seen in Figure 37, the origin of images shows a different pattern for AID and BID students. The number of images taken by AID students (n=170) was almost double the number of images they used from websites (n=94). In the case of BID students, the number of images they took (n=112) was close to the number of images taken from websites (n=88). This suggested that AID students were more exposed to users and stakeholders than BID students. The difference is more clear when the number of images taken by students is divided by the number of students in each group (AID: 11 students; BID: 22 students). In average, an AID student used in presentations 15 images of users and stakeholders taken by him or herself. By contrast, the average number of images used by a BID student was just 5 images of users and stakeholders taken by himself or herself. If we assume that students had direct experience with users by taking images of them, and if familiarity between users and students was increased by these common experiences, then the origin of images used by students reveals that AID students were more familiar with users than BID students. This finding suggested that AID students had increased opportunities to develop empathy for users by sharing experiences with them while taking pictures and conducting observation sessions documented in said pictures.
Figure 37. Origin of images used by students to depict users.

**Examples of Students’ Graphical Expressions of Empathy**

In the study, graphical expressions of student empathy for users were analyzed in context and contrasted with other sources of evidence such as student discourse and field notes. To exemplify the range of students’ graphical expressions of empathy evidenced in the study, this section contrasts two opposite groups of images in which empathy expression varied from very low to very high.

Figure 38 presents a sample of images used by AID and BID students to depict users that suggest student empathy for the people depicted. Images 1 and 2 were presented by a group
of AID students to introduce to the class to participants of a research activity conducted. These images were accompanied by a detailed description of each participant and quotes from their experiences practicing athletic activities. Students talked about them with familiarity, calling them by their first names, and showing concern for the problems they reported. The same familiarity that students projected in their discourse is present in these two images that reveal the participants’ humanity and individuality; in the images participants were not grouped under a generic category, but their individuality and personal experience is highlighted both in images and in student discourse.

Figure 38. Images presented by students to depict users that suggest student empathy for users. Examples were extracted from presentations of AID and BID students.
Images 3 and 4 were presented by BID students to discuss the problems suffered by restaurant staff (in Project 1) and shoe-less African children (in Project 3). Image 3 was taken by a student to show the frequent bending of waiters and waitresses when cleaning tables. She expressed her concern for potential injuries suffered by this group of people and proposed a condiment organizer that would facilitate the task of moving condiments for cleaning tables. Image 4 was used by a student to show the types of injuries suffered by barefoot children in Sub-Saharan Africa. Likewise, she expressed her concern for these injuries in her presentation and project objectives and used this image as an argument for the design of a locally-made shoe that would protect children from suffering diseases associated with walking barefoot in areas with poor sanitation.

Both pairs of images show student empathy from different perspectives. Images 1 and 2 were intended to make the audience connect with the personal experiences of participants by showing their familiarity, humanity, and personal story. These images suggest a process of perspective-taking (PT) in the students who took the images and used them to communicate the story of these two people to the class. Images 3 and 4 were intended to communicate concern for the audience by highlighting the risks to which these individuals were exposed in their current work and living situations. These images suggested a process of empathic concern (EC) in the students who selected these images to emphasize the need for the products they were asked to design in the BID studio.
Figure 39. Images presented by a student to depict the average user and designed product.

By contrast, Figure 39 illustrates the case of a student whose use of images suggested an absence of empathy for users. Image 1 was presented by a BID student to exemplify the average user of a device to measure and control the use of water in the shower. He argued that “people use too much water when showering,” which had environmental consequences that needed to be addressed by shower users. Image 2 shows the product designed by the student: a water-proof chronometer that detects the flow of water to keep track of time when taking a shower and the cost of the water that users spend. Even though image 1 shows a relatable mother with three children, the problem addressed by the student was not particular to this group of users and was unrelated to the message communicated in this photo.

Image 2 suggests that product was not intended for children based on the height of the product display and the function of the object itself since it is uncertain if visualizing the cost of water used in the shower would change the water-consumption behavior of a toddler. This situation shows a dissonance between what the student stated was the purpose of the product, the intended user for the product, and the image depicting the average user. No evidence of
empathy for users can be found by contrasting these three dissonant elements in the project of the student and his use of images.

**What Does Students’ Use of Images Say About Their Ability to Empathize?**

Images depicting users in student presentations were quantified to compare with baseline empathy scores. Since the mere number of images depicting users did not provide a sense of how many images were presented in total, the percentage of images depicting users was calculated and compared with empathy scores. As in the case of verbal expressions of empathy, this comparison was not performed for students in the AID studio because of the images that were collected were from group presentations, which made it impossible to determine what images were selected by each group member. BID empathy scores and the proportion of images depicting users were analyzed with the Pearson product-moment correlation coefficient (or Pearson’s r), which found no significant correlation between these measures as seen in Figure 40. This finding highlights the fact that the frequency in use of images depicting users just offers opportunities for student empathy to emerge but it is not indicative of students’ actual levels of empathy. As concluded on the examples presented before and in Anna’s case study that follows this section, students’ use of images is useful as complementary evidence of their expression of empathy for users and can provide important insights, however, just the analysis of students’ use of images devoid of context or other sources of evidence is inconclusive.
In conclusion, it was found that AID students used proportionally almost three times more images to depict users than students in the BID studio. Likewise, it was found that in average AID students presented three times more original images taken by the student than their counterparts in the BID studio. This finding suggests that AID students had increased opportunities to develop empathy for users by sharing experiences with them while taking pictures, documenting observation sessions with said pictures, and selecting each image to be presented to the class.

Figure 40. Relation between students’ use of images to depict users and students’ baseline empathy scores (Empathic Concern and Perspective Taking).

However, it is crucial to note that students taking, selecting, and presenting images depicting users just has the potential to increase students’ opportunities to empathize with users and stakeholders. These actions cannot be interpreted automatically as graphical expressions of empathy. To determine whether or not the use of images suggests empathy for users, it is necessary to evaluate the context, and student discourse and actions. As shown in the
examples presented before and on Anna’s case study that follows this section, students’ use of images is useful as complementary evidence of their expression of empathy for users and can provide important insights on this matter, however, just the analysis of students’ use of images devoid of context or other sources of evidence is inconclusive.

5.2.4. Operational Expressions: Interacting with Users

Operational expressions of student empathy for users (what students do) refer to students’ implementation of research methods in exploring user-related issues, which reflected student attitudes, thoughts, and feelings towards users and stakeholders. Special attention was given to students’ implementation of methods that allowed for user-student interaction. Operational expressions of empathy for users were identified through the analysis and interpretation of students’ approach to research activities used to learn about users, context, and the problem (e.g., interviewing a potential user). This analysis was based on the assumption that user-student interactions create opportunities for students to empathize with users and stakeholders.

The identification of operational expressions of empathy was based on the analysis of 53 field notes and 122 documents prepared by students from both groups (AID and BID studios), which recorded the research activities they conducted. Students' research activities were classified using the following categories:
1. Potential for user-student interaction: a category used to differentiate research methods applied by students that allowed for user-student interaction (e.g., interviews) from those that did not allow for this kind of interaction (e.g., literature reviews).

2. User-student interactions: a category used to identify research activities conducted by students in which they interacted with users and stakeholders according to the research method they used. This category was useful in determining the frequency and intensity of user-student interactions and in identifying instances in which students were exposed to users and had the opportunity to empathize with them.

**How Frequently Students Interacted With Users?**

Research activities undertaken by students were classified according to whether or not they allowed for user-student interaction. Figure 41 visualizes the percentage of research activities conducted by students of both studios. This figure shows that almost half of the research activities that AID students conducted allowed for their interaction with users and stakeholders (e.g., sports bras users, bra fitters, and bra designers), whereas less than a fifth of research activities conducted by BID students allowed for user-student interaction. Consequently, this suggests that as AID students had more exposure to users and stakeholders than BID students, then they had more opportunities to develop empathy.
Figure 41. Percentage of research activities conducted by students (AID and BID studios) in which they interacted with users.

How Did Students Interact With Users?

The type and level of interaction that occurred between users and students varied from studio to studio and from project to project. Figure 42 presents the number of user-student interactions that occurred in each project undertaken by AID and BID students. A user-student interaction is defined in this study as each instance in which a student undertook a research activity with an individual user; for instance, if in a data collection session a group of 3 students interviewed together 2 users, that session would count as 6 user-student interactions (3 students x 2 users).
Figure 42. User-student interactions per project and research activity undertaken by AID and BID students.

Figure 42 shows that while AID students based the development of Project 1 on research activities that allowed for interactions with users and stakeholders, in Project 2 they relied very little on these practices. Likewise, this figure shows that while BID students had no
interaction with users and stakeholders on Project 3 (given the lack of access to context and users), in Projects 1 and 5 they undertook research activities that allowed for user-student interactions.

To explore the reasons for why students had more interactions in some projects than others, it is necessary to consider the brief of each project. In the AID studio, Project 1 required students to conduct design research to explore the experiences of users of sports bras aiming at “capturing and simulating breast and torso motion during athletic activity” (AID studio syllabus). By contrast, Project 2 required students to plan a design research proposal to study and propose solutions to a problem in the workforce and only required students to conduct a pilot study to inform their proposal. A similar situation was seen in the BID studio. While in Project 1 students were asked to visit restaurants and collect information through observations and interviews, in Project 5 they were asked only to observe and identify problems in their environment and everyday lives. Unsurprisingly, students engaged in more user-student interactions in projects that required data collection directly from users and stakeholders.

A consequence of the different approaches to research in project briefs was that each project offered different conditions for student empathy to emerge. For AID students, the project conditions stated in the brief offered the most opportunities to empathize with users engaged in research activities. By contrast, for BID students, the opportunities for empathy were fewer as they were less exposed to users. This difference is more obvious when the total
number of user-student interactions is divided by the number of students in each group. While an AID student had an average of 13.6 interactions with users throughout the semester, a BID student had an average of 5.14 interactions in the projects reported in this study (Projects 1, 3 and 5). If each interaction was an opportunity for students to empathize with users, then AID students had almost three times more opportunities to develop empathy than BID students.

**Examples of Students’ Operational Expressions of Empathy**

In the study, operational expressions of student empathy for users were identified by analyzing user-student interactions in context and contrasting them with students’ images and discourse. To exemplify the range of students’ operational expressions of empathy evidenced in the study, this section contrasts two opposite cases in which empathy expression varied from very low to very high.

A student in the AID studio proposed in Project 2 a design research project to investigate the causes and prevention of hand burns that occur during professional food preparation. This student was responsible for 42% of the user-student interactions that were documented in the AID studio for this project. The student conducted semi-structured interviews, sessions of participant observation, and an experiment to measure the hand grip of chefs and professional cooks. These research activities were motivated by the student since they were not a formal requirement of the project.
In analyzing the data collected on site, the student created a user journey map adopting the perspective of chef in a professional kitchen. In the map, she described each activity the chef executed, characteristics of the environment, interactions that the chef had, objects that he used for his work, and people with whom he interacted. She highlighted the problems the chef experienced in his work and provided detailed pictures that documented problems and concerns (Figure 43). The student expressed her empathy for the restaurant staff though a variety of behaviors: use of a selection of research methods that allowed her to learn about their work through direct experience; use of language that reflected her familiarity with the restaurant staff (e.g., use of first names); provision of rich and descriptive images that showed the staff’s humanity and individuality; and analysis of the collected data with a tool that allowed for taking the perspective of users and stakeholders.

![Figure 43. Images presented as research documentation by Student 1.](image)

By contrast, a student in the BID studio proposed in Project 5 the design of a mobile application to plan spring break trips. She provided the images shown in Figure 44 to present the user of her application and her research process, which consisted in starting to learn how
to program a mobile application and exploring what she called “components of app design.”

It is questionable that a sophomore student in industrial design understood the existing human factors, research, and methods in app design, which is a distinct area of design practice not developed in depth in the industrial design curriculum.

Figure 44. Images presented as research documentation by Student 2.

The student started her presentation by using the following language to describe her project:

“Today I’m presenting my app, the spring break app... The user that I had in mind is the young adult, college-age student who is planning a spring break trip. The problem that I figured out is that hundreds and hundreds of students flood to beaches, Las Vegas, Panama City... but there’s no app or website currently available that condenses all the information needed to properly plan a trip... the research that I did while creating this app was actually trying to learn how to code... also I learned about the important aspects of creating an app such as navigation, layout, color, and type.”

Even though both projects had open briefs and students could select the problem to address and methods to research it, the process and the outcomes of the projects presented above
were very different. While AID student conducted three different research activities that allowed her to interact with restaurant staff in order to learn from their experience, the BID student undertook activities that did not allow for interaction with users and stakeholders. Regarding the use of language and images by students, the AID student referred to people by their first names and provided images that reflected the humanity and individuality of restaurant staff she observed. The BID student’s language referring to the user was very generic (i.e., “Young adults, college students planning a spring break trip”) as well as the image presented to introduce users (Figure 44). While the project developed by the AID student reflected interest for understanding and taking on the users’ perspective, the BID student focused on the technical aspects of the project but disregarded users and user-related issues. The difference in approaches to each project created different sets of conditions for the emergence of empathy: the AID student planned and undertook research activities that allowed her to have meaningful interactions and empathize with restaurant staff, whereas BID student prioritized learning about technical aspects of her project, which prevented her from interacting and empathizing with users and stakeholders.

In conclusion, it was found that AID students had more exposure to users and stakeholders than BID students, and consequently they had more opportunities to develop empathy for users. By comparing the number of user-student interactions that occurred in each project with the respective project brief, it was found that student engagement in research activities was highly related to the brief of each project. This means that in order to promote user-
student interactions that create opportunities for the development of student empathy, it is necessary to structure research activities in the project brief that allow for such interactions.

5.2.5. Case Study: Kristoff, the Outlier

Kristoff (pseudonym) is a soft-spoken, committed, and humble student who throughout the semester showed an extraordinary sense of empathy for the people he observed and interacted with and for potential users of the products he designed in the Basic Industrial Design Studio. Throughout the semester, Kristoff showed motivation to explore the problems he addressed from the perspective of users and stakeholders for whom he showed concern and empathy. Also, in some of his projects, he raised issues of social justice such as racism, colonialism, inequality, and poverty.

Kristoff was an outlier. His empathy for users and stakeholders in the design studio was well above of that of the rest of students that were observed. His case was not representative of his group, but his behavior and discourse showed a wide range of expressions of empathy. Not all the students had the same interest in exploring the perspective of users to inform their work. For instance, some students were more interested in exploring issues of form and aesthetics, others were more interested in exploring the use of materials and technology, and others were engaged in exploring topics of personal interest. For this reason, his case is presented in the following pages as an example of the variety of verbal and operational expressions of empathy that may occur in the setting of an academic industrial design studio.
In Project 1, the design of a condiment organizer, Kristoff presented the specific problems he addressed in the project by discussing the needs, concerns, and priorities of servers and customers in the restaurant he visited. In Project 3, the design of a shoe for African children, Kristoff started his presentation questioning the preconceptions about Africa involved in the project brief and the ethnocentrism that motivated charitable projects of this nature. In Project 5, the design of a product based on students’ insights, Kristoff focused on food deserts, a problem common in low-income communities in American inner cities, which he attempted to perceive from the perspective of a member of such communities.

In presenting his goals for Project 1, Kristoff identified the different users of the condiment organizer, he acknowledged their particular needs and expectations, and stated that the focus of his project was to balance these same needs of different individuals by asserting that:

“The gist of [the project goals] is balancing the need of the patron—he needs something to be able to easily take in and take out the condiments—with the needs of the wait staff—being able to quickly and easily pick [the organizer] up and move it.”

Also, in discussing the problems addressed in Project 1 and justifying the need for a condiment organizer in the setting he studied, Kristoff showed concern for the risks associated with mishandling condiments in a crowded environment and for the burden on the servers to move condiments constantly without an organizing system. In his words:
“The biggest problem that I notice there was to clean the tables they have to scoop up all the condiments, and they have to move them onto a table. When it’s busy at night, sometimes they have to move them into a chair... [and] there’s a good chance that someone is going to bump into the chair while [the condiments] are sitting there, and they’ll be dropped, breaking glass, and making a mess.”

Project 3, the design of a shoe for African children, was sponsored by a couple of retirees worried about children in Sub-Saharan Africa who were exposed to injuries, infections, and diseases caused by walking barefoot. In his presentation, Kristoff questioned the real benefits of this type of charitable project for the populations that they intended to serve. He expressed concerns about how these projects preserved and spread misconceptions about developing countries and how initiatives like this tended to dehumanize their beneficiaries and create a distorted image of people. He even proposed to his classmates starting an initiative to establish a closer relationship with individuals in these countries with the purpose of getting to know them better:

“A lot of these charitable things that we do, they are good, and they do help people, but they hurt our perception of Africa and other Third World countries. We stop seeing people as people, and more as projects. So, I thought it would be neat if you started [something] like a pen-pal program... to get to know a kid there, so that [he or she] becomes a person and not just a project.”

It is interesting to note that when Kristoff was discussing these issues, he omitted a sentence written in his visual presentation that read “Perceptions: avoiding the ‘white man’s burden’.”
According to the American Heritage Dictionary of the English Language, the expression “white man’s burden” refers to “the supposed or presumed responsibility of white people to govern and impart their culture to nonwhite people, often advanced as a justification for European colonialism” (2011). Even though Kristoff did not introduce issues of racism, colonialism, or paternalism in his spoken discourse, the presence of this sentence in his visual presentation when he was questioning the project brief suggested that he was concerned about the ethnocentric ideologies that motivated this initiative. In an interview held at the end of the semester, Kristoff reiterated this concern when discussing the level of ability of the people in Africa who would manufacture the shoes students designed by asserting:

“We had no idea what their skills were... although, at the same time, we don’t want to marginalize and say ‘oh, because they’re from Africa they can’t figure this out’, because that’s bogus. People are smart and people can figure things out.”

In the same interview, I asked him to elaborate on his perception of this project. In general, he was disappointed with the fact that students did not have access to the context and the potential users of the shoes they were designing, which in turn made them work based on assumptions and preconceptions, basic online research, and the little information they received from the project sponsor. He expressed his lack of confidence in the outcome of the project, but he recognized that he gained a basic understanding of how to design shoes and how to work with textile materials. In his words, “I learned how to sew, I learned how to make shoes, [which] I have never done before… it was a great project for us, I just don’t know how much [this] is actually going to help kids in Africa.”
In Project 5, the design of a product based on students’ insights, the problem that Kristoff selected to address was the lack of access to healthy and affordable food for people living in food deserts; that is, areas with “limited access to affordable and nutritious food… composed of predominantly lower income neighborhoods and communities” (United States Congress, 2008). It is important to note that Kristoff’s project was the only one—out of 19—focused on a pressing social issue that affected a community different from his own. The other projects discussed more general topics (e.g., the scarcity of water in remote and dry areas), issues that affected students directly (e.g., the number of tools that designers need to carry every day), problems that students evidenced in their communities (e.g., the difficulty to control larger dogs by people with diminished strength). The uniqueness of Kristoff’s project was highlighted by one of his classmates in the critique of Project 5:

“My favorite thing about your project is that most of us are doing design solutions for these niche things or products for ourselves, but you looked around and you wanted to design for an underserved community, and I think that reflects well upon you, and it’s pretty admirable what you have.”

Kristoff’s interest in this issue came from his own experience helping a friend carrying groceries from a store to his apartment, as he recounted in and interview held at the end of the semester:

“I was hanging out with my friend… and we walked to [the store] to get some groceries, but we had to carry the groceries walking… That limits how much you can
The solution he proposed was an affordable, ergonomic, and visually appealing backpack to transport food over long distances, from grocery stores to the household of people living in food deserts. In his words: “I want to make things easy for you to go a long way with a lot of stuff. I want a backpack that looks good… [and] it really needs to be affordable.” However, in his presentation, Kristoff acknowledged that this backpack was a “band-aid solution” intended to satisfy the requirements of the project brief. For him, a systemic solution to this issue would be the creation of a program of incentives for supermarket chains to open stores in low-income urban areas that usually would not attract this kind of investment.

Despite the simplicity of the solution he proposed, Kristoff stated that he wanted the backpack to convey optimism, resilience, and encouragement for communities living in food deserts. The message that he intended to communicate through the design of the backpack was as follows: “You may not be dealt with the best hand, but you are doing everything you can to provide good food for your kids.” Besides accomplishing a semantic function, Kristoff argued that the design of the backpack was also conceived to accommodate a wide range of circumstances of potential users:

“I also thought about the users’ circumstances, where they are coming from... we need to be able to get this [backpack] on a city bus in case they’re going across
Finally, Kristoff closed his presentation by wishing that his project would help improve the living conditions of potential users of the backpack: “I hope this will help us make life better for people in lower-income areas.”

This final sentence summarizes Kristoff’s approach to the projects that were documented throughout the semester. In the three projects presented before, he showed a genuine motivation for improving the quality of life of the people who use and interact with the products he designed in the studio. Likewise, he showed a tendency to explore the problems he addressed from the perspective of potential users for whom he showed concern, respect, and, ultimately, empathy.

In Project 1, Kristoff’s discourse suggested that he empathized with potential users of the condiment organizer he designed by identifying the network of potential users and stakeholders, balancing the needs and priorities of these individuals and mitigating potential risks associated with situations he observed at the restaurant.

In Project 3, Kristoff’s discourse suggested that he empathized with children and communities in Africa by questioning the project brief, denouncing the attempts to dehumanize users and communities and showing respect for them and their culture.
Likewise, he expressed his intention to reduce the perceived distance between potential users and designers by proposing the use of methods that encouraged direct interaction between them (i.e., the pen-pal program).

In Project 5, Kristoff's discourse suggested that he empathized with people living in food desert areas by defining his project goals in terms of the benefits that they would perceive if implemented and by proposing alternative solutions beyond the project brief that would be more effective to solve the identified problem. Likewise, he showed empathy by selecting a real-world issue that affected a community different to his own, and by imagining how his experience walking a long distance with groceries would impact communities for whom this was a permanent issue. Additionally, in discussing the design of the backpack, Kristoff expressed empathy by aiming to convey a positive and encouraging message to users facing difficult living conditions, and accommodating their different needs and circumstances. In the case of Kristoff, it is likely that he was naturally empathic or developed empathy prior to studio enrollment. As such, he appeared more likely to identify user-centered opportunities in class assignments than the typical student in his group.

5.2.6. Case Study: Anna, Lots of Images and Lots of Questions

Anna (pseudonym) is an enthusiastic and devoted student involved in multiple extracurricular activities at her university. Throughout the semester, her use of images in her project presentations was notable due to her capacity to convey and elicit emotions using pictures of potential users in different kinds of situations. Additionally, she was the student
who presented the most number of images depicting potential users (n=28) compared to the average in her group (µ=10.9). Figure 45 presents a selection of the images used by Anna to depict people in the visual materials she created.

**Figure 45.** Selection of images used by Anna in her presentations throughout the semester. Images 1 and 2 correspond to Project 1, images 3-10 correspond to Project 3, and images 11-15 correspond to Project 5.

Anna’s case was identified and documented due to her extensive use of compelling and evocative images depicting users and stakeholders. However, her case also raises questions regarding the use of images for assessing student empathy for users. As it is presented in the following pages, in order to analyze and evaluate images as expressions of empathy, it is
necessary include in the analysis aspects such as the use of language (verbal expressions) and/or the use of methods to learn about users (operational expressions).

In Project 1, Anna photographed and used images 1 and 2 to discuss her design process and to illustrate the research she did on site. Both pictures portray people in a restaurant setting carrying out different activities, but each image depicts very different situations. While Figure 45-1 shows a stressed restaurant manager helping his staff serve drinks in the kitchen on a busy day (these details were mentioned by Anna in her presentation), Figure 45-2 shows a customer having a relaxed conversation while he enjoys a meal at the restaurant.

By presenting these two images side by side, Anna intended to contrast the experience of two types of potential users of the condiment organizer she designed, as well as the different needs and expectations that these two users had. Taking and showing these pictures with the comparative purpose suggested that Anna made an attempt to adopt the perspectives of these two users. Additionally, by selecting a pair of images that highlight the facial expressions of each person, Anna made an attempt to imagine and contrast the emotional states of the manager (anxiety) and the customer (joy). The combination of these two factors suggested that Anna empathized with both users while visiting the restaurant.

In Project 3, Anna used the most number of images depicting people (14 of 29) compared to her other two presentations. As can be seen in Figure 45, images 3 to 8, these pictures portray African children along with images of their feet and the diseases they can contract by
walking barefoot. Anna, used these images to introduce the context and the problem she addressed in Project 3 and the population she aimed to serve with her project. It is interesting that the group of images Anna used in this project focused on two very different aspects of the user: facial expression showing happiness and hope (Figure 45, images 4 and 8), and bare feet showing poverty, dirt, and disease (Figure 45, images 3, 5, and 7). These photos have the power to convey a full spectrum of emotions, from joy to sadness and disgust, which suggests that Anna selected this group of images because they elicited in her the same range of emotions and that she wanted to elicit these emotions in the audience of her presentation. This chain of suggested that Anna experienced empathic concern, “[an] other-oriented emotion elicited by and congruent with the perceived welfare of someone in need” (Batson, 2011, p. 11). Unfortunately, Anna was unavailable for interviews at the end of the semester to discuss her rationale behind the selection of these images and to check if my interpretation was accurate. Consequently, it is only possible to speculate as to the reasons why she used these images in her presentation.

The only source of information that can shed some light on Anna’s motivations is the written and spoken language she used when she presented the images in question. These images illustrated the problem Anna addressed in Project 3, which she enunciated as follows:

“In Ethiopia and Mozambique, the people in the villages are in such poverty, they cannot afford shoes. Because of this, they are subject to a parasitic disease, called jiggers. If not treaded soon enough, the disease can lead to amputations or death. The harsh environment takes a toll on their feet often causing wounds and infections.”
Several schools require students to wear shoes. Many impoverished children cannot gain this education. Thus, their chances of overcoming poverty are lessened.”

The problem definition presented in this discourse shows some evidence of Anna’s concern for some children’s situation in African countries but it is not conclusive. However, what this definition does provide is a glimpse into another aspect of the project: the information students used to guide their design process was limited and incomplete since they did not have direct access to the context or potential users. The sources of information they had were online research, the project sponsor, and their preconceptions about Africa. In turn, the ideas they had about the context and the users were also limited and incomplete. As a consequence, if Anna experienced empathic concern and empathy in Project 3, it is necessary to question with whom she empathized. Did she empathize with children walking barefoot in Ethiopia and Mozambique? Or did she empathize with an imaginary user that she built based on the scarce information she had? Again, it is only possible to speculate regarding these questions.

These same questions apply to Anna’s Project 5. In this project, she designed a technologically enhanced trekking pole intended to assist users with several activities while hiking. Despite the fact that this last project was supposed to be inspired by students’ insights from their everyday lives, at the beginning of her presentation Anna disclosed that she did not hike and all the images that she used to illustrate her work on this project were stock photos and came from online sources (Figure 45, images 11 to 15).
Based on the data collected from Anna, it is not clear why she chose to design the product or what prior experience she had with hiking. However, based on the images from her presentation in Project 5 and the assumptions that she verbalized in her oral presentation, it is possible to infer that she did not have direct interaction with the problem, the context, or the potential users that she discussed in this last project. Apparently, she chose a problem that she had never experienced, which could happen when doing an activity that she did not practice—i.e., hiking.

As with the images shown in the other two projects, in Project 5 Anna used pictures that were compelling and elicited several emotions such as joy, excitement, and adventure. However, the lack of experience that she expressed raised questions about the fidelity of the emotions and the user characteristics she depicted in the images chosen for her presentation. These images suggested that Anna did not experience empathy for hiking practitioners since there is no evidence that she made an attempt to adopt their perspective (Perspective Taking) or that she was authentically concerned about the difficulties experienced by hikers (Empathic Concern). Once again, since it was not possible to interview Anna to confirm these interpretations, they remain in the realm of speculation.

Despite the fact that Anna used the most images depicting users in her group and that the pictures she used were compelling and evocative, the lack of further evidence prevents conclusions that these photos were clear graphical expressions of empathy. However, this situation sheds light on the use of images for research purposes in design and education.
From Anna’s case, it can be concluded that an image without context does not tell the whole story, and therefore, it cannot be considered a manifestation of empathy without further evidence. Images need to be analyzed in context and contrasted with other data points, such as the student’s use of language and research methods.
CHAPTER 6: CONCLUSIONS

6.1. Summary of Findings

The study examined the educational practices of two industrial design studios at the undergraduate and the graduate level to identify strategies that had the potential to promote student empathy for users. With this purpose in mind, the study explored the following research question: How do teaching and learning practices in the industrial design studio promote the development and expression of student empathy for users?

The exploration of this question involved the examination of research sub-questions focused on the educational practices put in place in the design studio and sub-questions focused on students’ expressions of empathy for users. Data was analyzed following these sub-questions that represented the major units of analysis of this study. In the following pages a synthesis of findings is presented as a response to the research sub-questions.

Faculty's Educational Practices

This section explored three major components of design’s signature pedagogy observed in the Advanced and Basic Industrial Design studios: the brief, research, and dialogue and discussion. The exploration of these components aimed at answering the following research sub-question: How do faculty reflect concern for the development of student empathy for users in the context of the industrial design studio?
The Brief

In the observed studios, the brief was used by faculty as a mechanism to establish the conditions of the project and, consequently, create the conditions for students to develop and express empathy for users. The brief defined the problem addressed by students, established the priorities to address said problem, and structured the activities that students undertook.

In the Advanced Industrial Design studio, the brief was treated differently in the two projects that were developed. In Project 1—design of a device to test sports bras—the brief clearly defined the problem to be addressed by students and provided a robust structure for them to explore the experiences of users and stakeholders. In Project 2—research proposal addressing a workforce-related problem—the brief provided an open framework for students to define a topic of their personal interest and the strategy to address it in preparation for their thesis project.

Based on the analysis of student expression of empathy, the Project 1 brief was more effective in creating the conditions for empathy to emerge by proposing a problem that pushed students to consider other people’s experiences and concerns; requiring students to conduct research from primary sources and interact directly with users and stakeholders; providing a thorough definition of research methods that structured students’ research activities; and proposing a situated problem that offered students access to users and context. It is unclear if working in teams in Project 1 contributed to promoting student empathy for users. On the other hand, the Project 2 brief was less effective in creating the conditions for
empathy to emerge because it focused on developing planning skills, relied on students to decide the problem to address and methods to be used and was perceived by students as a low-stakes project that received less time and attention from students and faculty.

In the Basic Industrial Design studio, in terms of empathy promotion, the brief was used to structure activities and conversations with students, inviting them to consider and adopt the perspective of users and stakeholders; introduce the design problem progressively as a sequence of smaller, manageable issues that allowed students to learn sequentially from realities different from their own; and propose problems that balanced the use of students’ prior knowledge with the exploration of new realities intended to challenge students’ preconceptions.

However, based on the analysis of students’ expressions of empathy, the briefs in this studio were less effective in creating the conditions for empathy to emerge because they focused on aspects other than the user and user-related issues. User-student interaction was not reinforced in all projects for practical reasons (i.e., lack of time for thorough research and lack of access to people and context in some cases) and projects relied on secondary sources of information rather than on primary sources. In one case, students were asked to identify problems from their personal experiences and in their own environments, rather than in contexts that were unknown or unfamiliar to them.
The Research

In the observed studios, research methods and activities were used by faculty to promote students’ exploration of the problem, users, and context with the purpose of informing and inspiring the design processes they followed. Research was especially well suited for promoting conditions for developing empathy, since it required students to explore and understand the experience of users and stakeholders under a variety of methods of inquiry.

In the Advanced Industrial Design studio, research was used by the instructor in Project 1 to develop empathy. In promoting user-student interactions and by asking students to thoroughly plan and rehearse the research activities they conducted, faculty exposed students to an exhaustive process of planning that required the adoption of users’ perspectives and preserved the dignity, autonomy, safety, and equality of participants. Also, a considerable amount of time and effort was devoted by the instructor to help students in preparing their interactions with participants in the field. The research in Project 2 was less structured, received less attention than in Project 1, and was left to students’ initiative. As a consequence, not all the students engaged in research from primary sources, with some relying on personal experiences to inform the research proposal.

Based on the analysis of students’ expressions of empathy, the research conducted for Project 1 was more effective in creating the conditions for empathy to emerge because it promoted many more interactions between users and students than the rest of the documented projects combined (including projects undertaken in the BID studio). This suggested that students had
greater exposure to users and stakeholders in this project and, consequently, more opportunities to develop empathy.

In the Basic Industrial Design studio, the research was considered instrumental by the instructor for developing students’ understanding of the problem, context, and users, but in practice, the opportunities for empathy that research created in this studio were limited. Research from secondary sources was used in all the document projects, and research on primary sources received especial attention on Project 1, in which students were constantly asked to conduct observations and interviews with potential users of condiment organizers. Project 3 challenged students in the lack of access to context and users, for which they substituted arguably secondary sources. And Project 5 proposed students a problem-observation method that limited the spectrum of people to observe and with whom to interact.

Based on the analysis of students’ expressions of empathy, research in the BID studio was conducted with different levels of proficiency and at different levels of depth; while some students used research activities as opportunities to step into the users’ world, there were also students who perceived these activities as mere requirements of the project, thus their level of engagement in this activities was limited. The difference in approaches to research activities in the studio implied a difference in opportunities for student empathy to occur.
In Project 1, data analysis suggested that students were not as engaged as the instructor expected with the topic (condiment organization in a restaurant setting) and had issues in recognizing the value of research for this project. In Project 3, students were limited in their interaction with users due to the lack of access to the context. Even though literature does not discount the occurrence of empathy through indirect interaction with people, research in this project raised questions regarding the extent to which students could effectively empathize with people in an unfamiliar context from secondary sources. In Project 5, just a few students did research from primary sources and the majority of projects were aimed at solving problems that affected the students themselves or people in their immediate environment. This raised questions regarding the effectiveness for empathy promotion in asking students to identify problems in their daily lives.

It is necessary to highlight that the promotion of student empathy for users was not part of the learning objectives of this studio and, consequently, the difficulties described should not be assumed as a measure of the level of success of this studio.

**The Dialogue and Critique**

In the Advanced Industrial Design studio, the dialogue and critique were characterized by featuring a spectrum of faculty-student interactions that were used by the instructor to raise students’ awareness regarding user-related issues and promote empathy-related behaviors and skills. The empathy-related behaviors promoted by the instructor in this studio were as follows: identifying all users and stakeholders involved in a problem; considering and
acknowledging their different perspectives; caring for the welfare of participants; being respectful with potential users and representing their voice with dignity; expressing concern for users and stakeholders and showing sensitivity to issues that affected them.

The instructor promoted empathy-related behaviors by using the following strategies: alternating modes of faculty-student interaction; proposing the use of empathic research methods (e.g., “a day in the life”); suggesting preferred courses of action that would provide an empathic understanding of users and stakeholders; modeling empathic behaviors; redirecting student attention toward user-related issues; engaging students in empathic discussions; and using positive and negative reinforcements to promote empathic attitudes and behaviors in students.

In the Basic Industrial Design studio, the promotion of student empathy through the dialogue and critique occurred in small-group discussions guided by the instructor. During these discussions students had the opportunity to raise their concerns regarding the welfare of users and stakeholders. Even though student feedback was integral part of small-group discussions, it is uncertain to what extent giving and receiving feedback promoted student empathy for users or the degree to which sophomores were sensitive to the role of users in any design process. Based on the study’s framework, it was assumed that having empathic discussions about users and stakeholders in small-group meetings encouraged student empathy.
However, a thematic analysis of the studio’s outline for project presentations suggested that user-related issues were not a priority in students’ presentations, which leaves little space for the critique to be considered as an aspect used to promote empathy for users in the Basic Industrial Design studio. At the curricular level, this and other factors raised questions regarding how and when concern for users should be introduced in the industrial design undergraduate curriculum.

**Student’s Expressions of Empathy**

This section explored students’ responses to the educational practices that they experienced in the observed studios. Special attention was given to student discourse, use of images, and application of research methods in the studio. The exploration of students’ responses aimed at answering the following research sub-question: How do students express their empathy for users in the context of an industrial design studio?

**Variations in Empathy Measures**

In general, changes in pre- and post-test scores were not statistically significant according to the Two-way ANOVA that was conducted. The only statistically significant difference that this test showed was in perspective-taking (PT) scores between students in the AID studio and the HCD lecture course. These results suggest that when students were exposed to similar content in a studio setting compared to a lecture-based course, the gains in perspective-taking (PT) were significantly higher in the studio.
However, it is important to note that the groups were relatively small and they were not equivalent in number of students, gender composition, and student academic backgrounds. Also, some of the students in the AID studio took the HCD lecture course during the semester of observation. As a consequence, these findings are not conclusive and more research is needed to validate them.

**Verbal Expressions: Describing Users**

Students in the AID studio showed greater tendency to address user-related issues in their discourse than students in the BID studio. Likewise, since familiarity and similarity are factors strongly associated with empathy, and AID students used more specific terms to refer to users than BID students, it was concluded that AID students’ use of language reflected greater opportunities for empathy to occur than BID students’ language.

Regarding the use of student discourse as evidence of empathy for users, it was concluded that the analysis of student discourse is enriched when it is complemented by the analysis of other data.

Additionally, according to data collected from the BID studio, there is a positive and strong relation between the frequency with which students refer to users and their empathic concern (EC) scores. However, more research needs to be done to test this finding with a larger population and at different educational levels.
**Graphical Expressions: Depicting Users**

Students in the AID studio showed greater tendency to depict users and stakeholders in images used in their presentations than students in the BID studio. Likewise, it was found that, in average, AID students presented three times more original images than their counterparts in the BID studio. This finding suggests that AID students had increased opportunities to develop empathy for users by sharing experiences with them while taking pictures, documenting observation sessions with said pictures, and selecting each image to be presented to the class.

However, it is crucial to note that students taking, selecting, and presenting images depicting users has only the potential to increase students’ opportunities to empathize with users and stakeholders. These actions cannot be interpreted automatically as graphical expressions of empathy. To determine whether or not the use of images suggests student empathy for users, it is necessary to evaluate the context and student discourse and actions.

**Operational Expressions: Interacting with Users**

Students in the AID studio had greater exposure to users and stakeholders than did BID students, and consequently, more opportunities to experience empathy for users. By comparing the number of user-student interactions that occurred in each project with the respective project brief, it was found that student engagement in research activities was highly related to the brief of each project. This means that in order to promote user-student
interactions that create opportunities for student empathy, it is necessary to structure research activities in the project brief that allow for such interactions.

6.2. Recommendations for Design Education
This dissertation explored educational practices that may intervene in the development of design student empathy for users and stakeholders in two specific instances of industrial design education at the undergraduate and graduate levels. One of the motivations behind this exploration was the tension detected between the decline in empathy among American college students reported by Konrath and colleagues (2011) and the relevance of empathy in current approaches to design, which consider empathy a fundamental ability in understanding people so that designed products, services, environments, systems, and experiences meet human needs, expectations, and aspirations.

The reported decline in empathy raised questions regarding how this ability was acquired, developed, and expressed by new generations of design students, and about how design education contributes to the development of empathy. The considerations presented as follows intend to shed a light on how to create design learning environments that promote the development of empathy. It is important to note that these considerations are intended to inform design education practices at the classroom and project levels (which were the units of analysis of this study), but not at the curricular level.
Implications for the studio

One of the most important aspects that needs to be addressed in promoting students’ development of empathy in a design learning environment is to declare it as an explicit learning objective. This needs to be followed by defining specific learning outcomes that describe empathic behaviors that students are expected to develop and demonstrate as core competencies for the field. Likewise, it is necessary to define evaluation criteria aligned with empathy-oriented learning objectives and outcomes. As was evidenced in both design studios analyzed, even though faculty declared the importance of addressing user-related issues in the studio and promoting students’ sensitivity and empathy for users, in the evaluation criteria of some of the projects analyzed these aspects were disregarded and, consequently, poorly addressed by students in their projects.

Implications for students’ evaluation

As mentioned before, if empathy is considered an objective that is worthwhile to pursue through design education, then it needs to be present in the evaluation criteria both at the course and the project levels. One of the difficulties in assessing “soft abilities” such as empathy is determining concrete behaviors that can be observed and evaluated by the instructor. This study provided a sample of verbal, graphical, and operational manifestations of empathy in the development of design projects that can be extrapolated to other educational environments. However, it is important to emphasize what has been said before: it was found that establishing the manifestation of student empathy requires triangulating several data points taking into consideration the use of language, images, and methods.
Likewise, this study offers research methods (e.g., discourse analysis, document analysis, field notes) that can be used as classroom assessment techniques applicable in evaluating students’ development of empathy in industrial design education settings.

**Implications for teaching practices**

Even though it was not analyzed in the study due to lack of data, there is an indication that in the observed settings students progressively adopted some of the discipline-specific language used by instructors (especially at the undergraduate level). As a consequence, a strategy to promote student empathy for users is to include and reinforce user-related issues through the use of language by the instructor. If students are seldom exposed to user-related issues in their dialogue with faculty, and if user-related issues are not reinforced throughout the course of study, then these issues are less likely to be addressed by students.

The use of user-oriented language needs to be accompanied by user-oriented practices intended to expose students to the experiences of others. This can be achieved through the use of design research methods that promote user-student interactions such as interviews and observations. Even though co-design and participatory design methods were not observed or documented in the studios reported in this study, such methods promote intense user-student interactions as the user adopts progressively more active roles in the design process (as Liz Sanders suggests: from customers to co-creators).
Additionally, the design problems offered to students need to be situated and accessible. This means that in order to promote user-student interactions, students should address real problems in which they have access to the context. As seen in the design of a shoe for African children—a project with great potential for empathy—the lack of access to the context and stakeholders prevented students from having deep and meaningful insights into the experiences of users rich in opportunities for the expression of empathy.

In conclusion, based on the study findings, if empathy is considered a learning objective that is worthwhile to pursue in design learning environments, then the educational practices put in place to develop that objective need to be aligned, oriented to promote user-student interactions, and, most importantly, focused on equipping students with the tools to approach and understand and connect emotionally with users and stakeholders.

6.3. Study Scope and Limitations

A major limitation of this study is the generalizability of findings. The study explored two specific courses in the same industrial design school for one semester. Even though some of the phenomena documented in these studios have been reported in literature and in informal conversations with design educators from schools all over the United States, it is not possible to generalize the findings presented in this study to all instances of industrial design education. For this reason, the section that discusses faculty’s educational practices provides detailed descriptions of the studio, brief, research, and dialogue and critique. Instead of generalizability, this study hopes to inspire further investigations in similar settings.
Another limitation of the study is its scope. This study reported situations that occurred within two academic design studios for a semester. Situations that occurred out of this frame of reference were disregarded as were experiences leading to student enrollment in these two courses. This also means that students’ personal lives were not taken into consideration in the study, as well as the rest of curricular and extracurricular activities in which they were engaged during the data collection phase of the study. Additionally, changes in student empathy were documented at the beginning and at the end of the study, assuming that the educational experience to which students were exposed would have immediate effects on their behavior and attitudes toward users and stakeholders. The pre- and post-test model inherited from the medical field does not necessarily apply to educational contexts where changes are not evident immediately after the “treatment,” but these can take years to manifest. That represents an implicit challenge in conducting educational research that can be addressed by conducting a longitudinal study in which student empathy is documented for months and even years after the studio ends.

Another limitation regarding the scope of the study is that it focused on students’ use of language, images, and methods. The artifacts they designed were not reported in the study since they reflected circumstances different to empathy development such as students’ developing skills in form-making, limitations in students’ use of design software or prototyping materials, and imitation of current design trends or products in the market. These circumstances were more evident in BID students who had received just three semesters of design instruction before enrolling in the observed studio; BID students’ abilities to create
form were in development as were their skills to use design software and materials to create models and prototypes. Further, there were limited opportunities to connect student comments to their choices about form, thus confirming intent to craft artifacts as expressions of empathy. In the study setting, the analysis of designed artifacts would have required additional information to be adequately interpreted, such as written reflections from students explaining their design decisions, which were not part of the data collection strategy.

Finally, another limitation of the study was the quantity and quality of data collected. The quantity of methods for data collection implemented in this study produced a high volume of unstructured data that had to be selected, reduced, and analyzed. As a consequence, the data analysis process was cumbersome and time-consuming. However, despite the amount of data that was collected, in the data analysis process it was noticed that there were situations that were not documented that could have improved the strength of different arguments made through the findings section. For instance, data from feedback offered by one of the instructors to students via email would have better informed the discussion presented addressing the critique. Likewise, the discussion about operational expressions of empathy would have been richer if the off-site sessions in which students interacted with users were documented. As these sessions took place out of the studio space, they were not documented. Additionally, it was noticed that the amount and level of resolution of data collected from each studio was different: while one studio had 22 students, developed 5 projects, and students worked individually, the other studio had 11 students, developed 2 projects, and worked in groups for the longest project in the semester.
6.4. Future Research Directions

During the analysis of data and reporting of findings, new research questions emerged that were out of the scope of this study. A first step towards future research is to evaluate these questions and determine which are worth pursuing. For instance, this study could not determine whether or not students developed empathy for users whom were not accessible. Research suggests that direct interaction is not a prerequisite for empathy to occur (e.g., Batson, 1997), however, in the context of industrial design education, it is uncertain if students can empathize with users that they never interacted with or with “personas,” fictitious characters that combine characteristics of a group of determined users. Another question that was left open is how to assess the level of student empathy. This study provides manifestations of this ability, but establishing a range of levels at different points in the curriculum was beyond the scope of this study. As a consequence, another path to follow is to develop a rubric for evaluating student empathy for users based on behavioral evidence and several cycles of testing. The final question to explore is whether or not students’ gains in empathy in the context of design education can be transferred to professional practice and to others aspects of life. As I declared at the beginning of this document, my intention in doing research on empathy was to understand how people can empathize with others despite their differences, how educators can promote respect and tolerance for others, and how design education can contribute to these purposes.
REFERENCES


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Appendix A: IRB Application

Project Title
Empathy Expression and Development in the Context of Industrial Design Education

IRB File Number:

Original Approval Date:

Approval Period

Source of funding (if externally funded, enter PINS or RADAR number of funding proposal via 'Add New Sponsored Project Record' button below):
None

NCSU Faculty point of contact for this protocol:
Davis, Meredith: Graphic and Industrial Design

Does any investigator associated with this project have a significant financial interest in, or other conflict of interest involving, the sponsor of this project? (Answer No if this project is not sponsored)
No

Is this conflict managed with a written management plan, and is the management plan being properly followed?
No

Preliminary Review Determination

Category:

Provide a brief synopsis of the study (limit text to 1500 characters)
This study aims to understand how industrial design students acquire and develop empathic abilities that allow them to understand the users (and the users' needs) of the design solutions they develop.

In order to do so, three instances of industrial design education (in the Industrial Design program at NC State's College of Design) will be observed and documented under a naturalistic approach, using grounded theory as research strategy, and mixed methods for data collection and analyses. These instances comprise two design studios (+/- 15 students) and a design course (+/- 24 students).

The proposed methods are as follows: (1) Participant Observation of class sessions, (2) Semistructured Interviews with students and faculty members, (3) Discourse Analysis of students' presentations, (4) Document Analysis of students products and courses' curricula, (5) Artifact Analysis of student's products, (6) Empathy Questionnaires to assess students' empathic abilities (specifically, perspective-taking and empathic concern), and (7) Surveys to collect basic student information, and to assess students' priorities in their design projects.

It is expected that this study helps to identify educational practices and circumstances that foster students empathy for users, and identify students' expressions of empathy for users.

Briefly describe in lay language the purpose of the proposed research and why it is important.
The purpose of this research study is to identify the educational practices and circumstances that promote student's empathy for users in the context of industrial design education. Also, this study aims to identify how industrial design students express their empathy for users in four categories: verbal (what students say), graphical (visual representations), tangible (the objects/products they create), and operational (how students conduct their design projects).

The relevance of this study lays in the possibility to extrapolate its findings to other instances of industrial design education, and other instances of professional education in general, where empathy is a desired or a required learning
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is this research being conducted by a student?</td>
<td>Yes</td>
</tr>
<tr>
<td>Is this research for a thesis?</td>
<td>No</td>
</tr>
<tr>
<td>Is this research for a dissertation?</td>
<td>Yes</td>
</tr>
<tr>
<td>Is this independent research?</td>
<td>No</td>
</tr>
<tr>
<td>Is this research for a course?</td>
<td>No</td>
</tr>
<tr>
<td>Do you currently intend to use the data for any purpose beyond the fulfillment of the class assignment?</td>
<td>No</td>
</tr>
<tr>
<td>Please explain</td>
<td></td>
</tr>
<tr>
<td>If you anticipate additional NCSU-affiliated investigators (other than those listed on the Title tab) may be involved in this research, list them here indicating their name and department.</td>
<td></td>
</tr>
<tr>
<td>Dr. Sharon Joines, Department of Industrial Design, Dissertation Committee Member</td>
<td></td>
</tr>
<tr>
<td>Tsai-Lu Liu, Department of Industrial Design, Dissertation Committee Member</td>
<td></td>
</tr>
<tr>
<td>Dr. Amy Halberstadt, Department of Psychology, Dissertation Committee Member</td>
<td></td>
</tr>
<tr>
<td>Will the investigators be collaborating with researchers at any institutions or organizations outside of NC State?</td>
<td>No</td>
</tr>
<tr>
<td>List collaborating institutions and describe the nature of the collaboration</td>
<td></td>
</tr>
<tr>
<td>What is NCSU's role in this research?</td>
<td></td>
</tr>
<tr>
<td>Describe funding flow, if any (e.g. subcontractors)</td>
<td></td>
</tr>
<tr>
<td>Is this international research?</td>
<td>No</td>
</tr>
<tr>
<td>Identify the countries involved in this research</td>
<td></td>
</tr>
<tr>
<td>An IRB equivalent review for local and cultural context may be necessary for this study. Can you recommend consultants with cultural expertise who may be willing to provide this review?</td>
<td></td>
</tr>
<tr>
<td>Adults 18 - 64 in the general population?</td>
<td>Yes</td>
</tr>
<tr>
<td>NCSU students, faculty or staff?</td>
<td>Yes</td>
</tr>
<tr>
<td>Adults age 65 and older?</td>
<td>No</td>
</tr>
<tr>
<td>Minors (under age 18--be sure to include provision for parental consent and/or child assent)?</td>
<td>No</td>
</tr>
<tr>
<td>List ages or age range:</td>
<td></td>
</tr>
<tr>
<td>Could any of the children be “Wards of the State” (a child whose welfare is the responsibility of the state or other agency, institution, or entity)?</td>
<td>No</td>
</tr>
<tr>
<td>Please explain</td>
<td></td>
</tr>
<tr>
<td>Prisoners (any individual involuntarily confined or detained in a penal institution – can be detained pending arraignment, trial or sentencing)?</td>
<td>No</td>
</tr>
</tbody>
</table>
Pregnant women? 
No

Are pregnant women the primary population or focus for this research? 
No

Provide rationale for why they are the focus population and describe the risks associated with their involvement as participants

Fetuses? 
No

Students? 
Yes

Does the research involve normal educational practices? 
Yes

Is the research being conducted in an accepted educational setting? 
Yes

Are participants in a class taught by the principal investigator? 
No

Are the research activities part of the required course requirements? 
No

Will course credit be offered to participants? 
No

Amount of credit? 
No

If class credit will be given, list the amount and alternative ways to earn the same amount of credit. Note: the time it takes to gain the same amount of credit by the alternate means should be commensurate with the study task(s) 

How will permission to conduct research be obtained from the school or district? 
The study will be conducted in 3 different courses offered by the College of Design at NC State University. The permission has been asked to (and granted by) the Department Head of Graphic Design and Industrial Design (Prof. Tsai-Lu Liu) and by the instructors of the observed courses.

Will you utilize private academic records? 
No

Explain the procedures and document permission for accessing these records.

Employees? 
No

Describe where (in the workplace, out of the workplace) activities will be conducted.

From whom and how will permission to conduct research on the employees be obtained?

How will potential participants be approached and informed about the research so as to reduce any perceived coercion to participate?

Is the employer involved in the research activities in any way? 
No

Please explain:

Will the employer receive any results from the research activities (i.e. reports, recommendations, etc.)? 
No

Please explain. How will employee identities be protected in reports provided to employers?

Impaired decision making capacity/Legally incompetent? 
No

How will competency be assessed and from whom will you obtain consent?
Mental/emotional/developmental/psychiatric challenges?
No
Identify the challenge and explain the unique risks for this population.

Describe any special provisions necessary for consent and other study activities (e.g., legal guardian for those unable to consent).

People with physical challenges?
No
Identify the challenge and explain the unique risks for this population.

Describe any special provisions necessary for working with this population (e.g., witnesses for the visually impaired).

Economically or educationally disadvantaged?
No

Racial, ethnic, religious and/or other minorities?
No

Non-English speakers?
No
Describe the procedures used to overcome any language barrier.

Will a translator be used?
No
Provide information about the translator (who they are, relation to the community, why you have selected them for use, confidentiality measures being utilized).

Explain the necessity for the use of the vulnerable populations listed.
Since this research study is situated in the context of industrial design education, and aims to better understand how empathy is developed in and expressed by industrial design students, it is necessary to involve them as participants of the study. However, the addressed topic and the methods used in this study minimize any risk for this vulnerable population.

State how, where, when, and by whom consent will be obtained from each participant group. Identify the type of consent (e.g., written, verbal, electronic, etc.). Label and submit all consent forms.

Students: at the beginning of the semester, a letter explaining the study will be handed to the students of the three observed classes. This letter will be accompanied by the informed consent form that they will sign if they voluntarily decide to participate in the study.

Instructor: previous contacts with the instructors have been made to express their interest to observe their classes. Their approval has been obtained and the informed consent form will be handed to them at the beginning of the semester.

Additionally, the participants are asked for their permission to take photos, video, and audio recordings that will be used for data analyses purposes and for eventual publications (more details in the submitted form).

If any participants are minors, describe the process for obtaining parental consent and minor's assent (minor's agreement to participate).

Are you applying for a waiver of the requirement for consent (no consent information of any kind provided to participants) for any participant group(s) in your study?
No
Describe the procedures and/or participant group for which you are applying for a waiver, and justify why this waiver is needed and consent is not feasible.

Are you applying for an alteration (exclusion of one or more of the specific required elements) of consent for any participant group(s) in your study?
No
Identify which required elements of consent you are altering, describe the participant group(s) for which this waiver will apply, and justify why this
A waiver of signed consent may be granted only if:

1. The research involves no more than minimal risk.
2. The research involves no procedures for which consent is normally required outside of the research context.

Would a signed consent document be the only document or record linking the participant to the research?
No

Is there any deception of the human subjects involved in this study?
No

Deception is necessary and describe the debriefing procedures. Does the deception require a waiver or alteration of informed consent information? Describe debriefing and/or disclosure procedures and submit materials for review. Are participants given the option to destroy their data if they do not want to be a part the study after disclosure?

For each participant group please indicate how many individuals from that group will be involved in the research. Estimates or ranges of the numbers of participants are acceptable. Please be aware that participant numbers may affect study risk. If your participation totals differ by 10% from what was originally approved, notify the IRB.

Students:
- Group 1 (basic industrial design studio): 12
- Group 2 (advanced industrial design studio): 12
- Group 3 (human-centered design course): 24

Instructors: 3

How will potential participants be found and selected for inclusion in the study?
The students from the selected courses will be invited to participate in the research study.

At the beginning of the semester, the students from the selected courses will be invited to participate in the study through the attached cover letter. Participation is completely voluntary and does not affect the student's participation in the regular academic activities.

Describe any inclusion and exclusion criteria for your participants and describe why those criteria are necessary (If your study concentrates on a particular population, you do not need to repeat your description of that population here.)

There are two criteria to include the students in the study:
1. Be enrolled in one of the three courses to be observed in the program of industrial design at NC State University.
2. Accept voluntarily to be part of the study by signing the informed consent form.

Is there any relationship between researcher and participants - such as teacher/student; employer/employee?
No

What is the justification for using this participant group instead of an unrelated participant group?

Describe any risks associated with conducting your research with a related participant group.

Describe how this relationship will be managed to reduce risk during the research.

How will risks to confidentiality be managed?

Address any concerns regarding data quality (e.g. non-candid responses) that could result from this relationship.

In the following questions describe in lay terms all study procedures that will be experienced by each group of participants in this study. For each group of participants in your study, provide a step-by-step description of what they will experience from beginning to end of the study activities.

Students:
1. Complete the "Student Information and Academic Background" survey at the beginning of the semester.
2. Complete the "Interpersonal Reactivity Index" questionnaire at the beginning of the semester (pre-test).
3. Complete the "Project Criteria" survey at the beginning and end of each project.
4. Be observed throughout the semester in the class meetings.
5. Be recorded (video/audio) during their projects presentations.
6. Provide their models and visual presentations to the researcher who will take pictures of these materials.
7. Complete the "Interpersonal Reactivity Index" questionnaire at the beginning of the semester (pre-test).
8. Be interviewed at the end of the semester, under the "Member Checking Protocol", to extend, revise, and negotiate, the researcher's interpretations of their words, actions, and design solutions [not all the students, selected according their disposition to be interviewed].

Instructors:
1. Be interviewed at the beginning of the semester, under the "Instructor Interview Protocol", to learn about the course, his/her expectations, the integration of the course with the curriculum, and the relevance of empathy as an ability fostered in the course.
2. Provide access to the researcher to the class meetings, so he can take notes, pictures, and audio/video recordings of the students' work and presentations.
3. Be interviewed at the end of the semester, under the "Member Checking Protocol", to extend, revise, and negotiate, the researcher's interpretations of their words, actions, and design solutions [not all the students, selected according their disposition to be interviewed].

Describe how, where, when, and by whom data will be collected.

Observations: will be conducted by the researcher throughout the semester, in every session of the three observed courses, and documenting the sessions by taking notes, pictures, and video/audio recording (on presentation days). These observations will be made using the "Observation Template of Empathy Manifestations", and these recordings will be transcribed by the researcher himself, and then will be deleted.

Interviews: will be conducted individually by the researcher either in the RED Lab, the instructor's office, or in a group study room at the DH Hill Library, at the beginning and end of the semester, in a schedule appropriate for the participants.

Artifacts collection (visual representations and models): the researcher will take pictures and notes of the visual representations and the models the students create throughout the semester, in the classroom where the class meets.

Empathy questionnaire (Interpersonal Reactivity Index): the researcher will conduct this questionnaire to the students at the beginning (pre-) and at the end (post-) of the semester, in a time agreed with the instructor, using hard copies of the questionnaire. This questionnaire does not take more than 15 minutes to be completed.

Survey (Student Information and Academic Background): the researcher will conduct this survey to the students at the beginning of the semester, in a time agreed with the instructor, using hard copies of the survey. This survey does not take more than 10 minutes to be completed.

Survey (Project criteria): the researcher will conduct this survey to the students at the beginning and end of each project, in a time agreed with the instructor, using hard copies of the survey. This survey does not take more than 5 minutes to be completed.

Social?
No
Psychological?
No
Financial/Employability?
No
Legal?
No
Physical?
No
Academic?
No
Employment?
No
Financial?
No
Medical?
No
<table>
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<tr>
<th>Question</th>
<th>Answer</th>
</tr>
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<tbody>
<tr>
<td>Private Behavior?</td>
<td>No</td>
</tr>
<tr>
<td>Economic Status?</td>
<td>No</td>
</tr>
<tr>
<td>Sexual Issues?</td>
<td>No</td>
</tr>
<tr>
<td>Religious Issues/Beliefs?</td>
<td>No</td>
</tr>
</tbody>
</table>

Describe the nature and degree of risk that this study poses for each item marked "Yes" above. Describe the steps taken to minimize these risks.

If you are accessing private records, describe how you are gaining access to these records, what information you need from the records, and how you will receive/record data.

Are you asking participants to disclose information about other individuals (e.g., friends, family, co-workers, etc.)?  
No

Describe the data you will collect and discuss how you will protect confidentiality and the privacy of these third-party individuals.

If you are collecting information that participants might consider personal or sensitive or that if revealed might cause embarrassment, harm to reputation or could reasonably place the subjects at risk of criminal or civil liability, what measures will you take to protect participants from those risks?

If any of the study procedures could be considered risky in and of themselves (e.g. study procedures involving upsetting questions, stressful situations, physical risks, etc.) what measures will you take to protect participants from those risks?

Describe the anticipated direct benefits to be gained by each group of participants in this study (compensation is not a direct benefit).

No direct benefit is expected for the participants.

If no direct benefit is expected for participants describe any indirect benefits that may be expected, such as to the scientific community or to society.

The findings of this study have the potential to inform and enhance the industrial design program at NC State, and industrial design education in general, by identifying strategies to foster students' empathy for users.

Will you be receiving already existing data without identifiers for this study?  
No

Will you be receiving already existing data which includes identifiers for this study?  
No

Describe how the benefits balance out the risks of this study.

Even though no direct benefit is expected for the participants, the study does not pose any risk to them. On the contrary, it is expected that the study offers benefits for the industrial design field and design education in general.

Will data be collected anonymously (meaning that you do not ever collect data in a way that would allow you to link any identifying information to a participant)?  
No

Will identifiers be recorded with the data?  
Yes

Will you use a master list, crosswalk, or other means of linking a participant's identity to the data?  
Yes

Will it be possible to identify a participant indirectly from the data collected (i.e. indirect identification from demographic information)?  
No

Audio recordings?  
Yes

Video recordings?  
Yes

Images?  
Yes

Digital/electronic files?  
Yes
Paper documents (including notes and journals)?
Yes
Physiological Responses?
No
Online survey?
No
Restricted Computer?
Yes
Password Protected files?
Yes
Firewall System?
No
Locked Private Office?
No
Locked Filing Cabinets?
Yes
Encrypted Files?
Yes

Describe all participant identifiers that will be collected (whether they will be retained or not) and explain why they are necessary.
Name: in order to identify the different pieces of data collected from each participant.
Major: in order to understand the academic background of the student.
Year in the program: in order to understand the academic background of the student.
E-Mail: in order to send them the preliminary findings of the research to conduct, afterwards, the member checking interview.

If any links between data and participants are to be retained, how will you protect the confidentiality of the data?
Once the data has been collected and analyzed, the master list with personal identifiers will be deleted, keeping only a numerical identifier for each participant.

If you are collecting data electronically, what (if any) identifiable information will be collected by the host site (such as email and/or IP address) and will this information be reported to you?

Describe any ways that participants could be identified indirectly from the data collected and describe measures taken to protect identities.
In the written report of the study and in potential derived publications, the name of the participants will be changed for a numerical identifier (if any particular case requires attention), and the name of the observed courses will be omitted (including just a description of the courses), as well as the semester when the observations were conducted.

For all recordings of any type: Describe the type of recording(s) to be made Describe the safe storage of recordings Who will have access to the recordings? Will recordings be used in publications or data reporting? Will images be altered to de-identify? Will recordings be transcribed and by whom?
Video recordings of student presentations: will be stored in an encrypted drive protected with a strong password; only the researcher will have access to these recordings for transcription and data analyses purposes; the recordings will be deleted after the study has been conducted; these recordings will not be used for publication, exhibition, or data reporting.

Audio recording of interviews: will be stored in an encrypted drive protected with a strong password; only the researcher will have access to these recordings for transcription and data analyses purposes; the recordings will be deleted after the study has been conducted; these recordings will not be used for publication, exhibition, or data reporting.

Photos: will be stored in an encrypted drive protected with a strong password and may be used for publications and data reporting. However, the photos will depict the class dynamics, the different activities organized by the instructor, and the artifacts created by the students (models, prototypes, graphics, and presentations). The photos will not depict the students' faces in detail.

Describe how data will be reported (aggregate, individual responses, use of direct quotes) and describe how identities will be protected in study reports.
In the written report of the study the data will be presented in different ways (aggregated, individual responses, and
direct quotes), depending on the reported findings. However, the names will be replaced by a numerical identifier, and
the pictures will not depict the participants' faces.

Will anyone besides the PI or the research team have access to the data (including completed surveys) from the moment they are collected until they
are destroyed?
No one.

Describe any compensation that participants will be eligible to receive, including what the compensation is, any eligibility requirements, and how it will
be delivered.

No compensation will be offered to the participants.

Explain compensation provisions if the participant withdraws prior to completion of the study.

No compensation will be offered to the participants.
8.2. Appendix B: Informed Consent Form For Students

INFORMED CONSENT FORM FOR RESEARCH
North Carolina State University – College of Design

Study: Empathy Expression and Development in the Context of Industrial Design Education
Researcher: Andres Tellez (PhD Student in Design for Learning)
Advisor: Meredith Davis (Professor in Graphic Design)

What are some general things you should know about research studies?
You are being asked to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate or to stop participating at any time with no consequence. The purpose of research studies is to gain a better understanding of a certain topic or issue. You are not guaranteed any personal benefits from being in a study. Some research studies also may pose risks to those that participate. In this consent form, you will find specific details about the research in which you are being asked to participate. If you do not understand something in this form it is your right to ask the researcher for clarification or more information. A copy of this consent form will be provided to you. If at any time you have questions about your participation, do not hesitate to contact the researchers named above.

What is the purpose of this study?
The purpose of this study is to better understand how empathy is developed and expressed by industrial design students.

What will happen if you take part in the study?
If you agree to participate in this study, you will be asked to fill out a questionnaire at the beginning and at the end of the semester (10 minutes), to fill out a short survey at the beginning and end of each project (>5 minutes), and to take part of two interviews at different moments in the semester (30 minutes). Additionally, the researcher will be in the classroom throughout the semester to observe and document (through notes, pictures, audio, and video recordings) the development of the class sessions and the development of individual projects. The researcher will conduct these activities mostly during the class meetings (except for the interviews, which will be conducted in a different moment on campus) interfering minimally with the activities planned by the instructor.

Risks
No foreseeable risks are involved with participation in this activity.

Benefits
No direct benefit is anticipated for the participants of this study. However, the findings of this study have the potential to inform and enhance the industrial design program at NC State, and industrial design education in general.
Confidentiality
Data gathered during the study will be confidential. This means that only the researcher can identify the responses of individual subjects. Your identifying information will be replaced with codes. Only the researcher will have access to information that identifies you to carry out this research study. Additionally, data will be stored securely in the researcher’s computer (in an encrypted disk protected with a strong password), and in the researcher’s office in a locked drawer. No reference will be made in oral or written reports that could link you to the study.

Compensation
There is no compensation or fee for students’ inclusion in this study. Participation is completely voluntary. If a student chooses not to participate or to withdraw from participating at any point for any reason, there are no consequences.

What if you are a NCSU student?
Participation in this study is not a course requirement and your participation or lack thereof, will not affect your class standing or grades at NC State.

Questions
If you have questions at any time about the study or the procedures, you may contact the researcher: Andres Tellez, (919) 995-0524, fatellez@ncsu.edu

What if you have questions about your rights as a research participant?
If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Deb Paxton, Regulatory Compliance Administrator at dapaxton@ncsu.edu or by phone at (919) 515-4514.

Consent To Participate
“arerealreadandunderstandtheaboveinformation.Iharereceivedacopyofthisform.Iagreetoparticipateinthisstudywiththeunderstandingthatmaychosenottoparticipateortostopparticipatingatanytimesthpenaltyorlossofbenefitstowhichiamotherwiseentitled."

Student’s signature ___________________________________________ Date: ___/___/___

Researcher’s signature __________________________________________ Date: ___/___/___
8.3. Appendix C: Informed Consent Form For Faculty

INFORMED CONSENT FORM FOR RESEARCH
North Carolina State University – College of Design

Study: Empathy Expression and Development in the Context of Industrial Design Education
Researcher: Andres Tellez (PhD Student in Design for Learning)
Advisor: Meredith Davis (Professor in Graphic Design)

What are some general things you should know about research studies?
You are being asked to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate or to stop participating at any time with no consequence. The purpose of research studies is to gain a better understanding of a certain topic or issue. You are not guaranteed any personal benefits from being in a study. Some research studies also may pose risks to those that participate. In this consent form, you will find specific details about the research in which you are being asked to participate. If you do not understand something in this form it is your right to ask the researcher for clarification or more information. A copy of this consent form will be provided to you. If at any time you have questions about your participation, do not hesitate to contact the researchers named above.

What is the purpose of this study?
The purpose of this study is to better understand how empathy is developed and expressed by industrial design students.

What will happen if you take part in the study?
If you agree to participate in this study, you will be asked to take part of two interviews at the beginning and end of the semester (30 minutes). Additionally, the researcher will be in the classroom throughout the semester to observe and document (through notes, pictures, audio, and video recordings) the development of the class sessions and the development of students’ projects. The researcher will conduct these activities mostly during class meetings (except for the interviews, which will be conducted in a different moment on campus) interfering minimally with the activities planned by the instructor.

Risks
No foreseeable risks are involved with participation in this activity.

Benefits
No direct benefit is anticipated for the participants of this study. However, the findings of this study have the potential to inform and enhance the industrial design program at NC State, and industrial design education in general.
Confidentiality
Data gathered during the study will be confidential. This means that only the researcher can identify the responses of individual subjects. Your identifying information will be replaced with codes. Only the researcher will have access to information that identifies you to carry out this research study. Additionally, data will be stored securely in the researcher’s computer (in an encrypted disk protected with a strong password), and in the researcher’s office in a locked drawer. No reference will be made in oral or written reports that could link you to the study.

Compensation
There is no compensation or fee for students’ inclusion in this study. Participation is completely voluntary. If a student chooses not to participate or to withdraw from participating at any point for any reason, there are no consequences.

What if you are a NCSU employee?
Participation in this study is not a requirement of your employment at NCSU, and your participation or lack thereof, will not affect your job.

Questions
If you have questions at any time about the study or the procedures, you may contact the researcher: Andres Tellez, (919) 995-0524, fatellez@ncsu.edu

What if you have questions about your rights as a research participant?
If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Deb Paxton, Regulatory Compliance Administrator at dapaxton@ncsu.edu or by phone at (919) 515-4514.

Consent To Participate
“I have read and understand the above information. I have received a copy of this form. I agree to participate in this study with the understanding that I may choose not to participate or to stop participating at any time without penalty or loss of benefits to which I am otherwise entitled.”

Instructor’s signature __________________________ Date:____/____/____

Researcher’s signature __________________________ Date:____/____/____
8.4. Appendix D: Photo and Audio Recording Content Form

PHOTO, VIDEO AND AUDIO RECORDING CONSENT FORM
North Carolina State University – College of Design

Study: Empathy Expression and Development in the Context of Industrial Design Education
Researcher: Andres Tellez (PhD Student in Design for Learning)
Advisor: Meredith Davis (Professor in Graphic Design)

As part of the research study entitled “Empathy Expression and Development in the Context of Industrial Design Education”, the researcher will document the class sessions, the students’ projects, and the interviews through photography, video, and audio recording.

The photos will depict the class dynamics, the different activities organized by the instructor, and the artifacts created by the students (models, prototypes, graphics, and presentations). These will be taken in different moments throughout the semester, and will be used for data analysis, publications, and potentially as part of public exhibits.

The video and audio recordings will register the students’ presentations of their projects, and the conducted interviews. These recordings will be used for data analysis exclusively (transcribed by the researcher only), will be deleted once the study is over, and will not be published or shared to protect the participant’s confidentiality.

If you are willing to give your consent to having your picture taken, and your presentation and interview recorded, please fill out the following information, sign the bottom of the form, and return it to me.

Consent

Having read the above information, I __________________________ (printed name), give permission to have my photograph taken for purposes of this project. I give PhD Student Andres Tellez permission to use the photographs and video recordings that may include me in presentations about this project, as well as in publications. I have been told that I will not be identified by name or by other background information.

Participant’s signature __________________________ Date:__/__/___

Researcher’s signature __________________________ Date:__/__/___
Appendix E: Interpersonal Reactivity Index

INTERPERSONAL REACTIVITY INDEX

NAME: ___________________________________ DATE (MM/DD/YY): ____/____/____

The following statements inquire about your thoughts and feelings in a variety of situations. For each item, indicate how well it describes you by choosing the appropriate letter on the scale: A, B, C, D, or E; where A means "Describe me very well," and E means "Does NOT describe me well." When you have decided on your answer, fill in the circle next to the question. Please read each item carefully and answer as honestly as you can.

1. I often have tender, concerned feelings for people less fortunate than me.  
   A B C D E

2. I sometimes find it difficult to see things from the "other guy's" point of view.  
   A B C D E

3. Sometimes I don’t feel very sorry for other people when they are having problems.  
   A B C D E

4. I try to look at everybody’s side of a disagreement before I make a decision.  
   A B C D E

5. When I see someone being taken advantage of, I feel kind of protective towards them.  
   A B C D E

6. I sometimes try to understand my friends better by imagining how things look from their perspective.  
   A B C D E

7. Other people’s misfortunes do not usually disturb me a great deal.  
   A B C D E

8. If I’m sure I’m right about something, I don’t waste much time listening to other people’s arguments.  
   A B C D E

9. When I see someone being treated unfairly, I sometimes don’t feel very much pity for them.  
   A B C D E

10. I am often quite touched by things that I see happen.  
    A B C D E

11. I believe that there are two sides to every question and try to look at them both.  
    A B C D E

12. I would describe myself as a pretty soft-hearted person.  
    A B C D E

13. When I’m upset at someone, I usually try to "put myself in his shoes" for a while.  
    A B C D E

14. Before criticizing somebody, I try to imagine how I would feel if I were in their place.  
    A B C D E

Thank you!

IRI-PT/EC_PG1-1
INTERPERSONAL REACTIVITY INDEX - SCORING TEMPLATE

NAME: _______________________________ DATE (MM/DD/YY): ____/____/____

FOR RESEARCHER'S USE ONLY!

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EMPATHIC CONCERN SCORE (2+4+6+8+11+13+14) _________ / 28

PERSPECTIVE TAKING SCORE (1+3+5+7+9+10+12) _________ / 28
STUDENT INFORMATION AND ACADEMIC BACKGROUND
North Carolina State University – College of Design

Study: Empathy Expression and Development in the Context of Industrial Design Education

NAME: ___________________________________  E-MAIL: ______________________________________
CURRICULUM/MAJOR: ________________________  YEAR: ________________________

1. Please list the classes that you are enrolled in this semester (Spring 2015).

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<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>(E.g. ID 445)</td>
<td>(E.g. Human-Centered Design)</td>
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<table>
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<th>CLASS</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>(E.g. ID 445)</td>
<td>(E.g. Human-Centered Design)</td>
</tr>
</tbody>
</table>

2. Have you taken any classes on human-centered design, user-centered design, usability, ergonomics, user experience, user Research? ☐ Yes ☐ No

If Yes:

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<thead>
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<th>CLASS(ES)</th>
</tr>
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<tbody>
<tr>
<td>(E.g. Fall, 2013)</td>
<td>(E.g. ID 445 - Human-Centered Design)</td>
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<table>
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<tr>
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<th>CLASS(ES)</th>
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</thead>
<tbody>
<tr>
<td>(E.g. Fall, 2013)</td>
<td>(E.g. ID 445 - Human-Centered Design)</td>
</tr>
</tbody>
</table>

3. What extracurricular activities are you involved in this semester?

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Thank you!
### STUDENT INTERVIEW PROTOCOL (AID)

**Interviewee:** [Student’s Name]

**Interviewer:** Andres Tellez (PhD Student in Design for Learning)

**Where:** [Location of the Interview]

**When:** At the end of the semester

---

**Introduction**

The purpose of this session is to collect your final thoughts and perceptions about this Studio. I am interested in understanding what you learned throughout this experience; to confirm some of my perceptions of your work during the semester, and ask you some questions to deeper understand your process. I would like you to speak openly; the only person who will have access to this information will be myself, and when I report my findings, I will report generalities, without making your name public.

**Opening**

0. Can you tell me a little about your background? (Origin, academic background, work experience)

1. What did you like about this Studio?

2. What challenges you had during the Studio?

**First Project**

3. How do you feel with the results you had in the simulator project?

4. How did you feel about the particular topic of this studio?
   a. Do you think that having a woman in your group made a difference in understanding this topic?

5. What were your biggest lessons/takeaways from this project?

6. Can you briefly remind me who were the stakeholders of your project?

7. How did you approached these stakeholders? What strategies you used in your group?
8. How did you introduce the topic to them? How did you feel asking and making observations about the use of bra?

9. What did you learn from approaching these people?

Second Project

10. Can you briefly tell me about your second project? What workforce problem are you addressing and what research plan are you proposing?

11. How did you become interested in this particular problem with this particular population?

12. Have you done any kind of preliminary research with this population? (Interviews, informal talks, observations)

13. What have you learned about this particular project? (About this population and about yourself as a designer)

Closure

14. One of my concerns when doing my research was to be intrusive in the studio, bothering the students or the professor. How did you feel my presence in the studio?

15. Can I contact you next semester with further questions about your projects?
8.8. Appendix H: Student Interview Protocol (BID)

STUDENT INTERVIEW PROTOCOL (BID)

Interviewee: [Student’s Name]
Interviewer: Andres Tellez (PhD Student in Design for Learning)
Where: [Location of the Interview]
When: At the end of the semester

Introduction

The purpose of this session is to collect your final thoughts and perceptions about this Studio. I am interested in understanding what you learned throughout this experience; to confirm some of my perceptions of your work during the semester, and ask you some questions to deeper understand your process. I would like you to speak openly; the only person who will have access to this information will be myself, and when I report my findings, I will report generalities, without making your name public.

Guiding Questions

1. What did you like about this Studio?
2. What do you think can be improved?
3. Which was your favorite project? Why?
4. What do you think you learned during the semester?
   - Can you define briefly (in a word or a sentence) what you think you learned in each project?
   - What were the challenges in each one of these projects?
5. In each project you designed for a different audience or a different user. Can you remind me who were your audience/user in each project?
6. How did you get to know more about them? How did you approach these people?
7. What did you learn from these users/audience?
8. What, if anything, surprised you the most from the people you interacted/interviewed during the semester?

9. The last slide of most of your presentations you showed testimonials of people reacting to your designs. Can you tell me more about how you presented and asked others for their feedback to your designs?

10. One of my concerns when doing my research was to be intrusive in the studio, bothering the students or the professor. How did you feel my presence in the studio?

11. Can I contact you next semester with further questions about your projects?
8.9. Appendix I: Instructor Interview Protocol A (Start-of-Semester Interview)

**INSTRUCTOR INTERVIEW PROTOCOL A**

**Interviewee:** Instructor of [Name of the Course]  
**Interviewer:** Andres Tellez (PhD Student in Design for Learning)  
**Where:** RED Lab (Leazar Hall, NC State Campus) / Instructor’s office  
**When:** At the beginning of the semester

---

**Introduction**

The purpose of this interview is to learn more about the course [Name of the Course] that you are starting to teach this semester, to learn more about your expectations about the group of students and about this course, about your teaching techniques and philosophy, and about the profile you intend to foster in design students.

**Interviewee Background**

1. Can you briefly describe your **background**?
2. When did you first think you wanted to **become** a [designer/architect/engineer]?
3. How did you get involved in **teaching** design at the college level?
4. Do you have any experience in the **industry**?  
   a. What was your **role** in the industry?
5. What kinds of **research projects** have you worked in?  
   a. What kinds of research projects are you **interested** in?
6. What courses are you currently **teaching**?  
   a. What courses have you **taught** in the past?

---

**Observed Course**

7. When was the **first time** you taught [Name of the Course]?
8. What are your **objectives** for this version of the course?
9. What do you expect the students to **learn** throughout the course?
10. **What activities** you propose in order to achieve these objectives with the students?  
    a. During the semester, how are these activities **organized**?  
    b. In what **contexts** are situated the projects to be tackled?  
    c. What **population/communities** are involved in these projects?  
    d. What kind of **design solutions** you expect to obtain at the end of these projects?
11. **What criteria** you will use to evaluate the students’ projects and their progress?  
    a. **What strategies** you will use to evaluate students’ work?  
    b. Can you describe the **learning process** and the **design solution** of a student who gets an A+ in your class?  
       i. Can you do the same for a student who gets a C in your class?
Curriculum

12. Within the curriculum, what other courses are related or are relevant to this course?
13. What courses/studios can be considered a prerequisite for this course/studio?
14. How does this studio build on top of the previous studios?
15. What courses are recommended to take in parallel with this course/studio?
16. How are the contents and methodologies of these courses/studios articulated and aligned with this course/studio?

User-Related Issues

17. What are the most relevant aspects students have to take into account to address this courses’ activities/projects?
18. How relevant to this course is that students address user-related issues?
   a. How do you expect the students to address user-related issues?
   b. Within the course activities, how are user-related issues addressed?
   c. Within the evaluation criteria, what weight is given to user-related issues?
   d. What learning objectives are covered through addressing user-related issues?
   e. In the past, what do you think students have learnt from addressing user-related issues?

Empathy

19. In your opinion, what are the most important abilities and knowledge a design student must acquire throughout his/her education?
20. Do you consider empathy as one of the abilities that students must acquire throughout their education in industrial design?
21. Is empathy part of the core design abilities fostered in the program of industrial design at NC State University?
22. How would you define empathy in the context of industrial design?
23. In your experience, how do students acquire empathy for the users?
   a. How do they express their empathy for the users?
   b. Can you provide specific examples of these expressions of empathy?
24. What strategies have you used in the past to foster students’ empathy for users?
   a. What have been the results of those efforts?
25. Would you be willing to include and/or extend these strategies to foster empathy in future iterations of this course?

Closure

Appreciate instructor’s time for answering this interview and, if it is the case, ask for files of (1) syllabus, (2) examples of students’ work, (3) other materials.
Appendix J: AID Instructor Interview Protocol B (End-of-Semester Interview)

**INSTRUCTOR INTERVIEW PROTOCOL B (AID)**

**Interviewee:** Instructor of AID  
**Interviewer:** Andres Tellez (PhD Student in Design for Learning)  
**Where:** RED Lab (Leazar Hall, NC State Campus) / Instructor’s office  
**When:** At the end of the semester

**Guiding Questions**

1. How do you think the Studio went? Did it satisfy your expectations?
2. What, if anything, surprised you about this Studio?
3. How do you think students grew/changed from this experience?
4. On both projects you asked the students to explore a real context and interact with people (users or participants) to inform their projects.  
   a. What was your intention by making them pursue these activities?
   b. How did you think it went for them to being exposed to this direct interaction?
   c. Did students meet your expectations in this component of the project?
5. The simulator project forced students to consider a topic that could be considered sensitive (especially due the female:male ratio).
   a. How do you think students dealt with this situation?
   b. Did you see any difference in process and results in the groups with a female student and the group that didn’t a female student?
   b. You mentioned in the last presentation that they could get desensitized about this topic. In what kinds of situations did you see this?
6. In general, do you think students could go out of their comfort zones to inform their project, especially in terms of adopting the participants’ perspective?
   a. What do you think was the cause for this? The method or the topic?
7. From your professional viewpoint as an educator, do you think that student growth or change will extend beyond the students’ immediate experience in this course/studio?
8. In terms of empathy, how do you think students did?
9. For a next **iteration** of this course/studio:
   a. What aspects would you **change**?
   b. What aspects would you **maintain**?
   c. What aspects would you **add** to the course/studio?

10. Do you thing students were **comfortable** with my presence in the classroom?

11. Do you have any suggestions on how I might improve my **role as a researcher** collecting data from a context like the Studio?
Appendix K: BID Instructor Interview Protocol B (End-of-Semester Interview)

**INSTRUCTOR INTERVIEW PROTOCOL B (BID)**

**Interviewee:** Instructor of BID  
**Interviewer:** Andres Tellez (PhD Student in Design for Learning)  
**Where:** RED Lab (Leazar Hall, NC State Campus) / Instructor’s office  
**When:** At the end of the semester

---

**Guiding Questions**

1. How do you think the Studio **went**? Did it satisfy your **expectations**?  
   a. What was the role of the **presentation** structure in guiding the design process?

2. What, if anything, **surprised** you about this Studio?

3. How do you think students **grew/changed** from this experience?

4. On the **first** and **second projects** you asked the students to explore a **real context** and interact with **potential users** to find problems or opportunities to address in their project.  
   a. What was your **intention** by making them pursue these activities?  
   b. What were your **expectations** by making them do so?  
   c. Did students meet your **expectations** in this component of the project?

5. The **shoe project** forced students to think about a very different **user** and **context**, but they didn’t have access to them.  
   a. How do you think things went despite this **difficulty**?  
   b. What other **approaches** could have been used to mitigate this distance between them and the context?

6. In general, do you think students could go out of their comfort zones and adopt the **users’ perspective** to inform their projects?  
   a. What do you think was the cause for this understanding of the user?  
      - **Methods**  
      - **Topics** of each project

7. Throughout the semester students presented **testimonials** of people reacting to their designs at the end of their presentations.  
   a. What was the **intention** of asking them to bring these testimonials?

8. From your professional viewpoint as an educator, do you think that student growth or change will **extend beyond** the students’ immediate experience in this course/studio?
9. For a next iteration of this course/studio:
   a. What aspects would you change?
   b. What aspects would you maintain?
   c. What aspects would you add to the course/studio?

10. Do you feel the students were comfortable with my presence in the classroom?

11. Do you have any suggestions on how I might improve my role as a researcher collecting data from a context like the Studio?
### TEST 1: TWO-WAY ANOVA, EMPATHIC CONCERN, AID x BID, PRE- x POST-TEST

#### Summary

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<th>Description</th>
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<th>TEST</th>
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#### Comparisons among groups of factor 1 (GROUP) within each factor 2 (TEST) level

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#### Comparisons among groups of factor 1 (GROUP) within each factor 2 (TEST) level

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#### Omega squared for combined effect

<table>
<thead>
<tr>
<th>Factor 1 (GROUP) + Factor 2 (TEST)</th>
<th>Omega squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP x TEST</td>
<td>0.53715</td>
</tr>
</tbody>
</table>

#### Descriptive Statistics

<table>
<thead>
<tr>
<th>GROUP</th>
<th>BID</th>
<th>AID</th>
<th>POST-TEST</th>
<th>PRE-TEST</th>
<th>MEAN</th>
<th>STANDARD DEVIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.21581</td>
<td>0.21556</td>
</tr>
<tr>
<td>BID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.21536</td>
<td>0.21556</td>
</tr>
</tbody>
</table>

#### Test Statistics

<table>
<thead>
<tr>
<th>GROUP</th>
<th>BID</th>
<th>AID</th>
<th>POST-TEST</th>
<th>PRE-TEST</th>
<th>t-statistic</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.25314</td>
<td>0.20779</td>
</tr>
<tr>
<td>BID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.04402</td>
<td>0.39708</td>
</tr>
</tbody>
</table>

#### 8.12. Appendix L: Two-Way ANOVA Tables
## TEST 2: TWO-WAY ANOVA, PERSPECTIVE TAKING, AID x BID, PRE- x POST-TEST

### Summary

**Factor**: GROUP, TEST  
**Levels**: AID, BID  
**Levels**: Pre-Test, Post-Test

### Descriptive Statistics

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
<th>Sample Size</th>
<th>Mean</th>
<th>Variance</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP</td>
<td>AID</td>
<td>22</td>
<td>2.5792</td>
<td>0.46351</td>
<td>0.68582</td>
</tr>
<tr>
<td>GROUP</td>
<td>BID</td>
<td>34</td>
<td>2.65328</td>
<td>0.44049</td>
<td>0.66399</td>
</tr>
<tr>
<td>TEST</td>
<td>Pre-Test</td>
<td>28</td>
<td>2.65034</td>
<td>0.44055</td>
<td>0.64724</td>
</tr>
<tr>
<td>TEST</td>
<td>Post-Test</td>
<td>28</td>
<td>2.65034</td>
<td>0.44055</td>
<td>0.64724</td>
</tr>
</tbody>
</table>

### ANOVA

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1 (GROUP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 2 (TEST)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP x TEST</td>
<td>2.65034</td>
<td>11</td>
<td>0.24094</td>
<td>0.0082</td>
<td>0.0082</td>
</tr>
<tr>
<td>Within Groups</td>
<td>2.65034</td>
<td>55</td>
<td>0.04719</td>
<td>0.2429</td>
<td>0.2429</td>
</tr>
</tbody>
</table>

### Comparisons among groups of factor 2 (TEST) within each factor 1 (GROUP) level

#### Factor 1 (GROUP) = AID

**Tukey-Kramer**

<table>
<thead>
<tr>
<th>Group vs. Group (Contrast)</th>
<th>Difference</th>
<th>95% Confidence Interval</th>
<th>Test Statistics</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test vs Post-Test</td>
<td>0.05</td>
<td>0.04154</td>
<td>0.49184</td>
<td>0.02483</td>
</tr>
</tbody>
</table>

#### Factor 1 (GROUP) = BID

**Tukey-Kramer**

<table>
<thead>
<tr>
<th>Group vs. Group (Contrast)</th>
<th>Difference</th>
<th>95% Confidence Interval</th>
<th>Test Statistics</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test vs Post-Test</td>
<td>0.05</td>
<td>0.04154</td>
<td>0.49184</td>
<td>0.02483</td>
</tr>
</tbody>
</table>

### Comparisons among groups of factor 1 (GROUP) within each factor 2 (TEST) level

#### Factor 2 (TEST) = Post-Test

**Tukey-Kramer**

<table>
<thead>
<tr>
<th>Group vs. Group (Contrast)</th>
<th>Difference</th>
<th>95% Confidence Interval</th>
<th>Test Statistics</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AID vs BID</td>
<td>0.07334</td>
<td>0.27824</td>
<td>0.75188</td>
<td>0.08014</td>
</tr>
</tbody>
</table>

#### Factor 2 (TEST) = Pre-Test

**Tukey-Kramer**

<table>
<thead>
<tr>
<th>Group vs. Group (Contrast)</th>
<th>Difference</th>
<th>95% Confidence Interval</th>
<th>Test Statistics</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AID vs BID</td>
<td>0.07334</td>
<td>0.27824</td>
<td>0.75188</td>
<td>0.08014</td>
</tr>
</tbody>
</table>

### Variance

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F crit</th>
<th>Omega Sqr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1 (GROUP)</td>
<td></td>
<td></td>
<td></td>
<td>4.02663</td>
<td>0.82253</td>
</tr>
<tr>
<td>Factor 2 (TEST)</td>
<td></td>
<td></td>
<td></td>
<td>4.02663</td>
<td>0.82253</td>
</tr>
</tbody>
</table>

### Standard Deviation

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F crit</th>
<th>Omega Sqr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1 (GROUP)</td>
<td></td>
<td></td>
<td></td>
<td>4.02663</td>
<td>0.82253</td>
</tr>
<tr>
<td>Factor 2 (TEST)</td>
<td></td>
<td></td>
<td></td>
<td>4.02663</td>
<td>0.82253</td>
</tr>
</tbody>
</table>

### Conclusion

The results of the two-way ANOVA indicate a significant interaction between GROUP and TEST, suggesting that the effect of perspective taking (AID vs BID) varies across the pre- and post-test conditions. Further post-hoc comparisons using Tukey’s HSD test reveal specific differences between the groups that are significant. The omega squared values indicate a moderate effect size for the combined effect of GROUP and TEST interaction.
### TEST 3: TWO-WAY ANOVA, EMPATHIC CONCERN, AID x HCD, PRE- x POST-TEST

#### Descriptive Statistics

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1 (GROUP)</td>
<td>19.48639</td>
<td>18</td>
<td>1.08143</td>
<td>0.0113</td>
</tr>
<tr>
<td>Factor 2 (TEST)</td>
<td>18.1991</td>
<td>16</td>
<td>1.13744</td>
<td>0.00984</td>
</tr>
<tr>
<td>GROUP x TEST</td>
<td>0.00893</td>
<td>1</td>
<td>0.00893</td>
<td>0.9999</td>
</tr>
<tr>
<td>Alpha/N Bonferroni</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### ANOVA

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1 (GROUP)</td>
<td>19.48639</td>
<td>18</td>
<td>1.08143</td>
<td>0.0113</td>
</tr>
<tr>
<td>Factor 2 (TEST)</td>
<td>18.1991</td>
<td>16</td>
<td>1.13744</td>
<td>0.00984</td>
</tr>
<tr>
<td>GROUP x TEST</td>
<td>0.00893</td>
<td>1</td>
<td>0.00893</td>
<td>0.9999</td>
</tr>
<tr>
<td>Alpha/N Bonferroni</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Comparisons among groups of factor 1 (GROUP) level

**Factor 1 (GROUP) = AID**

- Post-Test vs Pre-Test
  - Tukey-Kramer: p-level = 0.001

**Factor 1 (GROUP) = HCD**

- Post-Test vs Pre-Test
  - Tukey-Kramer: p-level = 0.001

#### Comparisons among groups of factor 2 (TEST) level

**Factor 2 (TEST) = Pre-Test**

- AID vs HCD
  - Tukey-Kramer: p-level = 0.001

**Factor 2 (TEST) = Post-Test**

- AID vs HCD
  - Tukey-Kramer: p-level = 0.001
### TEST 4: TWO-WAY ANOVA, PERSPECTIVE TAKING, AID x HCD PRE- x POST-TEST

#### Summary

**Factor** 1 (GROUP) = AID vs HCD

**Factor** 2 (TEST) = Pre-Test vs Post-Test

#### ANOVA

**Source of Variation** | d.f. | MS | F | p-level | Omega Squared for combined effect |
--- | --- | --- | --- | --- | --- |
**Factor** 1 (GROUP) | 1 | 3.38669 | 2.50475 | 0.0363 | 0.13166 |
**Factor** 2 (TEST) | 1 | 0.04464 | 0.20624 | 0.65141 | 0.01543 |
**GROUP x TEST** | 1 | 0.30567 | 0.47087 | 0.49128 | 0.58281 |
**Within Groups** | 50 | 0.30987 | 1.72286 | 0.29475 | 0.70901 |
**Total** | 53 | 0.36916 | 1.84968 | 0.01361 | 0.85892 |

#### Comparisons among groups of factor 2 (TEST) within each factor 1 (GROUP) level

**Factor 1 (GROUP) = AID**

**Tukey-Kramer**

- Group vs. Group (Contrast) Difference p-level
  - AID vs Pre-Test 0.14286 0.01555
  - AID vs Post-Test -0.11945 0.0153

**Factor 1 (GROUP) = HCD**

**Tukey-Kramer**

- Group vs. Group (Contrast) Difference p-level
  - HCD vs Pre-Test -0.30567 0.0153
  - HCD vs Post-Test 0.04464 0.0153

#### Comparisons among groups of factor 1 (GROUP) within each factor 2 (TEST) level

**Factor 2 (TEST) = Pre-Test**

**Tukey-Kramer**

- Group vs. Group (Contrast) Difference p-level
  - AID vs Pre-Test -0.41315 0.09086

**Factor 2 (TEST) = Post-Test**

**Tukey-Kramer**

- Group vs. Group (Contrast) Difference p-level
  - AID vs Post-Test -0.41315 0.09086

#### Descriptive Statistics

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Sample Size</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AID</td>
<td>22</td>
<td>25.7192</td>
<td>0.46351</td>
</tr>
<tr>
<td>HCD</td>
<td>32</td>
<td>3.06862</td>
<td>0.29475</td>
</tr>
<tr>
<td>Pre-Test</td>
<td>27</td>
<td>2.86148</td>
<td>0.63591</td>
</tr>
<tr>
<td>Post-Test</td>
<td>27</td>
<td>2.86245</td>
<td>0.44974</td>
</tr>
</tbody>
</table>

### Footnotes

- d.f. = degrees of freedom
- MS = mean square
- F = F-statistic
- p-level = p-value
- Omega Squared for combined effect

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