

**SCIENCE IDENTITIES OF FEMALE STUDENTS
DURING PEER WORK: GENDER, DIALOGUE, AND
POWER IN THE SCIENCE FOR CITIZENSHIP
CLASSROOM**

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SUMMARY

The aim of this research is to study peer-group interactions within the new curricular context of collaborative and dialogue-based science to better understand how female science identities are promoted or restrained. The general objective is to understand the development of science identities in female high-school students during peer interactions in Science for Citizenship group tasks.

We propose viewing the female gender gap in science as an identity debt within the discipline, incorporating intersectionality and connecting academic learning with identity. We identify three key issues: first, there is a lack of theoretical frameworks to understand peer dialogue as a process that integrates content learning, identity, and emotions. Second, the Chilean curriculum lacks pedagogical guidance for implementing Science for Citizenship, which is essential for teachers to promote collaborative peer dialogues that include female voices and identities, especially in socio-economically segregated schools. And finally, there is a need for research that examines peer dialogue and female participation in science from an intersectional and non-binary perspective, considering how power dynamics, diverse gender experiences, and intersectional factors such as race and class shape female science identities.

Each of these problems is approached in an article. The first article is a theoretical inquiry based on Vygotsky and other sociocultural scholars to understand how and why peer-group interactions in school can be developmental and holistic experiences, but how they also risk reproducing dominant identities. The second and third articles are embedded case studies of a pedagogical experience in an 11th-grade Science for Citizenship classroom during a semester in a working-class school in Santiago, Chile. One of the cases analyzes the broader pedagogical experience of a teacher and the researcher/co-teacher promoting a dialogue-based pedagogy,

through deliberative teaching, fostering diversity of voices and inclusion. The other case study explores the experience of a specific group to analyze the micro-interactions and narratives of the classmates in relation to developing the science identity of one female cisgender student.

The study uses the metaphor of a tree to structure its findings, with roots (theoretical study), trunk (pedagogical case study), and leaves/flowers (interactions/identity). The theoretical roots offer an alternative to stereotype theory to understand the female gender gap as a social and interactional issue rather than focusing on individual self-representations. The pedagogical trunk suggests the need for flexible and trust-based relationships between teachers and researchers, including co-teaching, to transition to deliberative teaching and fostering diversity of voices. Finally, the micro-analysis of interactions and science identity represented in the leaves and flowers highlights the dialectical relationship between how students narrate their science identities and how they interact in group tasks, revealing how gender identity, expression, and heteronormativity intersect with social class and race to shape students' participation in knowledge construction.

The study provides actionable recommendations to address systemic inequalities in science education, promote inclusive curricula, and support teachers in underserved contexts. It emphasizes the importance of identity, intersectionality, and peer dialogue in transforming science classrooms into spaces for diverse voices and equitable learning opportunities.

INTRODUCTION

In a complex, interconnected world in which socio-scientific problems such as climate change, vaccination, and genetic testing have emerged alongside political polarization and fake news, it is essential to teach younger generations to critically understand these problems, imagine possible solutions, and adopt positions considering different identities and worldviews. Several stakeholders have called for science education to be transformed into an interdisciplinary field in which dialogue is used to solve problems and answer questions among peers, understanding knowledge as co-constructed and provisional (European Commission & Eurydice, 2011; Evagorou et al., 2020; Mansour & Wegerif, 2013). In this context, efforts have been made to teach science through scientific inquiry and argumentation, using models that give prominence to knowledge about the nature of science and collaboration among peers (Sengul, 2019).

These changes are expected to promote a type of education in which students *practice, do, think, and perform* science in the classroom. Therefore, science teaching is expected to change from traditional teacher-centered models into pedagogies that promote peer-work opportunities (Evagorou et al., 2020; Mansour & Wegerif, 2013). The underlying idea of this approach is to promote horizontal interaction among peers, who, through dialogue, solve problems by proposing their ideas, explaining their reasoning to their classmates, and overcoming their disagreements (Howe & Abedin, 2013).

In Chile, these transformations have resulted in a public policy that changed school curricula, establishing scientific inquiry as a science learning model and implementing a nationwide professional development program for in-service teachers focused on scientific inquiry (initially ECBI and currently ICEC-MINEDUC). In this context, the curricular reform of 2019

created the interdisciplinary subject of Science for Citizenship for the 11th and 12th grades based on a critical view of science.

The aim of Science for Citizenship is for students to gain an integrated understanding of complex socio-scientific problems, reflecting on the impact on their daily lives. To do so, the curriculum integrates biology, chemistry, physics, and some aspects of mathematics, encouraging students to work collaboratively to solve problems and complete projects. In 2021, at the end of the COVID-19 health crisis and the reopening of schools, 11th- and 12th-grade school students in Chile began to learn science in an interdisciplinary and collaborative way for the first time, tackling socio-scientific problems.

In these new curricular contexts, group dialogue among peers plays a key role in how science is learned and how scientific problems are discussed. Dialogue is considered a fundamental human phenomenon whose main function is “to negotiate meanings, in order for participants to develop shared understandings or find out how different their understandings are” (Linell, 2017, p. 304). Dialogue in the context of curricular science is understood as interactions between two or more participants using a system of signs. It is a multilayered, interconnected, multimodal, and reflexive process (Marková & Linell, 1996). But, from a wider point of view, dialogue is more than that: it can be considered a metaphor and metonymy of human thinking (Linell, 2009), and every form of discourse could also be considered dialogic (Bakhtin, 1986).

Although there is a range of definitions for peer interactions in the classroom, there is a consensus that they involve exchanges among students when they negotiate and discuss ideas while solving a problem or completing a common project organized by the teacher (Howe & Abedin, 2013). Specifically, it is expected to offer dialogue-based activities in which students discuss opposite points of view and critically and constructively address their differences (Littleton

& Howe, 2010). Even though verbal exchanges are a core component of exchanges of ideas, non-verbal communication elements such as gestures, intonation, posture, and the spatial arrangement of the group are also important when it comes to how group interactions among peers are constructed (Lefstein, 2010).

Promoting peer dialogue as a pedagogical tool is grounded in its learning benefits. Several studies have shown that dialogue among peers in the classroom has a clear and consistent effect on school learning (Howe, 2009; Howe & Zachariou, 2019). For instance, quasi-experimental studies, with pre–post evaluations and correlational studies, show that work among peer groups promotes learning across multiple areas and ages (Mercer et al., 2019; van der Veen & van Oers, 2017). Developing argumentative skills has been shown to mediate the promotion of learning in group interactions (Asterhan & Schwarz, 2016) while promoting the development of language and reasoning skills (Kuhn & Udell, 2003). Specifically in science, international studies (Baser et al., 2017; Fung et al., 2017; Springer et al., 1999) and research conducted in Chile (Larrain et al., 2019) reveal the benefits of peer-group interactions for learning.

However, although dialogue among peers has proven to be a valuable learning tool, it is less clear how power relationships between students could have a role in asymmetries in the co-construction of knowledge, reinforcing dominant identities. An emergent field of studies is showing that, despite established rules and roles for group work, students have unequal opportunities to access the conversational floor (Kayi-Aydar & Miller, 2018; Segal & Lefstein, 2017). Interactional spaces in peer-group work act as sociopolitical spaces in which students relate to one another according to social hierarchies of class, gender, abilities, and race (Langer-Osuna, 2018). Consequently, pedagogies that privilege peer interactions in group work may not necessarily promote the inclusion of historically marginalized identities in the science field.

This is especially relevant if we consider the so-called *female gender gap* in science, another main concern in the field of science education. The gender gap in science begins in school and persists in the labor world, but it cannot be attributed to differences in performance or skill in the discipline. A UNICEF study (2020) with data from 62 countries found that, in the last years of primary education, the same number of boys and girls attain the minimum levels of science skills in most countries. At high-school level, the minimum levels of achievement in science are equal between boys and girls, as in the case of Chile, or sometimes higher in female students; in fact, women take the lead in 45 countries. However, although boys and girls are equally appreciative of scientific inquiry, girls are less interested in science, except for the health sciences, even in countries where women perform better. The same is true of vocational aspirations: in nearly all countries, more men than women wish to pursue a STEM program, whereas more women than men wish to enroll in a healthcare program, even in samples of the best-performing students. Studies employing PISA data have documented that only 34% of girls believe they can succeed in STEM. Women's enrollment in these programs reaches 28% versus more than 70% for men (Mostafa, 2019).

The *female gender gap* phenomenon has mostly been explained through stereotypes and self-representations that affect women's decisions from an early age (Carli et al., 2016; Banchevsky et al., 2016; Smyth & Nosek, 2015; UNESCO, 2024). Stereotypes are beliefs about which social groups enjoy, are interested in, have skills for, or are associated with science (Master & Meltzoff, 2020; Ferguson & Lezotte, 2020). These stereotypes influence boys and girls from an early age through socialization practices reinforced by parents and teachers (e.g., Starr & Simpkins, 2021). In this context, girls tend to hold self-representations as possessing fewer abilities for science than

boys, even when their interests and skills are similar to those of their peers (Ertl et al., 2017; Mejía-Rodríguez et al., 2021; OECD, 2015).

Although studies on stereotypes and self-representations have shed light on the gender gap problem from the perspective of cultural variables, their focus on the individual and cognitive processes has made it difficult to understand the dynamics of how people experience, feel, interact with, and resist these cognitive representations. Understanding how stereotypes are experienced in daily interactions—beyond individual minds and self-representations—can enable us not only to describe the phenomenon but also to understand the processes whereby people use these social discourses in their interactions and thus accept, resist, or change these stereotype-based interactions (Harré & Langenhove, 1998).

To understand the dynamics that articulate the female gender gap with peer-group-work dialogue, this study advances a perspective grounded in identity. Understanding the gender gap through the lens of identity made it possible to establish comprehensive associations between constructs that operate at different levels of analysis, such as social discourses, classroom micro-culture, and social interactions (Wortham, 2005). In this way, identity is understood as the way students make sense and position themselves—and are positioned—in the science classroom, exerting their agency but also framed in social constructions such as gender, race, and the historical discourse of science (Varelas, 2018). This analytic multidimensionality makes identity a rich construct that yields a comprehensive view of phenomena despite the conceptual difficulties that its operationalization entails (Schwartz et al., 2011).

In Chile, studies on group peer interactions and gender are still scarce. However, studies on teacher–student interaction patterns reveal that teachers, regardless of the gender of the educator, tend to ask boys more and more complex questions, giving more feedback to them than

to girls (Espinoza & Taut, 2016; Ortega et al., 2021). Could gendered relationships also be found in group peer interactions? International studies align with the idea that students perform social discourses through group interactions that unequally organize student contributions (for a review, see Kayi-Aydar & Miller, 2018), although most are in Language and Math school disciplines, and in the early levels of schooling.

Considering that the new curricular reforms are encouraging schools to teach science, promoting collaboration and dialogue on socio-scientific problems, it is worth asking whether these aims can have the undesired effect of reproducing the dominant identities and social discourses in science. Furthermore, it is necessary to explore and understand the pedagogical conditions in which dialogue in peer-group work could promote learning and inclusion of marginalized identities at the same time.

Given the above, the aim of this research is to study peer interactions within the new curricular context of collaborative and dialogue-based science to better understand how female science identities are promoted or restrained. And the general objective of the research is as follows: *To understand the development of science identities in female high-school students during peer interactions in Science for Citizenship group tasks.*

THEORETICAL AND CONTEXTUAL FRAMEWORK

From gender gap to identity debt in science: elements to read and understand the problem

To understand how gender stereotypes in science are experienced in daily life, and how they influence women's decisions, researchers employing a range of theoretical frameworks have highlighted the concept of identity (Kim & Sinatra, 2018). This concept has made it possible to integrate into existing research the value of feelings related to the discipline in the spaces where science is practiced, such as science classrooms (Varelas, 2012).

We therefore argue that, to understand the processes and interactions that produce the existing gender gap in science, it is necessary to reframe the problem through the lens of identity. This would imply a richer understanding of the different dimensions intertwined in intersectionality, inclusion, and learning science. All these elements have the core concept of identity and power relationships.

First, introducing an intersectionality point of view implies that the gender gap in science is not a binary of women versus men, and it must be understood considering different structural axes of social marginalization (Crenshaw, 2006). Intersectionality is a theoretical and methodological tool to analyze how historically sociocultural categorizations, such as gender, ethnicity, race, and class, interact and, in doing so, produce different kinds of societal inequalities and unjust social relations (Lykke, 2011). Also, an intersectional lens implies that we need to avoid essentialism because there is no one female voice or one way of being a female (Troncoso Pérez et al., 2019). Feminist perspectives emphasize the specificity of contexts and recognize their influence on shaping a wide range of realities; this, together with critical theories, makes it possible to identify and examine the multiple positions of female voices originating from various cultures, races, and classes (Frost & Elichao, 2013).

Second, feminist and critical perspectives propose reconceptualizing the problem of inclusion, transforming it from a gender gap into an *identity debt* that has historically marginalized women, non-white races, and the working classes (Kang et al., 2019; Ladson-Billings, 2006; Szostkowski & Upadhyay, 2019). Though we must acknowledge the curricular progress derived from an approach to science teaching that comprises dialogue, reflection, and a focus on social problems, feminist and critical perspectives make it possible to recognize how the canonical discourse of the subject of science, historically associated with white, middle-class European men, continues to exert an influence on our daily lives. Hence, we must acknowledge the existence of an *identity debt* (Ladson-Billings, 2006) and promote the idea that traditionally excluded students feel they belong where science is practiced (Varelas et al., 2012).

A third point would be to integrate frameworks to understand how content learning is intertwined with identity construction, emotions, and thinking. If we want to heal the identity debt in science, we must highlight the central role of identity in the process of content learning, so curricular reforms based on pedagogical learning alone are not enough: “*In many classrooms, identity work is often considered secondary to constructing knowledge or a residual product of developing (or not) a strong knowledge base*” (Varelas et al., 2012, p. 336). Reforming how we understand learning science implies an effort to heal historical relationships of power that have marginalized women, non-white, and working-class students, which implies understanding that “*science is related to who students and teachers are as social beings*” (Szostkowski & Upadhyay, 2019, p. 350).

This implies a critical vision of the science knowledge(s) and an awareness of positionality. Learning science is understood as a sociopolitical and dialectical act with multiple dimensions: material, symbolic, cognitive, social, and emotional (Varelas, 2018). In that context, diversity and

differences are not just aspects to include; they play a central part in how science is, and should be, constructed.

All of these imply a challenge to the voices that are actually heard in teacher–student or student–student interactions, considering and expanding the notions of liberation pedagogy proposed by Freire (1968/2018). Students are never truly liberated from oppressive discourses; rather, students, guided by their teachers, can explore various perspectives in science as a way of deconstructing their beliefs about science and themselves, assessing their positions as students, teachers, and sexual beings, with a race, gender, and social class (Barton, 1997).

Deliberative teaching

This critical view of science and science education seems, at least in theory, to be aligned with the principles that guide curricular changes that promote science as a collaborative practice in schools. Science for Citizenship, for example, emphasizes a historically situated conception of science under permanent construction and revision, in which students are expected to develop scientific skills and apply them to problems that are important to them in their own context. The subject is organized so that students work on socio-scientific problems and collaborate to find a range of solutions and perspectives, developing communication and critical and creative thinking. Students' voice, selection, and identity are defined as key aspects of peer learning, which must be based on problems or projects that are meaningful to them (MINEDUC & UCE, 2019).

In this context, deliberative teaching, the pedagogical approach that framed the study, aligns with the principle of a critical conception of science. Deliberative teaching can be conceived of as a type of dialogic pedagogy. Dialogic pedagogies emphasize the role and centrality of dialogue and critically seek ways of promoting and creating dialogic spaces in classrooms (Mercer et al., 2020). Specifically, deliberative teaching focuses on the co-construction of possible

solutions to controversial open problems, generating instances of small-group peer dialogue and all-class plenaries. Through peer deliberative dialogue, epistemic ideas are collaboratively, critically negotiated, and revised in an open and respectful social space (Larrain et al., 2021).

Deliberation, in this context, is defined as:

A family of speech genres in which speakers carefully, critically, and affectively consider alternative solutions to controversial and dilemmatic open issues (whether practical or not). They do it through the persuasive and affective imagination, formulation, evaluation, and revision of arguments and counterarguments, and with the aim of reaching a shared (although plural) view on the matter. (p.8)

The proposal also considers the central role of affective positionings of students in engaging in the experience of deliberation, and highlights the importance of recognizing diversity and plural identities in collaborative, thoughtful school experiences with peers (Larrain et al., 2021). Considering all this, it seems reasonable to sustain a certain coherence between this framework and a critical view of science knowledge and teaching, as argued in the previous section.

The notion of identity

Even though multiple differences and controversies exist regarding defining identity, there is some consensus that identity concerns the dynamics that explain how we construct or become ourselves as subjects (Schwartz et al., 2011; Watzlawik et al., 2021). However, given the same phenomenon— identity— authors have constructed different objects of research. This operationalization entails adopting theoretical, epistemological, and ontological positions that make identity a researchable concept and that determine, for instance, whether it is an object that can be measured in individuals, a discursive practice in narratives, or a performative act in interactions (Widdicombe & Marinho, 2021).

Widdicombe and Marinho (2021) identified three broad approaches to conceptualizing identity: traditional, socio-constructionist, and post-structuralist. Traditional approaches are based on post-positivist epistemological frameworks and define identity as a relatively stable and individual representation of the self. Although the analysis focuses on the individual, the context is not overlooked but conceptualized as a separate unit (individual/context) (Berzonsky, 2004; Erikson, 1968). For their part, socio-constructionist approaches criticize the individual and mentalistic focus of identities and propose redefining them as a culturally produced construct anchored in social narratives of class, gender, and ethnicity, among others (Galbin, 2014). From this perspective, identity is a social and cultural process constructed and reconstructed through the narratives we are told and that we tell about ourselves. Unlike the socio-constructionist approaches, post-structuralism questions the scope of great historical narratives. Instead, it highlights the permanent interplay of multiple competing discourses that enrich, question, and challenge one another (Widdicombe & Marinho, 2021). This means identity is regarded as dynamic rather than stable, interactional instead of individual, and anchored in the spaces and contexts we inhabit and feel with others. Identity is performed through language and the positions adopted in discourse (Baxter, 2016).

This research focuses on identities from *social practice theory* (Holland and Lave, 2009). Drawing on Vygotsky (1999), Bakhtin (1986), and Davies and Harré (1990), Dorothy Holland and her team (1998) present an approach that is more particularistic than socio-constructionist theories, and more cultural than post-structuralist theories. Social practice theory is concerned with how people in the everyday social world become themselves, enact their agency, and, at the same time, are shaped by social structures at different levels (micro–meso–macro) (Holland & Lave, 2019).

Identity is conceived as a complex phenomenon that emerges in historically contingent, socially enacted, and culturally constructed worlds (Holland et al., 1998).

Holland's proposal distinguishes between two fundamental processes that configure people's identities: *in-practice* and *narrative identities*. In-practice identities are performed in interaction with others, carved out in social worlds that Holland named *figured worlds* (Varelas et al. 2012). Narrative identities are the reflective process of narrating our and others' stories. Holland proposed that not only are people determined by social structures, but there are also spaces for personal authoring with a degree of agency (Holland et al., 1998).

In-practice identities and figured worlds

In-practice identities are enacted, created, resisted, and recreated in interactions within figured worlds. Figured worlds are contexts where identities are produced, being defined as socially produced and culturally constituted activities (Holland et al., 1998). Based on Mikhail Bakhtin's (1986) concept of discursive genre, Holland proposes that figured worlds are traditions of apprehension that bring us together and shape us; we work out our identity in them as our lives intersect those spaces. A figured world can be referred to as a narrativized or dramatized world, connecting with the notion that the elements interact as a story or drama (Holland et al., 1998). Figured worlds are the context of meaning for social encounters, giving different positions to people who play a character in that semiotic world (Urrieta, 2007). Students inhabit and bring several different figured worlds when they speak to one another at school. For example, the figured world of science class includes the micro-culture of a particular science class. This might be who has the authority to speak (the teacher, some students), who structures the conversation, the material ways of organizing the classroom that are expected and allowed (the distribution of chairs, tables, the presence of a blackboard, the spots for students, and the place of the teachers), what

responses and bodily ways of enacting are expected, appropriate, and allowed, and for who (for example, what counts as a good student, good/bad behavior, smart way of talking). The specific ways of organizing each figured world are unique. However, broader social discourses such as gender, class, race, and the dominant science discourse also structure them.

If figured worlds are the semiotic contexts in which people work out who they are, positioning is how identities are enacted. Davis and Harré (1990) define positioning as the discursive process whereby subjects are placed in conversations as observably and subjectively coherent participants in jointly produced storylines. In contrast to the concept of role, which focuses on ritualistic and formal aspects, positioning highlights the dynamic and power-related aspects of social encounters, stressing the active nature of producing social and subjective realities (McVee et al., 2011). Positionings can be interactive or reflective. In interactive positionings, what a subject says positions another; in reflective ones, a subject positions themselves (Davis & Harré, 1990). It is worth noting that positionings are not necessarily intentional, since they occur constantly in the interactions that take place in the spaces we inhabit every day, such as classrooms (Wortham, 2005).

We see the unique process in which students can dialogue and construct knowledge together not only as an academic challenge that results in different academic identities but also as a critical developmental process that intersects the different figured worlds, emotions, and identities of the students (Salas & Larrain, 2024). As a performative tool, language is the key component that intertwines knowledge, emotions, identities, and power relationships. When students work together on challenging questions, just recovering memories to answer is not enough; they must actively imagine and relate the problems to their experiences and beliefs. So, the different figured worlds brought to the interactions act as landscapes of possibility to answer

the academic question. Through this performative imagination, students can think, explore possible answers, and enrich one another through language. Different voices mean different opportunities to enhance points of view, analysis, solutions to problems, and opportunities to connect, to highlight different values, and to empathize with other worldviews and communities. Furthermore, multiple and diverse voices allow us to grow our consciousness and enrich our subjectivity through language as a uniquely human capacity, amplifying what we see, what we think, what we feel, and who we are. In that way, students working together could be a transformative activity, putting into play interactional and psychological processes that push them forward.

However, if the figured world of science is restricted to certain kinds of identity, monopolizing the epistemic power in interactions, there are fewer possibilities to imagine and create through peer interactions, and, more than a developmental activity, group interactions can reproduce identities and the canonical view of science. Being immersed in human sociocultural life implies that language and other semiotic tools are not neutral but part of social structures that order and give meaning, and those orders intersect in an asymmetrical and unequal relationship, even for students of the same age in the same classroom (for example, gender, SES, conceptions of intelligence, ethnicity) (Salas & Larrain, 2024). Those social discourses are created, rejected, resisted, and recreated in classroom spaces, where power flows in interactions (Foucault et al., 1999), in dynamics that restrict and enhance epistemic power and position students unequally. Over time, positioning patterns in the classroom may prevent students from developing their science identities, causing them to feel they do not belong in those spaces.

For this reason, analyzing how students position themselves, what figured worlds they bring to their conversations, and how epistemic power is performed in their conversations is fundamental to creating generative science spaces where different identities and figured worlds have more balanced possibilities to flourish in interactions.

Narrative identities and inner speech

Students are not just performative beings; they also construct their subjectivity in a personal reflexive dialogic space, where the different social voices allow each student to narrate the story of themselves and others. Through these stories, students give meaning to the interactions and have a range of agency to create and recreate who they are and what they believe. Thus, the analysis of in-practice identities is complemented by narratives that subjects author about themselves. Narratives are not limited to representing reality in an individualistic and cognitive manner: the concept of narrative is always practiced and experienced in a language community (Rudrum, 2005). Thus, narratives do not just represent the subject; they are the subject acting at that time and in that place (Kane, 2012).

The concept of voice (Bakhtin, 1986) plays a key role. Voice is defined as the experience of the speaker and the listener as semiotic acts (Bertau, 2021). The experience of in-practice identities is the experience of voices calling, rejecting, recognizing, or silencing other voices (Bertau, 2021). Furthermore, the voice as authorship in narrative identities provides the necessary tools to recreate, in an internal dialogue, one's positions and those of others circumscribed to the spaces of cultural production or the figured worlds to which they belong (Holland et al., 1998).

We permanently try to make sense of the spaces we inhabit in relation to other spaces where we feel valued, which is a constant task of authorship and integration of ourselves and others (Holland et al., 1998). Therefore, the figured world of the science classroom may or may not meet with other figured worlds of the students, intersecting, or not, with their multiple social identities. As students make sense of the figured world of science by bringing elements from other figured worlds that are significant to them—for example, the figured world of their friends, hobbies, and everyday life—they are more likely to strengthen their science identity (Calabrese Barton et al., 2013).

Science identity

With the elements described so far, we can define science identity as a multidimensional, interactional, narrative, and constantly developing construct that becomes embedded in power systems in the figured world of the science classroom, in association with the multiple social identities that we perform and narrate for ourselves, framed dialectically in social structures. It is how students position themselves and are positioned by others as they become part of, and interact with, a community where science is practiced, such as the school classroom (Kane, 2012). It cannot be unbound from how students behave, act, and are in the classroom in the context of the norms and expectations of a social structure (Varelas & Kane, 2012). Identity is inseparable from the social structures that produce it, but it leaves room for authorship or agency (Holland et al., 1998). Thus, science identity is also how students make sense of the interactions and author and position themselves as science learners (or not), and relate the figured world of science to other relevant social identities.

If we consider peer dialogue as a developmental activity mediated by language and other semiotic tools, we understand that interaction, content learning, reflexivity, subjectivity, and identity are part of the same experience, and they are all mediated by power relationships (Salas & Larrain, 2024). This complex and interwoven perspective allows us to understand that promoting classroom diversity is much more than filling a learning gap or the lack of curriculum content. It implies that educational experiences must be meaningful to learn, and we need students who can feel that part of their figured worlds is present in each science class. In this process, we serve the historically neglected voices and enrich all student learning and developmental growth.

Despite the learning benefits and the developmental potential of peer academic interactions, studies are highlighting the reproductive risk of asymmetrical power relationships in group work. Especially in the science subjects, the lack of identification with science coincides with historically marginalized identities from the discipline discourse, such as females, LGBTQ+, non-white, and working-class students. Understanding how those students narrate and perform their intersecting identities and social worlds when working on science problems could allow us to understand the complex dynamics that promote and hinder the development of students' science identities. Therefore, it is necessary to analyze this phenomenon holistically to understand how to promote dialogic learning spaces that consider equity and learners' intersecting identities and social worlds in a richer and more complex way.

Previous studies on identities and positionings in the science classroom

Research on positionings and identity in school classrooms is emergent in science, especially at the high-school level. Most studies on science identity adopt a narrative approach (for a revision, see Simpson & Bouhafa, 2020), while studies on positionings tend to focus on the first years of schooling, especially on the subject of Language (Kayi-Aydar & Miller, 2018).

However, previous case studies on positionings in science classrooms suggest that much more than solving academic tasks is taking place in these exchanges. When working jointly with others, students use their knowledge and engage in micro-power relations, positioning themselves, or not, as science learners and leading them to identify with, or not, with science. Research shows that these dynamics are related to social and academic status and to larger social structures like race, gender, and SES. In the next section, we present a revision of case study research about science identity in school from the last 20 years that focuses on interactions, dialogue, intersectionality, or gender. We will break down previous study findings, organizing them by the focus of the case studies.

Case studies focused on narrative science identities. Calabrese et al. (2013) is an example of a narrative case study that provides evidence of how students position themselves and author their science identities, mediated and resisting social constructions of race, SES, and gender. She and her team followed up on the science identity trajectories of black female US students from a disadvantaged neighborhood from 4th to 6th grade. One of these students, who originally exhibited high interest and good performance in science, did not feel included in the group. The authors concluded that the social constructions of race, SES, and gender hindered her interests and excluded the figured world of science from her identity, even though her grades did not change. Another student, a passive girl identified as an average performer, managed to position herself as an intellectual authority after her classmates, thanks to the confidence she drew from an extracurricular science activity where she met peers of her race. Both cases show that identity is a controversial, cumulative effort that occurs with and against power, privilege, and oppression structures. Overall, the study addresses identity trajectories over time, focusing on students' narratives of events and the main milestones in the figured world of the science classroom; but it

does not pay close attention to discursive exchanges among students in the micro-analysis of interactions.

Case studies focused on all-class interactions. Dialogic pedagogies can also focus on teacher–student dialogue. Studies that analyze all-class interactions show that the intersection between social identities shapes, but does not completely restrain, the science identities performed by students in all-class activities. Also, they highlight the crucial role of teachers in balancing power relationships and distributing power. Similarly, Tan and Barton (2007) followed up two 6th-grade Latino students during one school year. One of the students, Ginny, identified herself as academically proficient, popular, intelligent, and successful in school activities. The other student, Amelia, was known for her conflicts with classmates and was not popular among her peers and teachers. Despite these differences, the study shows how both strengthened their science identities by managing to integrate other figured worlds that were important to them into the science classroom. The authors' conclusions highlight the teacher's role as a mediator. This was key to those identity trajectories because he recognized the importance of the students' experiences outside the classroom and allowed them to be integrated into classroom work. These cases illustrate how students develop their science identities as students with a gender and a race, with multiple figured worlds intersecting to perform this disciplinary identity. These processes of recognition and positioning in the classroom, which would struggle to be understood from the perspective of self-representation, highlight the interactional component of identity. But these cases do not just focus on peer interaction; they mostly examine classroom work mediated by a teacher.

Kumpulainen and Rajala (2017) evidenced how 3rd-grade students negotiate their science identities through the social architecture of classroom discourse, mainly mediated and orchestrated by the teacher. They also found that teachers were relevant actors to orchestrate and give voice to marginalized identities, facilitating diverse views about a topic while maintaining the curricular goals. The study evidenced relevant shifts in the science identities of the students mediated by the teachers. However, unlike Tan and Barton's (2007) study, it does not analyze intersectionality as a relevant factor. Although it mentions gender and immigration status as student characteristics, these factors are not the focus of the study. In light of Tan and Barton's (2007) study, an intersectionality analysis could deepen the results of the study, considering that it included two girls and two boys. The girls in the study were passive and contributed less to science class, especially the one who was an immigrant and struggled with the language. The two boys were active, and the one who was positioned with the most abilities and who participated more in class using traditional scientific words was not specified in his intersectional identities.

Case studies focused on peer-group interactions. Although fewer studies focus on peer-group interactions, Wieselmann and her team (2020) developed a research study to analyze the group work of 5th-grade students. They explored the small-group interactions in a STEM challenge from a gender perspective. Their findings showed a pattern of active participation in male students, who tended to manipulate and control materials, and take leadership roles, while the girls were mostly passive, observing, following directions, assisting, and taking notes. However, the girls expressed frustrations with these interactions, feeling excluded and having fewer opportunities to enjoy and explore the challenges in the engineering-focused challenges. The study highlighted a pattern of gendered interactions and the relevance of studying how students distribute power in small-group activities. However, they do not integrate an intersectional point

of view, which suggests that other power structures, such as race or SES, could be mediating those interactions. Finally, as they only focused on recording the group work, they did not fully capture how the students reflected and interpreted those interactions.

Case studies that analyzed in-practice and narrative identities. Kane (2012) followed up with a group of 3rd-grade African American students attending a school that mainly served black students. Through participant observations, video recordings of group projects, and interviews, she developed narratives about the science identity of each student, which she contrasted with her observations of classroom interactions. The article shows how the students constructed their science identities based on their performance, competencies, and recognition. In addition, she discusses how interactions and narratives were mediated by gender. Specifically, one of the girls struggled to feel competent in science despite participating actively in the class. During peer interactions, she was often interrupted and criticized, but she resisted those positionings and supported her science identity by integrating her art and drawing skills. The boys, one in particular, seemed to command group interactions and gain more recognition from their peers. This study illustrates how gender-mediated interaction, power, and identity patterns begin to emerge in the first years of school education.

Carlone et al. (2014) carried out a longitudinal study in which they followed up the cases of three diverse students, in terms of gender, ethnicity, and socio-economic status, from 4th to 6th grade. The study comprised interviews and recordings of group and all-class activities. The findings revealed how the participants' science identities became weaker over time. Each of the cases showed how race, gender, and class hindered the students' identity work through the positionings they experienced daily in their classrooms. Also, the narrowing of school science pedagogy and curriculum to a more traditional-based teaching pedagogy and a canonical science

curriculum in middle school also contributed to problematic science trajectories, particularly for non-mainstream students. The study highlights the need for an intersectional approach and the integration of practice and narrative identities. It also prompts questions about how science classrooms may be reformed in middle school to include diverse science identities and figured worlds, and how to prepare science teachers to denaturalize and critique structures of power to develop more equitable practices.

Finally, Gamez and Parker's (2018) study analyzes micro-classroom interactions in science groups with students from early primary school to middle school. They present the cases of two 3rd-grade Latino students who were learning English as a foreign language and were required to join a peer group in the science classroom where the teacher only permitted exchanges in English. The study revealed how the group's interactions created a micro-figured world outside the teacher's sight. Through positionings and narratives, this micro-world received the influence of class, gender, and race structures. For the participating students, being linguistically diverse was a central aspect of their relationship with their groups. While one of them, the boy, managed to position himself among his peers, the girl remained marginalized from the group's conversations.

Given the demand for innovations in science teaching, which encourages increased collaboration and constructive peer interactions with a focus on dialogue, it is key to examine the conditions and processes of identity construction that mediate these new ways of learning to inform public policy, teacher practices, and theoretical knowledge. This can help to generate educational science experiences where female students feel welcome in their multiple identities, reflections, thoughts, and ways of affecting themselves, allowing them to develop identities committed to science. In our revision of cases, it reminds us that no studies focus on high-school students. Also, although intersectionality is considered in the studies that take micro-interactions and narrative

identities, all of the studies consider gender as binary, mostly assumed by researchers, which may simplify how students live, feel, and perform their social identities.

Therefore, we need a clearer understanding of the dynamics of peer-group collaboration, power relationships, co-construction of science knowledge, and identity development, especially at the high-school level, the period that precedes important vocational choices and in which reaffirming identity is crucial.

Problems in promoting peer-group dialogue and diversity of voices in science

In the previous sections, we acknowledged the problem of the female gap in science, and we proposed reading through the lens of identity. We argued the necessity to reframe the gender gap in science, considering intersectionality, the problem of female inclusion in science as an identity debt in the field, and learning science as a developmental experience that intertwines content learning with socio-affective abilities and identity. Then we defined key concepts as deliberative teaching, identity, and science identity. With those elements, we revised previous studies regarding science identity performed and narrated in schools.

Considering all that, we propose a problematization of developing science identity in female students at schools, considering three main issues.

1. Theoretical problem: the entanglement of academic learning, identity, and emotions in peer dialogue

Despite recognition of the centrality of the co-construction of knowledge and the diversity of voices in science peer learning, most pedagogical approaches, including deliberative teaching, possibly neglect the influence of power relationships between students in peer interactions. Authors tend to suppose that explicit group roles or rules are enough to balance the interplay of voices among peers, focusing on understanding the dynamics of disciplinary learning and the

argumentation processes that occur in these interactions (Barak & Lefstein, 2021; Segal et al., 2017). This has caused educational research, including socio-constructivist approaches, to privilege academic learning over the other aspects of peer relationships despite acknowledging the value of socio-affective elements, as well as students' voices and identities (e.g., Mercer, 2010).

This problem appears to be grounded in a degree of dualism that, despite being considered outdated by many, does not make it possible to understand how intellectual and socio-affective aspects become integrated into peer learning. In part, this may be due to the lack of epistemological–theoretical frameworks enabling us to understand how intellectual and socio-affective aspects influence and co-construct one another in peer interactions (Langer-Osuna, 2018). Although a number of methodological models can shed light on these factors, including linguistic ethnography (Rampton et al., 2004), the model of influence in peer interactions (Engle et al., 2014), and the proposal advanced by Perret-Clermont (2015), they do not fully develop a theory that articulates the content learning with epistemic, identity-related, and socio-affective dynamics involved in peer-group dialogue at school.

To understand how, through dialogue, students learn and experience their emotions, expectations, relationships, and status, while sharing their opinions, it is necessary to understand peer learning as a developmental experience interwoven with identity. Learning shapes what we are, what we feel, what we know, how we make sense of the world, and how we situate ourselves in it (Wenger, 1998). It is closely associated with the identities that we perform in our daily interactions and in the stories we tell ourselves about ourselves (Perret-Clermont, 2015; Varelas & Kane, 2012). Learning is more than a cognitive act; it shapes us, we feel it, and it hurts us when we are excluded, which is why it has consequences for our life choices (Zembylas, 2005). All of

this seems to make sense when discussing learning from a developmental approach. But how do all these aspects become integrated and interact with one another when we learn?

Therefore, it is necessary to integrate these multiple dimensions of peer learning to explicitly define a proposal that articulates content learning, identity, and emotions to understand peer-group dialogue, not just as an academic task but as a developmental process.

2. Pedagogical problem: design spaces of developmental peer dialogue for underserved students

The second problem is the possibility of designing pedagogical activities that can foster peer dialogue as a developmental process. This is especially relevant if we consider that Science for Citizenship is a recent addition to the Chilean curriculum. While the Chilean Society of Scientific Education acknowledges and values that Science for Citizenship is promoting peer interaction, dialogue, and argumentation about socio-scientific problems, it has also highlighted a significant weakness in this curricular innovation: the absence of pedagogical guidance for its implementation. This lack of guidance may lead to confusion and uncertainty within schools (Cofré et al., 2020).

If promoting dialogue implies a significant change in traditional practices, teachers may need support adapting to these new pedagogical relationships, especially if it is expected to foster a developmental perspective of peer learning grounded in identity and gender inclusion. Valentina Guzmán (2024) sustains that, integrating the different voices of the students in dialogic practices, teachers learn not just a new teaching method but a *speech genre*. She considers this implies a pedagogical challenge that requires carefully designed materials to scaffold teachers' learning of dialogic teaching.

Furthermore, from an intersectionality point of view, the problem of promoting female science identities is more complex in underserved schools, such as those in less advantaged socio-economic contexts, those that are racially segregated, and/or those with a higher percentage of students with special educational needs. Chilean schools are governed by standardization regimes with high consequences, and it is considered one of the most socio-economically segregated school systems, where a circle of low expectations, authoritative teaching styles, and low student results in working-class schools have been seen (Falabella, 2020). In these contexts, students are usually exposed to a curriculum that is irrelevant to them, reinforced by the idea of a deficit in their intellectual abilities; and the low academic results obtained in such conditions close the circle of low expectations (Sleeter, 2012). Dialogic pedagogies involving innovative curricular activities that demand peer dialogue, imagination, and co-construction can therefore be seen as beyond student capacities and the scope of schools.

It is important to consider the conditions needed to teach dialogic pedagogies in classrooms that serve students from socio-economically segregated backgrounds beyond these low-expectation circles. A recent study (Maia et al., 2023) showed that disadvantaged students benefit less from deliberative teaching, and deliberation abilities decreased in the students after a deliberative project. Some questions that arise from this study are: Is it possible to change these kinds of results if we sustain a vision of dialogue and deliberation as developmental activities, and beyond low-expectation circles? What are the pedagogical conditions to promote peer collaborative dialogues in science as developmental activities in underserved contexts? And what are the complexities and affordances of promoting dialogue-based group work in underserved classroom contexts?

3. Analytical problem: Studying peer dialogue and the development of in-practice and narrative female science identities from an intersectional and non-binary perspective

As we argued in the revision of studies section, research on the power dynamics among classmates that integrates learning, knowledge, and identity is emergent, especially in science at the high-school level. Nonetheless, case studies on science shed light on how identities are being constructed in school classrooms. This research seeks to contribute to that group of case studies, taking their contributions and illuminating aspects that those studies have not emphasized: analyzing the entanglement of in-practice and narrative identities from an intersectional and non-binary perspective. As we argued before, we see intersectionality and a non-binary way of understanding gender as relevant elements to reading and understanding the problem of the female identity debt in science. Varelas and her team (2024) revised how positioning theory has been explored and used in research about equity and social justice in science education over two decades (2000–21). They highlight the need to address intersectionality, understood as how power structures of race, gender, class, and others construct one another in different spaces where science is practiced and learn. On the other hand, previous research has alerted us to how the predominantly binary approach of studying gender in science education is hiding a spectrum of possibilities regarding how gender is acted and felt by students in science education (Darin, 2025).

Considering these three problems, the objectives and research questions that oriented this study are developed in the next section.

OBJECTIVES AND RESEARCH QUESTIONS

General objective

To understand the development of science identities in female high-school students during peer interactions in *Science for Citizenship group tasks*.

Specific objectives and research questions

1. *To describe the pedagogical situation within which peer interactions and group tasks take place*
 - What are the pedagogical conditions to promote peer collaborative dialogues in science as developmental activities?
 - What are the complexities and affordances of promoting dialogue-based group work in underserved classroom contexts?
2. *To relate female students' positionings in peer interactions to knowledge construction in the group task*
 - How and why does peer-group dialogue transform not just intellectual processes but also emotional and identity dynamics?
 - How do female students position themselves, and how are they positioned in peer-group tasks?
 - How are positionings in group tasks related to participation in knowledge construction?
3. *To characterize the development of the science identities narrated by female students throughout the pedagogical situation*
 - How do female students narrate themselves and associate their science identities with their present and future lives?

- How do female students experience the figured world of the science classroom, how do they feel it, and how does it connect with other relevant aspects of their lives?
- 4. *To associate the narrative and in-practice identities of female students from an intersectional gender perspective that considers the figured worlds mentioned by them*
- What is the relationship between the identities that female students narrate for themselves and those that spring from their positionings in dialogues among peers?
- How does the development of narrated and in-practice science identities intersect with female students' experiences of gender, social class, or race/ethnicity?

THESIS AND ACADEMIC PRODUCTION MODE

This thesis is developed through a compendium of three articles: one theoretical and two empirical case studies (see Table 2). The aim of each one is to tackle one of the three problems identified in a previous section, and is related to the specific objectives. The first article, *A holistic theorization of the developmental potential of peer dialogue: revisiting Vygotsky*, is a theoretical paper aimed at advancing an argument about how peer dialogue in classrooms can become developmental activities intertwining identity, knowledge construction, and emotions. It contributes to the theoretical problem stated before, supporting the study of science identity and knowledge construction as a holistic process during peer interactions. The article has been published in the *European Journal of Educational Psychology* and aims to theoretically respond to specific objectives 2 and 4:

- To relate female students' positionings in peer interactions to knowledge construction in the group task
- To associate the narrative and in-practice science identities of female students from an intersectional gender perspective that considers the figured worlds mentioned by them

The second and third articles are empirical case studies that emerged from the same educational experience, one with a focus on the pedagogical experience (broad case study) and the other on the micro-interactions and narratives of one group of students (core case study). The aim of “*We don’t come here to learn; we come to pass.*” *Promoting deliberative peer dialogue in an underserved and diverse science class*, which was submitted and accepted (with revisions) by the *Science Education Journal*, is to respond to the pedagogical problem. This empirical article analyses the broader pedagogical experience of promoting peer dialogue, responding to specific objective 1:

- To describe the pedagogical situation in which peer interactions and group tasks occur

Finally, the third article of the compendium is *Science Identities of Female Students During Peer Group Work: Intersectionality, Power, and Knowledge Construction in the Science Class*. This qualitative micro-ethnographic case study corresponds to the core case study, in which we analyze the interactions and dialogues of a group of students to follow the development of the science identity of a female student. The aim of this article is to respond to the analytical problem and to specific objectives 2, 3, and 4:

- To relate female students' positionings in peer interactions to knowledge construction in the group task
- To characterize the development of the science identities narrated by female students throughout the pedagogical situation
- To associate the narrative and positional identities of female students from an intersectional gender perspective that considers the figured worlds mentioned by them

Considering that objective 4 is the analytical association of objectives 2 and 3, it made sense to report all the objectives together in a single study. Also, with the support of paper 1, the project stated the need to study the phenomenon of knowledge construction in peer interactions and science identities as a holistic and entangled phenomenon.

The compendium also includes, as an annex (see annex 1), a chapter that analyzes the affordances and challenges of working with gender-dissident students in deliberative teaching (to be added to the final thesis). Specifically, the chapter will contribute to the Springer book series on Social Interaction in Learning and Development. The particularities of dissident students that we found at the school (and reported in paper 2) had an important impact on the thesis project. The

diversity of the student identities widened our conception of gender in a non-binary way, which enriched our conception of intersectionality and the analysis of peer interactions in paper 3.

Table 2: Key components of the thesis compendium

Article	Aim	Kind of inquiry	State
<i>A holistic theorization of the developmental potential of peer dialogue: revisiting Vygotsky</i>	To respond to the theoretical problem: advance a theoretical argument about how peer dialogue in classrooms can become developmental activities intertwining identity, knowledge construction, and emotions. Theoretically respond to specific objectives 2 and 4: 2. To relate female students' positionings in peer interactions to knowledge construction in the group task. 4. To associate the narrative and in-practice science identities of female students from an intersectional gender perspective that considers the figured worlds mentioned by them.	Theoretical paper	Published in <i>European Journal of Psychology of Education</i> (WOS/SCOPUS) https://doi.org/10.1007/s10212-023-00730-4
<i>“We don’t come here to learn; we come to pass.” Promoting deliberative peer dialogue in an underserved and diverse science class</i>	To respond to the pedagogical problem. It narrates the broader case study, responding to specific objective number 1: 1. To describe the pedagogical situation within which peer interactions and group tasks take place.	Qualitative case study with ethnographic elements	Accepted and in the second revision process: <i>Science Education</i> (WOS/SCOPUS)
<i>Science Identities of Female Students During Peer Group Work: Intersectionality, Power, and Knowledge Construction in the Science Class</i>	To respond to the analytical problem, it evidences the core case with a focal group and a focal female student, responding to specific objectives 2, 3, and 4: 2. To relate female students' positionings in peer interactions to knowledge construction in the group task.	Qualitative micro-ethnographic case study	Sent to <i>Cultural Studies of Science Education</i> (WOS/SCOPUS)

-
3. To characterize the development of the science identities narrated by female students throughout the pedagogical situation.
 4. To associate the narrative and positional identities of female students from an intersectional gender perspective that considers the figured worlds mentioned by them.
-

While each paper addresses different aspects of the development of female science identities through peer interactions, there may be some redundancy in certain areas, particularly in the introductions and theoretical backgrounds. This is expected, since they all belong to the same compendium and share a common theoretical and contextual framework. Also, as this report includes a theoretical and methodological framework that unifies the three studies, it is inevitable that parts of the articles will reiterate elements specified in this introduction to the compendium.

THE ANALYTICAL PROCEDURE OF THE THEORETICAL INQUIRY

The theoretical inquiry in the first article, *A holistic theorization of the developmental potential of peer dialogue: revisiting Vygotsky*, implied revising the seminal works of Lev Vygotsky, including:

- *Thinking and Speech* (1934)
- *Tool and Sign in the Development of the Child* (1930)
- *The Psychology of Art* (1925)
- *The Historical Meaning of the Crisis in Psychology: A Methodological Investigation* (1927)
- *On Psychological Systems* (1930)

- *The problem of the environment* (1935)

We critically analyzed these articles to understand the central role of language in the interplay between thinking, emotions, and identity development. Then we interpreted the findings in light of the present challenges of group-based dialogue in the classroom. We engaged with contemporary interpretations and critiques of Vygotsky's concepts, such as *inner speech* and *perezhivanie*, to address epistemological challenges and propose a developmental perspective on peer interactions. Our inquiry also synthesized insights from sociocultural and post-structuralist theories, highlighting the performative and transformative nature of language in shaping both individual and collective development. This approach aimed to clarify how and why peer-group learning, through language and inner speech, integrates academic learning, identity, and emotions. Finally, the inquiry highlighted the pedagogical implications of understanding peer dialogue as a developmental activity.

METHODOLOGY OF THE CASE STUDIES

The case studies are part of a main project, Fondecyt 1210264: *Deliberación y enseñanza de las Ciencias para la Ciudadanía* [Deliberation and Teaching of Sciences for Citizenship], whose principal investigator is Antonia Larrain Sutil (thesis adviser). The project evaluates the effect and understanding of the conditions of teaching climate change through deliberative argumentation for sustainable citizenship.

As described in the theoretical framework, deliberative teaching is a framework that promotes interactions within peer groups in order to discuss controversial problems, focusing on critical thinking, idea generation, and joint reasoning (see Larrain et al., 2021). The main project adopted a mixed design (quantitative and qualitative). It was conducted over a 4-year period (2021–25) and enrolled 10 teachers of Science for Citizenship.

The project included a professional development program for teachers to learn deliberative teaching focused on the climate change unit. Acknowledging that the context of the climate change unit has its own nuances, the aim of this study is to understand the development of science identities in the context of discussing socio-scientific problems in general, and their relationships with peer interactions.

Because the thesis research is part of the Fondecyt project, teachers received training and curricular materials to promote peer-group dialogue. However, this advantage may also be considered a limitation because the analysis is conducted within the context of this teaching framework, which is new and scarcely known by teachers not affiliated with the project. Yet, bearing in mind this limitation, it is also necessary to highlight that the Fondecyt project follows the curricular guidelines established by the Ministry of Education (MINEDUC) for the 11th and 12th grades, representing the goals of Chilean curricular policy for Science for Citizenship, as well as the recent international trends in science teaching mentioned in the introduction.

Design

We conducted a qualitative case study (comprising two sub-cases) with ethnographic and micro-ethnographic elements. Case studies are characterized by “an intensive, holistic description and analysis of a bounded phenomenon such as a program, an institution, a person, a process or a social unit” (Merriam, 1998, p. 13). Case studies should shed light on how actors construct their reality, requiring the multiple voices and multiple and contradictory views about what is happening in the classroom to be preserved (Stake, 1995).

Sharan Merriam (1998) asserts that this methodology is characterized by:

- *Focusing on the particular.* They are small-scale studies centered on a single problem.

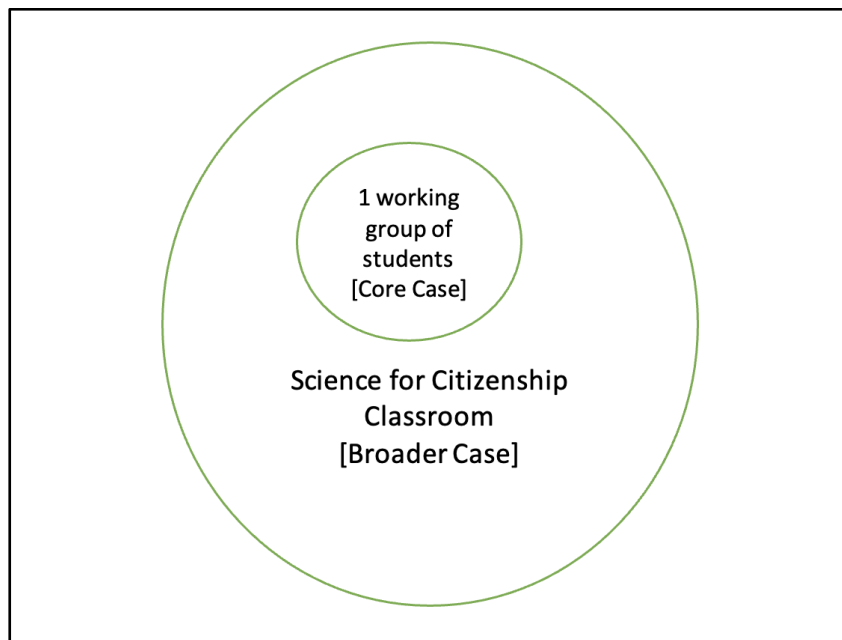
- *Being descriptive.* The final research product consists of dense descriptions of the phenomenon anchored in its context.
- *Being heuristic.* They illuminate our understanding of the phenomenon studied, and, in doing so, they make it possible to rethink it. They examine a specific situation but shed light on a general problem by illustrating the phenomenon's complexity.
- *Contextuality.* They are concrete and resonate with other experiences because their results are vivid and sensory rather than abstract. They are rooted in their context, which is the type of knowledge they offer, which sets them apart from propositional or abstract knowledge.

The case study method is well suited to the objectives presented for two main reasons. First, it is an especially suitable methodology when interested in the processes underlying a complex phenomenon rather than its results (Merriam, 1998). They privilege the context and discovery over confirmation (Merriam, 1998). Furthermore, case studies are characterized by comprehensive and contextual depth (Creswell, 2013). Second, qualitative case studies are guided by concepts, models, and theories that make it possible to illustrate, support, or challenge theoretical assumptions (Merriam, 1998). They seek to provide an in-depth understanding of the research problem, oriented by theory, to modify or refine these theoretical developments (Rohlfing, 2012). Thus, this study analyzes the identity development of female students, employing a specific theoretical framework to illustrate it, challenge its pertinence in context, and improve this theoretical approach.

According to the categorization proposed by Stake (1995), our case is an *instrumental case study*, because its purpose is to gain an understanding of the situation to be studied (a science class) but also to shed light on the phenomenon of the identity debt of female students in the context of

peer-group dialogue in the science classroom. Also, our case is an *embedded case study* (Budiyanto et al., 2019), characterized by presenting more than one sub-case or unit of analysis that focuses on different aspects of the same case. The boundaries of the two sub-cases can be illustrated as a circle with another circle inside: the core is the heart of the study, while the broader circle defines the limits of the case (Merriam, 1998). Therefore, in this study we delimit a *broader case study* that describes implementing deliberative teaching in the science class in general. On the other hand, we delimit a *core case study* to report the specific and in-depth experience of interaction of a focal group of classmates in the same science class. Figure 1 illustrates the limits and boundaries of this case study.

Figure 1: *Limits and boundaries of the case study*



The case study was approached with ethnographic and micro-ethnographic elements. The *broader case*, which comprised the study of the Science for Citizenship classroom, took elements of ethnography as participant observation, the analysis of dense descriptions, and the presentation of data in the form of narratives and chronicles (Geertz, 1992). The *core case* was approached with

a micro-ethnography of classroom discourse approach (Bloome, 2005), an interdisciplinary approach that analyzes multimodal conversations at important junctures and then builds an evidence-based narrative of the group interaction (Green et al., 2020).

Expected contribution of the case studies

The aim of the case studies is to shed light on how peer-group interactions, learning, and identity are interwoven to promote pedagogical group experiences that foster learning and inclusion of female students. Thus, we expect to enrich the work of teachers, contribute to a community of research, and inform public policies focused on science curricula.

Accordingly, we expect our case studies to contribute to the community of teachers and other educational practitioners. The literature has revealed that abstract principles alone cannot improve pedagogical practices and that teachers fail to transfer knowledge to their own contexts (Darling-Hammond & Oakes, 2021). The situated, richly contextualized, and narrativized knowledge of case studies may allow teachers to situate it and make sense of it within their own reality. This is likely to occur because cases are a valuable tool for linking abstract theoretical principles with concrete pedagogical practice (Shulman, 2002).

Thus, Stake (1995) asserts that the value of cases lies not in their generalization, since this is not their purpose, but in the dialogic nature of their results. This author considers that the contribution of the case is never limited to itself; rather, the process occurs actively on the reader's side, since they also reconstruct and interpret the case and try to make sense of it by bringing it closer to their own context (Yazan, 2015). This becomes easier by presenting contextualized theory, preserving the complexity of the factors embedded in the phenomenon by covering them in association with the situations where they emerge (Stake, 1995).

Just as we expect the cases to contribute to the communities of practice of teachers, we also expect them to contribute to a community of research. This study is presented within the context of other studies on identity, positioning, and learning, and the question emerges from a dialogue with other case studies. Thus, we intend to contribute to this repertoire of cases, establishing connections with them and distinguishing specific aspects.

Finally, case studies are frequently used in political science, sociology, and economics to provide feedback and enrich public policy analysis. Following Pal (2005), a case study could shed light on how curricular changes in Science for Citizenship are experienced in contexts where the policy is concretely implemented. This allows a view of its implementation that incorporates the complexities of the context where it is taking place. Likewise, a case study can illustrate the micro-practices and relationships among students that the policy promotes, making it possible to suggest improvements from a non-mechanistic perspective. Lastly, by focusing on complexity, a case study methodology can enable us to understand the influence of human factors on the implementation of curricular change. Although it would not be possible to generalize, we may learn from the social contexts targeted by the policy.

Positionality of the researcher

In qualitative methodology in general, and in case studies in particular, the researcher is the main instrument for producing and analyzing the data, which allows her to adapt to situations to maximize data production regarding the study objectives (Merriam, 1998). The researcher uses her strengths and limitations as a human being, her worldview, and her mistakes, as well as the chances she leverages and squanders. Reflectivity is one of the main rigor and control strategies in qualitative research. Consequently, an essential quality criterion (Berger, 2015) is understanding the association between a study and the researcher's characteristics and experiences. Specifically,

in a study that seeks to analyze positionings, power relations, and identity construction, it would be paradoxical to ignore the researcher's positionality, social identities, and worldview regarding research. For this reason, in the next paragraphs we present the positionality of the researcher:

I am not only a doctoral research student, but I also have multiple social identities that intersect: a cisgender woman, a mother of two, a partner of my husband, and part of a family of powerful women that I profoundly admire. Both of my grandmothers were strong women from disadvantaged contexts. From my mother's side, my grandmother came to Santiago with nothing to live in the poorest side of the city. But she believed in education, despite the fact that she hadn't had the opportunity to finish primary education, so she filled her house with books and encouraged their three daughters to be curious and to love reading. My mother died when I was a child, but her love for books and curiosity for the world instilled in me was a powerful inheritance. My other grandmother was a Mapuche woman who came to Santiago for better opportunities, and she managed to educate her two sons. With this family inheritance, I strongly believe in education as a powerful way of promoting social justice and a source of pleasure in human life. Still, I also think that it is urgent to improve the system so it does not have to take two generations of committed women—my grandmothers and my mother—to achieve that the female daughters finally arrive at university, as in my family case.

Positioning and identity theory makes sense to me because I—as a female human being, part Mapuche, former public-school student, later an elite university student, and South American researcher—have experienced situations where I have felt, in the educational spaces that I inhabit, that an argument does not necessarily prevail because it is original, well founded or logical, but mostly because a more privileged person advances it. This affinity with the theory allows me to understand, feel, and support it; however, given my position of power as a researcher, it can lead me to interpret what I expect to see.

Therefore, constant reflection and dialogue were present throughout the research process to promote rigor. A field notebook was used to record the researcher's main feelings, opinions, and analyses during data production. These records were revisited, re-read, and contrasted with the analyses to constantly reflect on the researcher's positioning. Likewise, the analyses conducted as part of this study were led in a constant dialogue with others. The thesis adviser and the committee encouraged me to permanently reflect on myself and the data produced in the study at each step of the doctoral project, especially Antonia Larrain (thesis adviser) and Maria Varelas (part of the thesis committee). Also, using accessible language, the observations of positioning dynamics and narratives were shared with the students and teacher who participated in the case study to reflect with them and clarify any doubts that emerged during the analysis.

Participants

The case study was conducted in a school selected for its socio-economic characteristics, diversity, and interest in participating. It is an urban, secular, and mixed establishment in which 66% of the students presented indicators of socio-economic or educational risks such as low attendance, performance, or dropout (JUNAEB, 2023). The school is subsidized; in other words, it is managed by private individuals with public funds. Following the classification of Carrasco et al. (2019), it corresponds to a center with an autonomous collaborator. These types of school are characterized by their difficulties accessing networks, professional skills, infrastructure, and financial capabilities. They are schools that, motivated by students' social or educational inclusion, founded a single establishment with low enrollment and reduced staff. However, the small number of students does not translate into a systematic improvement in teaching strategies. In these establishments, multiple roles and assigning positions to relatives are common.

Coinciding with the above, the school's educational project stood out for its emphasis on school coexistence, inclusion, respect for diversity, and promoting a social vision among students. The school is characterized by receiving students who are lagging behind in the school system or who have experienced harassment or discrimination. Roughly half of the enrollment are students in the National School Integration Program, who have special educational needs, mainly mild intellectual disabilities, ADHD (attention deficit hyperactivity disorder), and ASD (autism spectrum disorder). According to the national standardized test, SIMCE, the school has lower academic results than establishments in the same socio-economic group, and higher socio-emotional and coexistence indicators. In reading, 57% are in an insufficient range, and in mathematics 76.2% are in this range. The test shows no gender differences in performance. On the other hand, the school results are higher in academic self-esteem, motivation, and emotional climate than establishments in the same socio-economic group. Men showed a significantly greater difference in these socio-emotional outcomes (Agencia Nacional Educación, 2023).

In the school we worked with the 11th grade and the science teacher, Mariela,¹ a young professional who recently graduated in Natural Sciences at a public university in Chile. This was her first job. At the time of the study, she was the homeroom teacher of the fourth grade and taught Science, Chemistry, and Science for Citizenship at all levels of the school.

The 11th-grade homeroom teacher emailed passive informed consent to parents and guardians. The class consisted of 25 students, of whom 15 agreed and had parental consent to participate in the study. The average age of the 15 students was 16 years; 3 students defined themselves as cisgender women, 7 as cisgender men, and 5 as gender dissidents; 4 were non-binary students, and 1 was a trans man. On the other hand, one student was diagnosed with a mild

¹ All participants' names are pseudonyms.

intellectual disability, one with a psychiatric illness, two students with ASD, and two with ADHD, and two students presented significant behavioral and psychosocial problems, according to the school psychologist.

These 15 students were grouped into 3 peer groups of 5 members each, according to their own preferences. However, the records of group interactions were mainly from two of the groups. This is because one of the groups participated only in the first two deliberative guides; then, one of the students asked not to be recorded in the discussions. While the two groups remained relatively stable, there were some changes during the semester, mainly due to student absences during an influenza outbreak that affected the city during the study.

The group for the core case was selected following the maximum variation criteria (Flyvbjerg, 2006). This criterion for selecting case studies implies selecting the richest case that allows the deepest analysis. We selected a group because it was the group with the most cisgender female students and gender diversity (3 cis women, 1 trans man, and 1 agender student), and for its diversity of interest and achievement in the science subject.

Procedure and curricular activities

The project unfolded during the first semester of 2023 (March to July). At the beginning of the school year, the head of teachers (*jefe de UTP* in Chile) was invited to participate; he said the deliberative teaching project seemed to align with the school's educational project and their concerns about how to promote more student participation in class. The first meeting was held with him and Mariela to discuss the project and methodology more deeply. We sent the project materials and guides, and they enthusiastically agreed to participate. We told them the guides could be modified and adjusted to Mariela's lesson plan.

In the beginning, the project was formulated within a more traditional research scheme. The researcher came to observe the implementation of the guides and give feedback to the teacher after each class. Then, the researcher became a co-teacher and the teacher a co-researcher, and they implemented changes to the design of the deliberative guides together. All of these changes are explained more deeply as part of the case study results.

The curricular unit was organized around six guides (see annex 2), each organized around a problem to be discussed. Students were given scientific evidence for their discussions, and teachers were supported with back-up information and complementary resources. In addition to the group-work sessions, the science teacher held five classes during the semester to deepen aspects that she considered pertinent before the deliberative work. For example, in one of the sessions the teacher reinforced the content to learn how to read graphics; in another, she clarified basic ecology concepts.

Instruments and fieldwork

We visited the school 25 times. The following strategies were developed to produce the data:

-Video recordings of classes implementing deliberative lesson plans. We recorded 10 classes covering the 6 deliberative lesson plans of the curriculum, registering the group interactions of the groups and the all-class activities.

-Participant observations of classes (not videotaped). Class sessions that did not involve implementing deliberative lessons were registered in the field notebook and through voice notes. The researcher took notes of small conversations with the students and the teacher, including personal reflections, descriptions, and feelings that emerged before, during, and after classes.

-Lesson-planning meetings. The case study included five lesson-planning meetings, in which the researcher and teacher met to reflect on the implemented classes and prepare the

following activities. Meetings were registered in the field notebook and as voice notes by the researcher.

-Interviews. We interviewed the teacher and 7 students; 3 of them were part of the focal group of students. The interview strategies differed for the core group of students in the case study from those for students not in the focal group and the teacher. The teacher was interviewed twice at the beginning and end of the pedagogical experience. The four students who were not part of the focal group were individually interviewed once. The objective of those semi-structured interviews was to enrich the case narrative, and it did not follow a fixed script or question structure, instead employing a set of broad themes, axes, or questions woven into the flow of the conversation (Merriam, 1998). The idea was to respond to the interviewee's worldview, not to follow the interviewee's structure. We interviewed students who wanted to be interviewed in-depth (two of them were asked to give their testimony proactively), which could enrich the observation process in relation to the research question.

Three of the five students of the focal group agreed to be interviewed. We individually interviewed each of the three students on three occasions: before, during, and after the curricular activities. An interview guideline was constructed and presented to the thesis adviser and two professors, experts in the field, to collect feedback (see annex 3). The first interviews with the students were mediated by photo elicitation, a technique that complements interviews and includes a group of photos to stimulate conversation during the interview (Azzarito, 2023). In this case, students were asked to bring three photos of important objects or places to describe who they were. The objective was to connect with the students and evoke deeper meanings about the students' relevant social identities. The images were considered as evocators of narratives more than objects of analysis per se. After the analysis, we interviewed the students again to get feedback on the

interpretative process, clarify some doubts that emerged in the analysis, and close the research process with them.

-Ethnographic field notes. While the project was carried out, the researcher kept a field notebook where she took notes about the experience, dialogues, feelings, reflections, and doubts. Likewise, the researcher and thesis adviser recorded their conversations and reflections about the fieldwork in voice notes.

Analysis

Analysis of the thesis was segmented into two studies. The first study corresponded to the broader case study of the pedagogical experience (specific objective 1), and the second study corresponded to the core case study, the micro-analysis of the focal-group interactions (specific objectives 2, 3, and 4).

First case study: pedagogical experience (broader case study)

Objective: To describe the pedagogical situation within which peer interactions and group tasks occur

The study combined qualitative and some quantitative data with a qualitative ethnographic narrative as a main production strategy. In this context, quantitative data supported the qualitative view, respecting the ethnographic narrative as the center of interest.

Ethnographic narrative. Participant observations, class videos, voice notes, and interviews were transcribed. All material was read comprehensively and then coded using thematic analysis (Cohen et al., 2007) through inductive and deductive codes derived from the theoretical framework. Then, the codes were contrasted to create a chronicle-type text (Jha, 2018; Merriam, 1998) to give an account of the main milestones of each of the sessions (classes and planning sessions), including the different voices of students, the teacher, and the main researcher. This

included the description of teaching strategies and interactions, milestones, anecdotes, relevant quotes, and the researcher's personal feelings and reflections at the end of each session. This long chronicle, session by session, was then summarized to account for the main milestones. With this, the final narrative of the pedagogical experience was written.

Analysis of peer interactions of the three groups. We analyzed the video recordings of the three groups to describe how students participated in the deliberative experience. Videos of the group dialogues were transcribed, and all the material was read comprehensively. To codify the type of deliberative and non-deliberative dialogue, a guideline developed in previous research on Chilean students was used (Larrain et al., 2020). This analysis allows us to understand how students were talking about the problem: in a confrontational or non-deliberative way, or in a constructive and dialogical way, understanding that all conversations can have elements of both. The transcripts were coded with the guidelines independently by the main researcher and by an external investigator (linguistics graduate, cisgender man). The codes were contrasted in iterative meetings until a consensus was reached. This process added two new inductive codes: mirroring and interrupting an argument. Because each deliberative guide was a unit of reflection and design for the teacher and researcher, we quantified the codes per guide. Annex 4 presents the codes, their definitions, and examples with dialogues of the case groups.

Second case study: peer interactions on the focal group of peers (core case study)

Objectives

1. To relate female students' positionings in peer interactions to knowledge construction in the group task
2. To characterize the development of the science identities narrated by female students throughout the pedagogical situation

3. To associate the narrative and positional identities of female students from an intersectional gender perspective that considers the figured worlds mentioned by them

This case study is based on the interactions and narratives of a specific group of classmates, focusing on one female student. After observing the group and conducting the interviews, we selected one of the female students, Luna, to be the focal student of the case study, because she was the student who most expressed differences in her vision of science before and after the academic experience and whose pattern of participation varied the most during the group activities.

The interviews were transcribed and read thoroughly several times. Then, a thematic analysis (Cohen et al., 2009) was developed with inductive and deductive codes derived from the research question and theoretical framework. This first codification allowed us to capture the main themes and small stories present in the interviews. Then, we recursively interpreted the codified data by asking: How do students portray their group peers and themselves? How are these characters and figured worlds brought into the participants' stories when they talk about themselves and their groupmates? What are the interactions in these small stories, and how are the positionings? How is epistemic power distributed? What identities are brought by the students to describe themselves and others, and how do they intersect with social discourses such as gender, race, socio-economic status, and the canonical view of science?

The objective was to achieve dense descriptions of the science identities and other social identities portrayed in the interviews. Dense descriptions are an ethnographic tool of analysis that involves the researcher's interpretations in a comprehensive effort grounded in the data. Dense descriptions employ metaphors, keywords, or central moments to disentangle and describe how participants see, feel, and interpret the world (Geertz 1992).

To analyze the group interactions, we watched all the videos at least twice, transcribed them, and read all the group interactions thoroughly. We created notes to summarize each encounter, highlighting the richer group interactions and knowledge construction moments, considering our focal student. We then selected the richest three class discussions during the semester for deeper analysis. Then, we came back to the video recording of the three episodes selected to analyze the interactions moment by moment with the transcript and the video recording. We created a grid to register the transcript, with a column for each participant in the group discussion. In the columns, for each student, we registered the embodied ways they communicated and reacted during the verbal exchanges, such as rolling their eyes, smiling, or nodding. In another column, we tracked the development of ideas for the collective answer (what was said or referred to, and who was the author). To analyze the in-practice identities, we adapted our theoretical framework to the three levels of analysis of small stories' narrative analysis (Bamberg et al., 2008). Annex 5 shows the main codes and examples.

ETHICAL CONSIDERATIONS

We followed the ethical guidelines of the APA (American Psychological Association, 2017), which are based on the principles of beneficence and nonmaleficence, fidelity and responsibility,

integrity, justice, and respect for people's rights and dignity. Also, the Institutional Review Board of Universidad Alberto Hurtado approved the project and the ethical documents, acknowledging that the thesis research is part of a broader Fondecyt project of the university headed by Antonia Larrain (see annexes 6 and 7).

We presented the characteristics of the project to all of the participants and asked for their informed consent. We gave a letter to the school principal to convey the information necessary for him to decide whether to authorize his school's participation in the study. Then, we handed another letter of informed consent to the Science for Citizenship teacher detailing the study's purpose, objectives, procedures, benefits, and the voluntary nature of the whole process. Once the teacher agreed to participate, we submitted an informed consent to the parents of the 11th-grade science class. We also went to the class before the beginning of the project and explained the research process to the students, answered questions, and handed them the informed assent.

Regardless of ethical codes and consent letters, the onus of carrying out a study ethically is always on the researcher, who must apply principles and criteria in the concrete situations of the research process (Merriam, 1998). To enter the figured world of the science classroom and access part of the identities that the students will narrate is to be invited into the private spaces of subjects (Stake, 1994). In fact, the students' narratives are detailed descriptions of important parts of their lives, their ways of seeing the world, and themselves. Even though the names of the students and the school were anonymized, this anonymity, because of the descriptive nature of case studies, is incomplete: third parties, especially within the school community, may deduce who took part in the study (Simons, 1989).

For that reason, the interviews and observations were conducted according to the principle of confidentiality, and the report was constructed with the aim of resonating with the judgments

and opinions of the students involved (Simons, 1989). The principle of confidentiality is reflected, for example, in paper 3, in which we anonymized the registers of the students talking about the characteristics of their friends, even taking off the pseudonyms to protect their friendship. Also, to resonate with the judgments and opinions of the students, the final interview session with the participants was key since they had the opportunity to have a degree of voice, giving feedback and consent to the analysis and content to be published.

1. Article: **A Holistic Theorization of The Developmental Potential of Peer Dialogue:
Revisiting Vygotsky.**

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A Holistic Theorization Of The Developmental Potential Of Peer Dialogue: Revisiting Vygotsky

Abstract

Students face a complex, globalized, digitalized and polarized world, with world-wide challenges such as the pandemic, climate change and political conflict. In this context, the younger generations face the challenge of developing complex, yet articulated, identities to collectively imagine possible futures in an uncertain and fragmented world. Schools can address part of this challenge by promoting peer dialogue in classrooms, but only if we understand it as developmental experiences in which thinking and academic learning are intertwined with emotion and the development of identities. Research in the field has advanced the academic, personal and socio-emotional outcomes of peer interactions. However, these lines have unfolded practically in parallel, partly because of the lack of a theoretical argument about how peer dialogue fosters these developmental processes in the same stream of life. This article argues the need for a holistic theoretical perspective about classroom peer dialogue, and it proposes, based on the work of Vygotsky and contemporary scholars, that language, especially inner speech, is key to understanding its developmental potential. The diverse use of language among peers forms and performs – through other-directed and self-directed speech – not only new ways of thinking but also – and with complex interconnections – new ways of feeling and becoming bodies, and relating to themselves, that have historical and cultural roots but singular outcomes for each individual.

Keywords: holistic theoretical perspective; peer interactions; peer dialogue; sociocultural theory; identity; emotions

Introduction

Children and adolescents live in an increasingly challenging world. They face an ever-more diversified, fragmented and complex social and cultural knowledge; and they experience an often-threatening social environment that is technologically mediated, which demands constant positioning and exposure. At the same time, they need to develop their sense of self and integrity, articulating their beliefs and knowledge with body, affective and sexual positioning, projecting themselves into an adulthood that is tensioned by the worldwide crisis of environmental, political and economic sustainability. The challenge, in part, is to develop complex, yet articulated, identities (Graham, 2018) for living in a complex world. *What kind of pedagogical experiences can schools offer to support their development in such a complex context?* The authoritative and unilateral transmission of information from teachers to students seems a limited option for such a challenge. Promoting classroom peer interactions as a crucial articulating experience – where students relate to one another, negotiate and elaborate knowledge, try to solve conflict and manage their, sometimes intense, emotions while building their identity – seems to be a necessary educational goal (Larrain et al., 2021; Perret-Clermont, 2011; Tartas, Baucal et al., 2010).

In recent decades, interest has grown in promoting and studying peer interaction in the classroom as a socio-educational space that offers opportunities for a holistic way of learning (Alexander, 2019; Maine & Vrikki, 2021). However, this interest is not new. Piaget (1935) positioned peer interactions as a privileged medium of knowledge construction, and since then a variety of educational and psychological research has focused on its benefits. There is cumulative and conclusive empirical evidence showing the effect of peer dialogue on academic learning and thinking abilities (e.g. Howe et al., 2019; Larrain et al., 2019; Mercer et al., 2019; van der Veen

& van Oers, 2017). There is also more recent evidence focused on the emotional, subjective and cultural aspects of peer dialogue (Langer-Osuna, 2011; Sedova & Navratilova, 2020; Segal & Lefstein, 2016).

One problem is that these research approaches have advanced practically in parallel, and little is known about how peer interactions can, at the same time, promote school learning, strong and healthy social relations and diverse identities that enable the imagination of a future. In part, this difficulty could lie in the fact that Western culture, at least since the Enlightenment, has conceived of cognitive learning, emotions and the environment as separate dimensions of human experience (Linell, 2009). Also, it may be related to the epistemological practice of fragmenting scientific knowledge that has predominated in psychology in the last century (see Valsiner, 2006). However, Vygotsky, at the beginning of the twentieth century, argued against psychological knowledge fragmentation. The author highlighted the dualism present in different schools of psychology, which does not account for the multidimensional aspects of human experience (Vygotsky, 1927).

We argue that – in order to overcome this fragmentation and study classroom peer interaction while acknowledging its multidimensional potential– we need a holistic theoretical perspective. Such a perspective should account for the generative power of peer dialogue and, at the same time, its role in knowledge construction and personal development. We believe that Vygotsky's sociocultural theory could offer helpful insights, even though it was written almost 100 years ago in a singular geopolitical and historical context. This may not be read as a novelty, given that sociocultural studies of peer interactions have drawn heavily on Vygotsky's ideas. However, we argue that his theory of personal and emotional development has been overlooked by some of this literature (Rampton et al., 2004; Zembylas, 2005). Moreover, contemporary

theorizations that include the multidimensional experience as *perizivanie* (Fleer et al., 2017; Roth & Jornet, 2014), or *cultural learning* (Tomasello, 2016), have somehow disregarded the role of language in Vygotsky's works, which is – from our reading – pivotal to understanding learning as a holistic experience.

Considering the above, this article aims to advance a holistic theoretical perspective on classroom peer interactions inspired by Vygotsky's theory. To achieve that, first, a definition of peer interactions is proposed in order to offer a panoramic view of the main lines of research, which reveal a lack of integration of the different aspects of peer interactions. Then, current theoretical frameworks will be offered to propose a conceptual base and outline the challenges that remain when it comes to understanding holistic learning and development through peer interactions. The third part of the article delves into Vygotsky's key passages, which we believe it is important to advance in a holistic theory. Then, we propose a reading of the elements revisited to advance the challenges inherent in a holistic theory of peer interactions.

Research on peer interactions in classroom settings

Although there are different approaches to what is understood by classroom peer interactions, there is a consensus that they involve discursively performed interactions (Littleton & Howe, 2010). The type of dialogue that has been the focus of attention is one in which students discuss opposing points of view and work through the differences critically and constructively. Thus, language appears as a tool for collective creative thinking, based on the possibility that speakers interpret one another's world in different ways (Mercer, 2013). This type of dialogue has been called different things, including *exploratory talk* (Mercer & Wegerif, 1998), *accountable talk* (Michaels, 2008) and *productive talk* (van der Veen et al., 2017), each with their own emphases, while maintaining the core principles.

Studies have shown that peer dialogue in the classroom has a clear and consistent effect on school learning (Howe, 2009; Howe & Zachariou, 2019). Quasi-experimental and correlational studies show that dialogue promotes learning in different areas and ages (Kuhn & Udell, 2003; Larrain et al., 2021; Mercer et al., 2019; van der Veen et al., 2017). Although there are various theoretical approaches, most studies in this line recognize their sociocultural inspiration (Mercer & Howe, 2012).

Despite integrating aspects of sociocultural theory, another group of studies based on the Piagetian model agree about the benefits of dialogue for school learning (Tenenbaum et al., 2020). Within these, the benefits of socio-cognitive conflict are highlighted – that is, of students working collaboratively with peers who initially differ in their knowledge or approaches to the subject (Perret-Clermont, 2020). From this perspective, the existence of egalitarian and collaborative relationships is relevant, since students have the opportunity to express their ideas to their classmates (Fawcett & Garton, 2005).

Likewise, another line of research has emphasized that, although peer interactions involve processing curricular issues, especially when students discuss things, they also involve social and psychosocial processes of identity construction and asymmetries of power, status, authority and friendship (Segal & Lefstein, 2016; Tartas et al., 2010; Varelas, 2012).

Moreover, qualitative studies have revealed the strong relationship between peer dialogue for learning and power unfolding. Thus, for example, case studies have emphasized that students who speak less in class feel threatened by the emphasis on cognitive challenge, participation and the prominent voices of higher-status students, which highlights their perception of themselves as low-ability students (Snell & Lefstein, 2018). These students usually describe their experiences as being located in the background of the gaze of others, with a lower sense of agency in relation to

the protagonists of the dialogue: the ones who tell their experiences of interaction motivated by the desire to learn (Clarke et al., 2016).

Other studies, based on the positioning theories of Davis and Harré (1990), and on the identity construction of Holland (1998), have shown that sociocultural constructions around gender and ethnicity have a profound impact on how exchanges between peers are generated in group tasks (see Kayi-Aydar & Miller, 2018). These studies show, for example, that the leadership and participation attempts of students of non-dominant genders and ethnicities are positioned as inappropriate by their peers, which impacts the identities and academic commitment of these students (Calabrese Barton et al., 2013; Langer-Osuna, 2011).

This group of research is showing an undesired effect of peer interactions in classrooms, namely, that they could favour culturally dominant identities (Barak & Lefstein, 2021). This is interesting because, in classroom practice and research, a certain horizontality in peer dialogue has generally been assumed. Authors often assume that explicit group roles or rules are sufficient to balance the interplay of voices among peers, focusing on understanding the dynamics of disciplinary learning and the argumentation processes that occur in these interactions (Barak & Lefstein, 2021). However, this might not be the case, and although peer dialogue would be excellent for promoting academic learning, it might be less suited to promoting diversity and horizontality, favouring certain identities over others (Segal et al., 2017).

Engle and Langer Osuna (2014) have shown that when students work in small peer groups without an adult mediating their conversation, disagreements are likely to be solved mainly through micro-power social relationships in the classroom. To understand how students construct learning together, these authors consider the influence of each utterance in the context of how students are positioned in classroom discussions. Influence is understood to be interactional and

negotiated through discussions among peers within the framework of local cultural norms. Langer-Osuna (2018) employs this model to examine mathematical discussions, highlighting that complex power mechanisms mediate peer interactions and are interrelated with commitment and mathematical identity. Thus, through the analysis of group interactions among peers in concrete class discussions, the author reveals how students' social identities intersect with social and academic status, resulting in interaction patterns where students with non-dominant genders, races or social classes experience difficulties influencing discussions and struggle to position themselves as intellectual authorities (Esmonde & Langer-Osuna, 2013). She concludes that discursive exchanges that lie within the assigned task, as well as those that fall outside the topic, are used by students to access and gain status in group conversations (Langer-Osuna, 2018).

That group of research highlights other aspects of peer interactions that have not been the focus of more traditional sociocultural research in the topic, unveiling power relationships, emotional aspects and identity development during peer educational encounters. However, the question remains: *How and why does peer interpersonal dialogue transform not only intellectual processes but also emotional and identity dynamics beyond the interactive here-and-now space? And how does peer dialogue foster developmental processes that endure over time?* We believe it is necessary to reframe the scope of peer interaction as a holistic experience that intertwines learning, emotions, power and identity.

Peer dialogue and personal development: a theoretical challenge

Anne-Nelly Perret Clermont (2019, 2011) has shed light on the issue, arguing that students are more than just *pure minds*. Students are subjects with more than just cognitive needs: they are in search of their identity; with diverse interests; looking for a social position and security; and trying to manage their emotions; that is, they have multiple objectives:

We have observed that when children argue they deploy important efforts in different directions, e.g., deciphering the goals of the adult and of the children who are partners; asserting oneself; finding one's way at the intersection of different worlds of meanings; exploring these worlds; securing one's voice or at least the acceptance by others of one's own contribution; interpreting the co-conversers' statements; or even escaping the task set by the adult by finding alternatives! (Perret-Clermont et al., 2019, p. 15)

However, the question is this: *Do we have a theoretical background that allows us to take an empirical, holistic or a field perspective* (Marková, 2003) *on the matter*? The available theorizations are somewhat dispersed. On the one hand, there are general sociocultural accounts, such as Zittoun and Perret-Clermont, (2009), who argue that learning is a process of development that includes change and transition, which are emotional, cognitive, imaginative, embodied, interpersonal and interactional, and which, intertwined, allow individuals to co-weave transitional gaps and project themselves into the future. Learning is conceived as a process of change that leads a person to further possibilities of future transitions and which is crucially related to the integrity of a person. This implies that the opposite, when transition and learning are blocked, could be perceived as threatening to one's integrity, to the sense of who a person is or where they belong. However, the specificity of peer dialogue, and the unique role played by language in the development of complex identity and its materiality, is not fully elaborated.

On the other hand, performative notions of identity have been used to understand peer interaction, conceiving of it as dynamic rather than stable; as interactional instead of individual; and anchored in the spaces and contexts that we inhabit and feel with others. Identity is conceived of as performed through language and the positions adopted in discourse (Baxter, 2016; Davies & Harré, 1990). Moreover, post-structuralist theories of identity consider identities developing in

relation to emotions, intellectual learning and the body as a whole, alerting us to the excessive focus on cognitive experience in learning (Zembylas, 2005).

What is missing, from our perspective, is a more concrete and specific theory about why and how peer dialogue promotes knowledge construction and personal development as an intertwined process that is not only context-dependent and interactionally bounded at a specific time point but also a process with lasting consequences that unfold through the life course. In that sense, following Holland's framework (1998), we believe that the performative experience of peer interactions is complemented by narrative interpretations that *figure our world*, including positional hierarchies that act as interpretative frameworks and which mediate broader social structures of power and privilege. In these figured worlds, students tell themselves stories about themselves and others, giving continuity and coherence to their performed identities in peer interactions and in other worlds of life. But how do students tell these stories? Here, we agree with Zittoun and Perret-Clermont (2009) about the relevance of accounting for interiority as one of the dimensions of human development when learning in social interactions has been disregarded by social and culturalist approaches.

Moreover, why is language at the heart of the developmental potential of peer interaction? How is language for learning potentially beneficial (or detrimental) for identity and personal development? The fact that the different lines of research outlined above have been advanced with little synergy has prevented researchers from answering these questions, which are nevertheless tough, given the predominant epistemological fragmentation that has tended to organize psychological research (Valsiner, 2006).

For this reason, we insist upon revisiting Vygotsky's theory, highlighting his sociocultural theory of development about how language articulates intellectual and emotional processes of self-

becoming. By doing so, we expect to bring the attention of researchers in the field to some of the key passages that have been overlooked, which could be insightful. Even though Vygotsky did not directly address the problem of peer interactions as a holistic experience, by revisiting part of his work we expect to offer a reading that allows us to advance in that direction in light of the challenges that students face in today's world.

Vygotsky's holistic approach to consciousness: the role of language

A still valid and difficult epistemological challenge to psychology, which should be a starting point for raising a holistic perspective, is to account for the articulation of what has been conceived of as mind, body and culture. For Western culture, being strongly influenced by Cartesian thought, it has become natural to think of mind, body and culture as separate entities (Ryle, 2005).

Some of Vygotsky's ideas on this can be found in *Thinking and Speech* (1934), in which he posits the primary role of verbal thinking in making the leap from the biological to the sociocultural, which makes the mental possible. In Chapter 4, Vygotsky talks about the intellectual growth of the child:

A basic and indisputable, and decisive, fact emerges here: thinking depends on speech, on the *means of thinking* and on the child's socio-cultural experience. (...) the development of the child's thinking depends on their mastery of the social means of thinking, that is, on their mastery of speech. (pp. 120)

Vygotsky points to the fact that a child's verbal thinking development is not a matter of natural science but a matter of social history. A child's thinking is transformed by social thinking that has been formed and performed through language, generation after generation, according to specific social and historical needs. Therefore, when children start to talk, they become immersed in a socio-historical and cultural world where language has not only been collectively and intergenerationally invented but has also become a material way of saving and enacting social

experiences, which, in turn, mediate individual experiences of becoming. Through language, the given individual psyche becomes not only socialized but, more importantly, historical – that is, open to historical and sociocultural genesis and transformation. The implication of this is serious: the biological is not replaced or dismissed but now open to cultural transformation.

Moreover, language is understood not as a propositional system with representational powers but – following W. Von Humboldt (1999) – as performed worldviews; as an activity – a *doing* or living materiality through which the social past and collective experience, in both its affective and intellectual dimensions, participates in and organizes individual development (Bertau, 2011). This way of understanding language is radically different from the Western cognitive tradition influenced by the atomistic theory of John Locke (Billig, 2008), in which a language is understood as a means of communication that mediates the internal (cognitive minds) and external world through representations (Linell, 2009).

Human consciousness, then, acquires – through language – a historical nature. As a system of psychological functions, as soon as children participate actively in verbal thinking (around 2 years old), consciousness starts to unfold through language. Language affordance relies particularly on its functional diversity (Humboldt, 1999): the diverse ways of using signs, and the diverse language forms, perform different worldviews or perspectives. In Vygotsky's terms, the different functional uses of the signs involve diverse ways of generalizing experience that are socially shared but, at the same time, singularly re-enacted and transformed. Language is productive, not as an abstract structure but as a diverse group of life forms performed in action. Therefore, it is not only intellectual functions that are transformed but also the unitary experience of thinking and feeling with words in social activities (Vygotsky, 1925). Language forms involve

not just intellectual generalizations but also generalized ways of feeling and responding (Larrain & Haye, 2014) and transforming our own bodies (Larrain & Haye, 2020).

Recently, there have been attempts to shed light on this aspect of Vygotsky's theory through elaboration of the concept of *perezhivanie*, understood as subjectively lived experienced. Although this is not a concept that is fully developed in Vygotsky's work, authors have argued that *perezhivanie* addresses the fact that human experience is not reducible to mental states or different dimensions considered as factors standing in a certain hierarchy (Roth & Jornet, 2014). It is referred to as the prism that refracts the multiple dimensions of human life, in the indivisible unit of personal and situational characteristics (Vygotsky, 1935). "*Perezhivanie* refers to the ongoing transaction of that activity, the interplay between practical, intellectual, affective and situational aspects, that affects the individuals involved" (Mok, 2017, p. 24).

The important message that we believe has often been overlooked in contemporaneous readings of Vygotsky – including interpretations of *perezhivanie* – is language. And we hypothesize that one of the reasons for this is that language sounds too cognitive to have such an important role in Vygotsky's theory. However, it is likely that contemporaneous readers are taking the predominant cognitivist view of language, instead of a performative one, when reading Vygotsky. And here we must insist: language is a key piece of Vygotsky's theory of development, not because it is a cognitive or representational tool but because it is the material form that performs historical worldviews or social ways of generalizing and apprehending experience that, when enacted, organize individual experience and becoming. From our reading, language is important because it is an ongoing collective, creative and generative activity (Bertau, 2011), unfolding through material forms, which includes verbal communication but is not reduced to the verbal; which involves intellectual activity but is not reduced to the intellect; which unfolds

through intelligent practical experience but is not reduced to isolated adaptative acts; and which enacts embodied affective ways of responding but is not reduced to instinctive ones.

Therefore, we find in Vygotsky a monadic view of human development, coherent with his readings of Spinoza, where language plays a central role, but for different reasons to those typically given in cognitivist accounts of cognition. Vygotsky argues that consciousness is neither stable nor developed once and for all; rather, it undergoes important transformations. These transformations occur not because new functions appear but because the relationships between the functions change based on the changing social demands and concomitant forms of language activities in which people participate (Vygotsky, 1930). In the following, we shed light on two main transformations highlighted by Vygotsky: childhood and adolescence. Acknowledging some of the challenges and transitions associated with these two moments in human life will allow us to look into the particularities of the peer interactions at these two important times in Western school life.

Thinking, emotion and language in childhood

There has been much discussion about the origin and history of the text *Tool and sign in the development of the child* (see Kellogg & Yasnitsky, 2011). However, we will discuss some of its main ideas because, although they are clearly recognizable in *Thinking and Speech*, they emphasize aspects that are later overlooked and which are important for the discussion of this paper.

While in *Thinking and Speech* Vygotsky (1934) argues for a phylogenetic different and ontogenetic, initially independent, developmental line of thinking and speech, in *Tool and sign in the development of the child* (Vygotsky & Luria, 1930) he argues for an independent

developmental line between language and practical activity. This is not completely different considering that in the former text non-verbal thinking is conceived of as a practical *proto* mediated problem-solving-oriented activity. The interesting thing that emerges in the latter text is the role of emotions: as initially, language and practical activity function independently of each other, the child tries to solve problems perceptually and emotionally but without planning and control.

When children start to actively participate in social language and then begin to use egocentric language, that is, as they articulate out loud the problem they are trying to solve, the gain is twofold. They gain in planning and in the subsequent transformation of emotions, which are no longer organized around discharged ways of dealing with the issue at hand but rather generalized social ones: “With the help of speech, the child's behaviour is raised to a higher level and acquires a relative freedom from the immediate attracting situation, and impulsive attempts are transformed into planned, organized behaviour” (Vygotsky & Luria, 1930, p.16). For the child, talking about what they are doing when faced with a task is “a single, complex mental function directed toward solving the problem” (Vygotsky & Luria, 1930 p.15), which implies the articulation of activity, language, thinking and emotion in the resolution of the problem.

At first, emotions are conceived by the child as physical and motor discharges; however, with the mediation of language, they can be perceived and mediated to solve the problem, for example, as containment against impulsiveness or as motivation to persist. Language development also integrates planning, which would not be possible without this emotional correlate. All of this is within a relational framework with another person, who gives external support or scaffolding to the child, including the words needed to be able to mediate the problem. The child subsequently uses their egocentric language to guide them towards resolution. Being overwhelmed, the child learns to ask someone else for help until they acquire the ability to solve the problem themselves.

This action is carried out through their first external, or other-directed, and then *internal*,² or self-directed, speech, which reorganizes the interpersonal relationship of help in a personal realm and thus manages to coordinate the aspects of planning and emotion necessary to resolve problems (Vygotsky & Luria, 1930).

Through these forms of self-directed speech, which Vygotsky identified as inner speech in Chapters 6 and 7 of *Thinking and Speech (1934)*, children are able to plan, use motivation and postpone their impulsiveness to reach a solution. However, they also transform their subjective experience of practical life: children become subjects and objects of themselves, which implies a new and complex psychological structure, including the relation with one's self, which is the building block of personal and identity development. By doing so, and being able to take a perspective towards their own emotional states, children are able to transform their own body through language.

This does not happen in a linear way; nor is it acquired in a sudden moment. It is a gradual process, in which resorting to the help of another becomes a central and necessary part of the child learning to plan the activities that they cannot do themselves. Through this process children learn to generalize using the words of others, starting from concrete perceptually driven concepts to more verbally driven ones (Larrain, 2017).

Consequently, personal and social history are closely linked: the way one person learns to solve practical problems is mediated by the way others in the past, and as a product of historical and cultural development, have addressed those kinds of problem. In other words, the way that children articulate thinking, emotions and language in practical activity to solve problems,

² According to Yasnitsky (2018), it was Roza Levina, a graduate student in Vygotsky's and Luria's laboratory at the time, who made the crucial observations about the development of what was later conceived of as inner speech.

including the problem of one's own sense of self, progressively resonates with and responds to the cultural ways of doing so that are available through participation in social language.

The development of identity in adolescence: scientific concepts and reflection

However, based on Vygotsky's theory, it is not until adolescence that self-awareness undergoes a radical transformation. The transformation that is generated is called reflective self-awareness and is achieved with the formation of what he called *scientific* concepts in some of his work, differentiating them from the concepts that children *spontaneously* elaborate in their relationships with others. *Scientific concepts*, or the possibility of thinking through an interrelated system of meanings, are developed as a consequence of the functional use of signs that are typical of instruction (Vygotsky, 1934). It is not a passive maturational process; rather, it is socioculturally triggered:

The tasks that are posed for the maturing adolescent by the social environment – tasks that are associated with their entry into the cultural, professional, and social life of the adult world – are an essential functional factor in the formation of concepts (Vygotsky, 1934, p. 132).

Instruction provides the basis for conceptual development, not insofar as it provides specific information but rather by enabling – through social participation in these ways of thinking – the ability to reflect on one's own thinking (Miller, 2014). This is achieved by thinking in terms of relationships: “To think in concepts means to possess a certain ready-made system, a certain form of thinking which in no way predetermines the further content at which we arrive” (Vygotsky, 1930, p.101).

In adolescence, with the emergence of scientific concepts, the global psychological system is reorganized, leading to reflective self-awareness (Vygotsky, 1930). A new relationship between basic functions (memory, perception, motor control), mediated by thinking and language, is enabled, fostering the development of a new sense of self or self-relation that is characterized by

the ability to take a perspective regarding our own psychological positioning and by the formation of a personal way to articulate experience, or what Vygotsky conceives of as *personality*:

A concept is a system of judgments which involves a relation to the entire, broader system. Adolescence is the age when both the world view and personality take shape, when self-consciousness and coherent notions of the world develop. Thinking in concepts is at its basis (Vygotsky, 1934, p. 101).

This reflective capacity also includes feelings. Emotions are conceptualized and related to cultural and historical conceptions of them in the reflective process. The bodily anchored emotions are transformed by cultural systems of thought (Vygotsky, 1930). This does not mean that emotions are rationalized but rather that emotional life and ways of feeling adopt new cultural and historic forms of affective experience. This type of emotions was labelled *complex emotions*, enabling the development of personality (which resonates with what we also refer to as *identity*), since “human emotions get connected with general sets, both in what regards the individual's self-consciousness and in what regards his knowledge of reality” (Vygotsky, 1930, p.103). The author exemplifies this using the situation of when someone tries to scold a young child by telling them that a specific behaviour does not belong to *decent* people. This is very difficult, since their emotionality is not yet associated with these social categories.

However, this interrelation can only be understood by shedding light on the role of language. Language is not only a social and historical asset but a personal one: through the interplay between other-directed and self-directed language (or inner speech), the cultural, social and historical ways of thinking and being bodily affected organize – in a new singular way for each individual – the personal, intellectual and affective dispositions. Individuation processes, including personality or identity, are language-based and relational: they are founded on a socio-historical basis and,

therefore, ideological, but at the same time they become part of a language-based reflexive system, which allows its own construction in interrelationships with others.

Therefore, for Vygotsky, the real difference, which allows us to have what we call identity, is not the biological or the character but the singular web of connections that we establish rooted in our socio-historical contexts: “The social and social class type of the person are formed from the systems that are brought into the person from the outside. They are systems of social relationships between people” (Vygotsky, 1930, p. 133). At the social and psychological level, the social relationships in which a subject develops are *internalized*; that is, they are used for self-purposes, as a singular individual way to relate to others and oneself. As these relationships have their origin in sociocultural life, they are also affected by ideology. Therefore, individual consciousness arises in a cultural framework and as a singular system of ways of feeling and thinking that is not neutral, which involves hierarchies and power relations.

A Vygotskian-inspired holistic theory of the generative nature of peer dialogue

From this reading of Vygotsky, one can conceive of peer dialogue as a process of becoming, as Perret-Clermont (2011) pointed out. However, this developmental potential is not only enabled by the opportunity to interact with others; rather, we argue, based on the reading of Vygotsky, it is driven by the opportunity to participate in purposeful, diverse ways of using language. Through these ways, students participate in authentic co-formative activities that transform the interrelation between psychological processes, pushing them forwards. This does not mean that the direction of this movement is always felt as good. When solving disciplinary problems in groups, for instance, students put their thinking into motion guided by specific forms of conversation that become inner matter for thinking formation. Through these conversations, they not only explore the culturally

available web of knowledge but also enact and rehearse different ideological assumptions, which are implicit or explicitly contested and responded to, with the consequent identity shifts (Varelas et al., 2012). This has not only interpersonal here-and-now consequences but also long-lasting individuation consequences that are not completely grasped by the idea of positioning and co-positioning (Davies & Harré, 1990). By participating in diverse and co-constructed purposeful ways of using language they also gain language forms to relate to themselves (and to others) and are asked to respond to the perspectives enacted through these forms in a private, often delayed, plane. This pushes identity and personality formation forwards, putting in motion an intertwined movement of thinking, feeling and being that is then interactively enacted, making these concrete dialogues eventually so determinant for future self-construction.

Students do not enter classroom conversation in a vacuum: the field of knowledge in peer classroom discussions is not completely shared and explicit but has to be imaginatively reconstructed (Larrain, 2017), being partially accessed from each student's *figured world* (Holland et al., 1998) and different normative references (Perret-Clermont, 2011). After the discussion presented in this paper, we would also argue that these *figured worlds* do not act as horizons or backgrounds of understanding (Bakhtin, 1981); they also unfold through students' own inner languages, perspectives and forms of self-relation and self-valuation. *Figured worlds* brought to the conversation are not only cultural imaginaries but also the complex personal (ideological, axiological, logical, affective, among others) synthesis of them. Therefore, peer dialogue involves an opaque process that, through its infinite combinations, has singular individual formations. Participation in dialogue is responded to by others and one's self through other, self-directed, languages, not only in the here and now but for years afterwards. These responses, in turn, are felt, having emotional, personal and intellectual formative effects.

In order to accomplish this, not only do children need to work together in adequately challenging situations, but they also need to learn to talk and listen to one another, to fail together and be open to different approaches, even ones that were not expected for the task. Because in this process students are not only exchanging instructions or ideas, they are practising the use of language as a sociocultural tool, practising how to distance themselves from the immediate reality and to handle their feelings and actions through words. As students face the challenge of using language with one another to solve academic problems, they progressively enter the sociocultural world, handling their impulsive emotions with words used by others (their partners and all the others in cultural life), gradually acquiring historicity, the possibility to behold complex emotions such as injustice, empathy and shame. And in this process students become subjects of themselves. If we consider language as a sociocultural tool in use, and not a representation of an *outside* world, language holds the sociocultural construction of a semiotic world, which implies not only ways of thinking but also ways of affecting, being and feeling in a certain space and historical time. And these dispositions are not neutral; they underline historical ideologies embraced in power relationships. So, when students talk to one another in discursive interactions, the use of language performs the socially constructed world of life, which positions students differently, intersecting social constructions such as gender, ethnicity, sexual orientation, social class and labels for ability, among others.

Grossen and Muller Mirza (2019), based on Bakthin and Latour, propose a multi-layered conception of interactions and dialogue that adds complexity to the notion that has been highlighted so far. They define interactions as processes where the performed interactions are always framed by absent dialogues which echo and tension present interactions, as multiple social identities of students, the curriculum and materials among other social constructions. This

conception of dialogue seems to fit better with the notion of language as a sociocultural tool that is intertwined with multiple dimensions of human life. We should add, however, that through interpersonal and inner language in the interplay and tensions of multiple dialogues, students internalize concepts and complex emotions, becoming authors of themselves.

Discussion and conclusions

The aim of this paper was to advance a holistic theory on the role of peer interaction in school learning and development. We have elaborated key, and sometimes overlooked, aspects of Vygotsky's theory to show the primal role of language as the matter and engine of psychological processes as interrelated activities: self-construction and identity, thinking and emotions. This reading puts (inner) language at the centre, which may feel too *cognitive* or too *internalised*. Here, two aspects are worth emphasizing. First, to make sense of this proposal, the theory of language that one holds as a reader is pivotal. If language is understood as an individual, abstract system, or a representational channel of communication, it is not possible to understand why language is so relevant in emotions, body, identity and subjective life. We propose a reading of Vygotsky where language is central, not for its representational powers but for its capacity to perform and transform cultural ways of thinking, feeling and being, both in interpersonal and intimate realms. We argue that the under-theorization of language in psychology has prevented us from recognizing the pivotal role that language should have in any sociocultural theory of development.

Second, our proposal allocates a crucial role to what Vygotsky calls inner speech. We are aware of a long-standing debate about Vygotsky's notion of internalization and inner speech. Critics include concerns about the under-development of the concept in Vygotsky's texts (Fleer et al., 2017); about the reinforcement of a dualist and spatial-based metaphor of the mind (Matusov,

1998; Wertsch, 1993); about a distinct notion of language that trespasses spatial boundaries without changes (Jones, 2009); or about implying a passive reception (Rogoff, 1997). It is likely that this debate has ensued the neglect of the whole Vygotskian concept of inner speech. We think – following authors such as Álvarez Espinoza and Balmaceda, (2018) and Sawyer and Stetsenko (2018) – that internalization should be viewed as a process of transformation through which language is internalized, not as a whole but as diverse and heterogeneous forms of speaking that carry diverse worldviews and ways of feeling, thinking and responding. We believe that this transformation does not imply a simple spatial trespass but an active and complex formation of new singular ways of speaking/thinking/feeling/being in the interanimation between individual and social history; and that it involves the formation and transformation of new ways of relating to oneself insofar as it is a group of language forms directed at one's self. Inner speech then is not inner because it is in a different spatial place; or because it is accessed from one, and only one, individual; or because it is private or non-social. We see internalization as the process through which *mind* becomes materially transformed, opening up the socialization and historization of mind and providing a dialogical dynamic to consciousness (Larrain & Haye, 2012).

Sociocultural and Piagetian studies have advanced the understanding of the benefits of peer interactions in the classroom for learning, argumentation and thinking skills (Tenenbaum et al., 2020). However, one important implication of our view of peer dialogue is the need to guarantee diversity in language forms at school. Dialogue between peers, it seems, conceptualized as a homogeneous practice, is not a panacea: the available empirical evidence shows that some voices are listened to more than others (Sedova & Navratilova, 2020); that there may be a reproductive potential between peers that has been forewarned (e.g. Segal et al., 2017). Our point is that diversity should not be overlooked. If one language form prevails, the risk of reproducing and

reinforcing certain identities over others is high. Considering the favoured access to certain language uses of privileged families, it is essential to promote different practices and ways of speaking and listening among peers that allows for the emergence of different voices, valuing different outcomes beyond academic ones.

But why do we need this diversity of voices in classrooms? The answer is not only ethical but an urgent requirement in the context of a globalized and fragmented world. We are facing global problems such as climate change, pandemics, polarization of ideas and wars that tension and confront our possibilities as humanity. So, we are educating not only to preserve and develop the present sociocultural knowledge but also to imagine possible futures and solutions to live together in a fragmented and complex world. There is an urgent need for different, yet articulated, identities that can dialogue, considering diverse perspectives to reach possible solutions and ways of collaboration considering those differences.

Identities and feelings are two concepts that are generally used in confused, even opposing, ways for different authors. Following Vygotsky's theory, we proposed that the uniqueness of complex emotions is their integration into language historicity. But this doesn't mean that they become unmaterial or abstract; indeed, they are bodily performed in a semiotic way (Vygotsky, 1925). On the other hand, in our interpretation of Vygotsky, we are naming as *identity* what the author refers to (or which is translated) as *personality*. We aligned with the term *identity* because it resonates better with the contemporaneous literature on peer dialogue and self-development (Kayi-Aydar & Miller, 2018; Langer-Osuna, 2011; Varelas, 2012). We acknowledge the notion of Vygotsky as accounting for an idea of interiority (materialized through inner speech), which addresses in part what Zittoun and Perret-Clermont (2009) said about imagination and interiority. Thinking in concepts together in peer interactions is relevant, not so much as a product but as a

process of mutual understanding in a historical moment. In that way, the practice of the language form of schools will move towards greater reflexivity and enable the development of imagination and interiority. This also differentiates between the notion of identity referred to in this paper and the post-structuralist conceptions of mostly performative discursive positioning (Baxter, 2016; Zembylas, 2005).

Finally, given the challenges discussed so far, it is evident that the role of the teacher is key. Teachers can contribute to the dialogue, not only designing different tasks for diverse purposeful language uses but also helping to balance the power of cultural positions, orchestrating their voices and encouraging them to reflect upon them. With this, teachers can create the conditions that foster reflective and dialoguing subjectivities, as well as spaces for the co-construction of knowledge(s) through dialogue (Perret-Clermont, 2011). Teachers are crucial in framing and fostering ethical school communities that frame relationships with others, caring about the consequences of what we say. Because words *hurt*, it must be taught and practised not only how to talk together but also when to *keep silent*.

REFERENCES ([click to link](#))

2. Article: We don't come here to learn; we come to pass. Promoting deliberative peer dialogue in an underserved and diverse science class.

Status: Sent and accepted with changes. In the second phase of the peer review process.

Journal: Science Education (WOS/SCOPUS)

“We don’t come here to learn; we come to pass.”

Promoting deliberative peer dialogue in an underserved and diverse science class.

Abstract

In a complex and connected world, schools need to change their science teaching methods to promote spaces that encourage dialogue, different interpretations, and critical analysis of complex socio-scientific problems with no clear solutions. Despite efforts to promote curricular change, transferring these pedagogies to classrooms has proven difficult. This is critical in underserved and diverse schools labeled as low-achieving according to standardization regimes. In these contexts, pedagogical innovations are even more challenging, often reinforcing traditional teaching or the belief that dialogic pedagogies are only for neurotypical upper/middle-class students. This single-case study illustrates in-depth the process of implementing a teaching method based on peer dialogue—deliberative teaching—in a science class in Chile characterized by low expectations and academic performances and a high number of students with psycho-educational diagnoses. With a mixed design focused on a qualitative narrative of the experience, it addresses the relationship between teacher and researcher, who collaborate on a project of deliberative pedagogy in an 11th-grade science class. Codification of peer interaction data is presented to complement the case narrative. The study illustrates the complexities of implementing dialogic pedagogies in contexts of low academic expectations, and how collaboration, dialogue, trust, and flexibility were needed to address the pedagogical innovation. It emphasizes that, with enough support, peer dialogue, motivation, and engagement can flourish in an underserved classroom context.

Keywords: pedagogies, expectations, single-case study, teaching methods, students, schools

Introduction

Despite curricular reforms and international organizations seeking to change teacher-centered science, it has proven difficult to transfer pedagogical innovations to classrooms (Penuel, 2017). In these pedagogical innovations, students are expected to be able to explain a phenomenon, identify questions, and interpret and evaluate data and scientific evidence (OECD, 2019b). The expectation is that it will promote awareness of the relevance of science in students' lives and help them understand aspects of the nature of science and critically analyze scientific information (Evagorou et al., 2020). For this, teachers must be reflective professionals who can promote active and critical students who can relate science to a socially, politically, and economically just society (Sengul, 2019). However, evidence shows that the predominant pattern of interaction in the classroom is still characterized by a triad of teacher-student interactions structured around initiation, response, and evaluation, or what has been called IRE (Sinclair, 1975; Vrikki et al., 2019). In this pattern of interaction, the teacher asks closed questions, which are answered individually or together, closes with an evaluation of the answer (e.g., "Very good!"), and then continues with their lecture (Howe et al., 2019). The IRE pattern fails to provide quality educational experiences (Alexander, 2008), and many teachers are not comfortable with such traditional practices, which are seen as hierarchical (Lefstein & Snell, 2014).

One possible reason why it is difficult to bring peer dialogue into the classroom is that pedagogical models that promote interaction in the classroom do not fully recognize the complex scenario and the multiple dimensions where they are installed. This has led to pedagogies that promote dialogue in the classroom being perceived as ideal (Lefstein, 2010) or very difficult to

successfully implement in real classrooms (Limón, 2001). Added to this are the pressures of standardized tests and achieving curricular coverage, which have led to maintaining a teaching style based on the transmission of knowledge (Au, 2007). This is especially critical in more underserved schools, such as those in less advantaged socio-economic contexts, those that are racially segregated, and/or those with a higher percentage of students with special educational needs.

Chile, where this study took place, is a country characterized by schools governed by standardization regimes with high consequences. In this type of educational setting, a vicious circle has been observed between expectations, developing activities, and student results (Falabella, 2020). Sleeter et al. (2016) propose that student outcomes are a *routinized drill*: students are exposed to a curriculum that is irrelevant to them; and, reinforced by the idea of a deficit in their intellectual abilities, the circle closes with the low results initially expected of them. In this context, dialogic pedagogies involving innovative curricular activities that demand peer interaction and exercising an entanglement of knowledge and skills (linguistic, social, motivational, and affective) can be seen as beyond student capacities and the scope of schools.

In this context, it is worth asking how possible it is to implement dialogic methodologies in classrooms that serve students in socio-economically segregated schools, with a significant number of students labeled as *low performers*, with disabilities, neurodiversity, or learning difficulties, and with social, psychiatric, and behavioral problems. Considering this, the aim of this case study is to understand the development and outcomes of implementing *deliberative teaching*, a kind of pedagogy that promotes peer dialogue, in a diverse and underserved school.

The study took place in a charter school in Chile, an urban, secular, gendered, mixed-educational institution in a working-class neighborhood. The school achieved lower academic results than

similar schools, and 66% of its students had indicators of socio-economic/educational risks. The case shows the difficulties and strengths of a process of implementation, focusing on how the teacher and researcher worked together to promote dialogue and academic challenge between students who expect to be, and are seen as, *low performers*. For that reason, the case is presented as a narrative of the implementation, illustrated with some quantitative data from the peer interactions during the peer group work.

Dialogic pedagogies and deliberative teaching

Deliberative teaching, the pedagogical model implemented in this case study, is a type of dialogic pedagogy. Dialogic pedagogies emphasize the role and centrality of dialogue and critically seek ways to promote and create dialogic spaces in classrooms (Wegerif, 2020). Several studies support the benefits of dialogic pedagogies for student learning (see Asterhan & Schwarz, 2016, for a revision) and skills development (Larrain et al., 2021; Mercer et al., 2019; van der Veen & van Oers, 2017), including science classes (Weasel & Finkel, 2016; Casado-Ledesma et al., 2021). However, there has also been some criticism. According to Barak and Lefstein (2021), dialogic teaching presupposes a direct relationship with deliberative democracies, assuming that all students have equal access to academic content and that they have similar discursive experiences to make their voices heard and recognized and thus contribute to the group in a reasonable and convincing way.

On the other hand, it has been argued that these pedagogies are ideal frameworks requiring conditions that only a small group of schools can meet, thus being more productive for upper/middle-class students. For example, Maia et al.'s (2023) experimental study suggested that middle-class students benefited more from deliberative pedagogies than disadvantaged students.

Typical schools (like most of the countries around the world), with their diversity, conflicts, and less rational way of functioning, would be less equipped to implement these pedagogies. If implemented, there would be a reproductive risk because they can favor students from advantaged backgrounds with higher cultural capital (Lambirth, 2006), deepening cultural and learning gaps and resulting in more exclusion and segregation. Snell and Lefstein (2018) developed an ethnographic study with teachers implementing dialogic pedagogies; they found a tension between dialogic pedagogies and teachers' fixed views of student abilities. The teachers claimed that only students they perceived to have high abilities benefited from peer dialogue. The study concludes that dialogic pedagogies can be detrimental to students labeled as *low achievers*, and dialogue-based learning can only serve marginalized students if teachers change their fixed views of intelligence and abilities.

The latter is related to how intelligence and abilities are perceived. If teachers hold a view of intelligence as something fixed, individual, and inherent, attempts at equity through dialogue can do more harm than good, benefiting the voice and identity of those labeled high achievers, the students that are already privileged. Snell and Lefstein (2018) claim that we need to promote a vision of intelligence as something that is socially constructed, dynamic, and context-dependent to offer dialogue as a space for equity. This is consistent with Freire's vision of learning through dialogue, considering and giving value to the knowledge and voice of whoever has been marginalized in a monological education (Freire, 1968):

Attempting to liberate the oppressed without their reflective participation in the act of liberation is to treat them as objects which must be saved from a burning building; it is to lead them into the populist pitfall and transform them into masses that can be manipulated (p. 66).

Aligned with Freire's pedagogy, deliberative teaching highlights the central role of dialogue, learning, and democracy. Deliberative teaching focuses on the co-construction of possible solutions to controversial open problems, generating instances of small-group peer dialogue and all-class plenaries. Through peer argumentative dialogue, epistemic ideas are collaboratively and critically negotiated, and revised in an open and respectful social space (Larrain et al., 2021).

Difficulties implementing approaches that promote dialogue in underserved school contexts

The relationship between teacher expectations and student outcomes has been studied for at least 60 years. From studies of the self-fulfilling prophecies of teachers in the 1960s (Rist, 1970; Rosenthal & Jacobson, 1966), arguments were made for a relationship between expectancy and student results. Weiner (1972) proposed that teachers' attributions are significant in student learning and performance, reinforcing the marginalization of low-income students. Then, in the 1980s, studies on learned hopelessness (first studied by behavioral psychology in animals) were transferred to the field of education to understand how low teacher expectations were related to low student outcomes (Hunter et al., 2020). Moreover, in the 1980s and 1990s, teacher and student expectations were conceptualized in research as *learned hopelessness*.

Today, there is some consensus among the scientific community that teacher expectations play an important role in student outcomes (Gentrup et al., 2020). A systematic review of a decade of studies on the topic from 2008 to 2018 (Johnston et al., 2019) confirmed that if teachers have high expectations of their students, the students tend to perform better. Factors related to different teacher expectations of students are previous performance, ability, ethnicity/race, socio-economic level, and gender, which is coherent with previous studies. The review also highlights other factors previously less studied, such as the perception of psychological or psycho-educational diagnoses.

The studies show that teachers tend to have lower expectations of students traditionally classified as disadvantaged, such as Latino and African American students, which translates into lower school performance among these student groups. Likewise, students with diagnoses of attention deficit hyperactivity disorder, other psycho-educational diagnoses, or behavioral problems known to teachers, were also affected by lower expectations and consequent lower performance. The review shows that qualitative studies are scarce, which limits the possibilities of understanding the phenomena in a richer and more complex way, adding value to the context in which these expectations are developed and how to transform them.

Understanding how low expectations are explained by teachers can reveal how they respond to the socio-economic educational disparities and structural conditions of students. Low expectations are usually associated with deficit or grit ideologies that reinforce the belief that poverty is an individual failure of marginalized students and their families. This belief fails to address the structural causes of root inequities (Gorski, 2016). For example, many schools and teachers consider the labels provided by funding programs for at-risk students to explain and predict student achievement. Despite intentions of providing support, an uncritical and pathologizing reading of students' diagnoses tends to perpetuate deficit thinking, low expectations, and the reinforcement of structural inequities for marginalized students (Shields et al. 2005).

Other studies problematize not only the beliefs but also the socially learned feelings of teachers. Rojas and Liou (2017) argue that teachers who work in segregated contexts often pity their students, which deepens social injustices in the education system, especially for black students. They propose that these feelings of pity and compassion from a deficit perspective lead to the belief that students should be exempted from academic demands, which impacts what is expected of them and the image that students ultimately have of themselves as learners.

In the same vein, Falabella (2020) argues that accountability policies in the Chilean education system, recognized as a country with one of the most segregated education systems in the world, have affected the subjectivities of students and their teachers. The performance labels imposed by the system have perpetuated an image of *excellent*, *good*, and *mediocre* schools, students, and teachers. These labels leave emotional and subjective imprints that negatively impact the identities of under-resourced students and schools, who, year after year, obtain similar low results on national standardized tests. The question is whether it is possible to break this cycle and implement deliberative pedagogies in these kinds of schools.

Designated academic identities and identity debt in science

Dialogic and deliberative pedagogies have demonstrated learning and skills benefits in STEM fields and science (Howe et al., 2019; Larrain et al., 2021). However, implementing this kind of pedagogies in the field of science can have its own challenges. Canonical science as a discipline has also encompassed structural ways of exclusion (Morales-Doyle, 2024), which complicates the phenomenon further.

While we must recognize the curricular progress of sciences toward a discipline focused on inquiry and collaboration, powerful macrosocial and social structures continue to impact students' academic identities, specifically the historical marginalization of the discipline toward women, non-white people, and the working classes (Kang et al., 2019; Ladson-Billings, 2006; Szostkowski & Upadhyay, 2019). From this perspective, a critical conception of scientific knowledge and an awareness of positionality are important. The learning of science is understood as a socio-political and dialectical act with multiple dimensions: material, symbolic, cognitive, social, and emotional (Varelas, 2018). In this context, diversity and differences are not only aspects

to be included; they also play a central role in how science is, and should be, constructed. All of this involves questioning the voices heard in teacher-student or student-student interactions and considering and reformulating Freire's notions of liberation pedagogy (1968) because students are never truly free from oppressive discourses. Rather, guided by their teachers, students can explore diverse perspectives in science to deconstruct their beliefs about science and themselves, assessing their positions as students, teachers, and sexual beings with a race, gender, and social class (Barton, 1997).

Questioning the historical discourse of *who should belong* to science implies changing what we define as a *low-achieving* student. Re-reading the academic gap, critical positions propose transforming the prevailing focus on the deficit in students to account for identity debt that has historically designated marginal identities to certain students (Kang et al., 2019; Ladson-Billings, 2006; Szostkowski & Upadhyay, 2019). Varelas et al. (2012) use the term *designated identities* to account for the process in which students are positioned by others (their teachers or peers, for example) with respect to what is expected of them or the future they are supposed to have, considering sociocultural aspects such as class, ethnicity, or gender.

Therefore, to move toward equity, it is first necessary to recognize this identity debt and promote spaces where science is practiced and where traditionally excluded students feel they belong (Varelas, 2012). The question is whether deliberative and dialogic pedagogies offer those spaces. Theoretically they should, because they are spaces designed for hearing everybody's voice and engaging in purposeful interactions. They also provide challenging intellectual tasks and atmospheres, in which collaboration replaces competition and where everybody is invited to think and create, contribute and dispute, based on common rules of interaction and thinking. But is it possible to recreate those spaces transforming everyday implicit, and typically oppressive,

structures for some groups? Are teachers prepared for this challenge, and what resources do they need for it?

Teacher development and methodological innovations in underserved schools

Many schools and communities around the globe, especially in North and Latin America, are situated in segregated or underserved socio-educational contexts. To implement dialogic and deliberative pedagogies in these spaces, teachers need sophisticated knowledge and skills. On the one hand, teachers need to know how to create or select problem-based curricular activities, which are not easily available for most topics in science. They also need to manage classroom social organization for peer collaborative work and manage the dialogue in small groups and the whole class in a dialogic way, maintaining the intellectual challenge but leading the group to reconstruct canonical knowledge. They need to manage the social, affective, and psychosocial dimensions of interactions, establishing and monitoring social rules and giving precise and opportune feedback. On the other hand, teachers need skills and resources for working with students with identities marginalized from school learning, with a diverse set of skills and learning achievements, and with complex sociocultural conditions and life situations.

The literature demonstrates the lack of specific support through teacher professional development, especially aimed at complex contexts. A systematic review (Bancroft & Nyirenda, 2020) of teacher professional education strategies for equity aimed at K-12 science teachers shows that training tends to be unidirectional, with teachers receiving strategies and materials rather than co-designing or adapting materials to the reality of their schools. The review also illustrates the persistence of the deficit view of the students served by the teachers, and evaluations that promote these training strategies do not usually incorporate student voices in the process or results. Also,

most of the studies are aimed at teachers in the initial years of school, leaving high-school teachers with fewer possibilities to access transformation opportunities.

Similarly, Nag Chowdhuri and Archer (2023) argue that, despite the urgent need to promote better science learning to diverse populations, there is little evidence to guide teachers on how to do so. They explain the need for professional teacher support that promotes reflection, collaboration, and discussion of difficult issues such as race or social privilege. A possible problem that hinders teacher training in these subjects is that the view of science as a neutral discipline prevails, even when large-scale forms of social injustice are recognized in the social system (Crabtree & Stephan, 2023).

In terms of dialogic teaching, research has shown that pedagogical change is difficult, and professional development initiatives, typically led by university researchers, tend to show modest results (Ruthven et al., 2017; Hennessy & Davies, 2020). Providing curricular materials has been shown to promote pedagogical change, but it is a complex process requiring different types of support in order to be sustained (Guzmán, 2024).

Through a contrasting case study, Lowell et al. (2024) show that innovative curriculum materials in science education can be used in opposite ways in schools, depending on how teacher leaders and educators interpret the changes. One of the schools in the case study focused on strictly implementing the materials as scripts, which led them to see the activities as ineffective given the characteristics of their students. The teachers felt the material restrained their autonomy as educators because they couldn't adapt them to their context. In this case study, the materials reinforced a style of teaching centered on memorization and on the teacher. The other school interpreted the material as complex and highlighted the pedagogical principles promoted in them instead of following the instructional activities as templates. These teachers worked together to

understand and adapt the teaching materials to their school, allowing them to tailor the materials without losing the features of the instructional curriculum innovation. Leadership and teacher collaboration played a key role in understanding and implementing the materials in both cases. Something this study does not consider is that the school that more rigidly implemented the materials was the one with more diverse and low-income students. Could this play a role in interpreting the possibilities of implementing a science innovation?

A study that sought to improve the performance of students in urban schools in socioeconomic settings was organized by John Hopkins University (Ruby, 2006). In this study, a model of the relationship between teaching and research was implemented, with a view to professionally developing teachers in highly complex schools. The study sought to respond to the needs and problems of teachers and the contexts in which they worked: difficulties implementing the curriculum coherently; the need for training in curricular content, especially physical sciences; and the need to motivate students with science, to connect science with the diverse cultural and social contexts of students. The project included a support network for teachers, who were offered a certified professional development program at the university, a curriculum with activities to implement in classes, support in classes by instructional coaches in the classroom, and instances of teacher collaboration. The coaching support involved weekly visits to observe the classes and support the adaptation of the materials to the reality of each room. The coaches also deployed modeling and co-teaching strategies where necessary. They followed the teachers for 3 years. Over the years, the students improved significantly on standardized tests and typically climbed in performance. This study presents instructional coaching with co-teaching and modeling strategies as a powerful tool to promote innovation in science in complex contexts. However, the focus of the study is on students' standardized test scores rather than describing the collaborative process

and pedagogical outcomes that are not measured by such tests. The research demonstrates the need to strengthen relationships in research designs that promote greater leveling of power and knowledge, including teachers as active actors in professional development. According to Penuel (2017), schools in urban communities face complex challenges related to racism, classism, sexism, and heterosexism, and they require a transformative alliance between teachers and universities that promotes equality, learning, and social justice.

Although there is no clear agreement on how the relationship between research and teaching practice should be developed, there is some consensus on the importance of investigating how this alliance is developed (Juuti et al., 2021; Sjölund et al., 2023). There is still little evidence to support recommendations on what type of relationship is more appropriate for certain strategies or challenges, as the evidence tends to be separated into studies focused on describing the relationship and studies that report the results. Few studies integrate both perspectives (Coburn & Penuel, 2016).

The study discussed in this paper enhances our understanding of how science curriculum innovations can be co-constructed through a collaboration between teachers and researchers, particularly in environments with low academic achievement. Additionally, it investigates whether these implementations can potentially disrupt the recurring cycle of low expectations and low achievement. The research questions guiding this study are as follows: *What is the process of implementing deliberative teaching in an underserved science class with diverse students and low academic expectations? How can the teacher and researcher relationship implementing a pedagogical innovation promote—or not—peer dialogue?*

Method

Design

A qualitative ethnographic case study was conducted. Case studies are characterized by “an intensive, holistic description and analysis of a limited phenomenon such as a program, an institution, a person, a process, or a social unit” (Merriam, 1998, p. 13). Case studies should shed light on how actors construct their reality; therefore, they require multiple voices and multiple and contradictory views on what is happening in the classroom to be preserved (Stake, 1995). The study also sought to contribute in a situated way to pedagogical practice. The literature shows that abstract principles alone do not improve pedagogical practices and that teachers fail to transfer knowledge to their own contexts (Darling-Hammond & Oakes, 2021). Knowledge that is situated, richly contextualized, and narrativized in cases can allow teachers and teaching teams to situate knowledge and make sense of it within their own reality. This is likely to occur because cases are a valuable tool for linking abstract theoretical principles with concrete pedagogical practice (Shulman, 2002).

In case studies, especially ethnographic ones, the researcher is the main instrument for producing and analyzing data, allowing them to adapt to situations in order to maximize data production with respect to the study objectives (Merriam, 1998). Therefore, the researcher makes use of their strengths and limitations as a human being, of their vision of the world and their mistakes, as well as the opportunities they seize and waste. Reflexivity is one of the main strategies of rigor and control in qualitative research; therefore, understanding the link between a study and the characteristics and experiences of the researcher is essential (Berger, 2015). The positionality of the main investigator of this study is explained below.

Not only am I a research student in a PhD program, but I also have multiple intersecting social identities: woman, mother of two, my husband's partner, and part of a family of powerful women that I deeply admire. Both of my grandmothers were strong women from disadvantaged backgrounds. On my mother's side, my grandmother came to Santiago with nothing, to live in the poorest part of the city. But she believed in education, even though she didn't have the opportunity to finish elementary school, so she filled her house with books and encouraged her three daughters to be curious and love reading. My other grandmother was a Mapuche woman who came to Santiago in search of better opportunities and managed to educate her two children. My mother died when I was a child, but the love of books and curiosity about the world she instilled in me was a powerful inheritance. With all of this in my family heritage, I strongly believe in education as a powerful way to promote social justice and a source of pleasure in human life, but I also believe there is an urgent need to improve the system so that it doesn't take two generations of committed women—my grandmothers and my mother—to finally get the daughters to college.

How I worked with the teacher and the students and organized this research paper is deeply tied to my story and who I am. I chose to work with students from disadvantaged backgrounds because, in part, I was like them and because of what sets me apart as a doctoral student. Coming to the school where the project took place was difficult at first because I had been moving in much more socio-economically privileged environments for years and felt that my ways of speaking, dressing, and understanding were foreign to the school environment. However, as I entered this school world, I found many aspects of my own story in them, which allowed me to connect with the students. While I am now a motivated and engaged doctoral student, my high-school life was a disconnected, dull, and unmotivated experience. I rarely participated in most classes, and for some teachers, I was a “difficult” student. Despite school, my interest in learning remained in a parallel world, except for a couple of teachers who made a difference and connected with me and my interests.

However, many of my peers did not have the opportunities that I had. My story had a lot to do with the decision to look for alternative ways to continue with the project because I know, many years later, that students can be motivated, face complex challenges, and be present in the classroom if the classes are conceived differently.

Participants

The case study was conducted in a school selected for its socio-economic characteristics and interest in participating. It is an urban, secular, and mixed establishment in which 66% of the students have indicators of socio-economic or educational risks such as low attendance, performance, or dropout (JUNAEB, 2023). The school is subsidized; in other words, it is managed

by private individuals with public funds. Following the classification of Carrasco et al. (2019), it corresponds to a center with an *autonomous collaborator*. These types of schools are characterized by their difficulties accessing networks, professional skills, infrastructure, and financial capabilities. They are schools that, motivated by the social or educational inclusion of students, founded a single establishment with low enrollment and reduced staff. However, the small number of students does not translate into a systematic improvement in teaching strategies. In these establishments, multiple roles and assigning positions to relatives are common.

Coinciding with the above, the school's educational project stands out for its emphasis on school coexistence, inclusion, and respect for diversity, as well as promoting a social vision in its students. The school is characterized by receiving students who are lagging behind in the school system or who have experienced harassment or discrimination. About half of those enrolled are students in the National School Integration Program who have special educational needs, mainly mild intellectual disabilities, ADHD (attentional disorder with hyperactivity), and ASD (autism spectrum disorder). According to the national standardized test, SIMCE (2022), the school has lower academic results than establishments in the same socio-economic group; and higher socio-emotional and coexistence indicators. In reading, 57% are in an insufficient range, and in mathematics 76.2% are in this range. The test shows no gender differences in performance. On the other hand, the school results are higher in academic self-esteem, motivation, and emotional climate than establishments in the same socio-economic group. Men have a significantly greater difference in these socio-emotional outcomes (Agencia Nacional Educación, 2023).

We worked with the 11th grade in the school and their science teacher, Mariela. Mariela is a young professional who recently graduated from a career in natural sciences at a public university

in Chile. This was her first job. She is the homeroom teacher of the fourth grade and teaches Science, Chemistry, and Science for Citizenship at all levels of the school.

Mariela sent passive informed consent to parents and guardians via email. The class consisted of 25 students, of whom 15 agreed and had parental consent to participate in the study. The average age of the 15 students was 16 years; 3 students defined themselves as cisgender women, 7 as cisgender men, and 5 as gender dissidents: 4 non-binary students and a trans man. On the other hand, one student was diagnosed with a mild intellectual disability, one with a psychiatric illness, two students were diagnosed with ASD, two with ADHD, and two students presented significant behavioral and psychosocial problems, according to the school psychologist. All these students were part of a special program in the school to receive psychological support. We consulted the school psychologist during the semester to understand the special needs of the students, and we referred students to her when we had any cause for concern.

The 15 students were grouped into 3 peer groups of 5 members each, according to their own preferences. However, the records of group interactions were mainly from two of the groups. This is because one of the groups participated only in the first two deliberative guides, and one of the students asked not to be recorded in the discussions. For the rest of the classes, the attendance of the other members in that group was low, so they were distributed among the other groups according to their preferences. While the two groups remained relatively stable, there were some changes during the semester, mainly because of student absences resulting from an influenza outbreak that affected the city during the period of study.

Procedure and materials

Procedure. At the beginning of the school year, we contacted the head teacher, who said the deliberative teaching project seemed to be in line with the school's educational remit and with concerns they had about how to promote more student participation in class. The first meeting was with the head teacher and Mariela, the science teacher at the school. At the meeting, we presented the project and methodology. We then sent the project materials and guides to Mariela, who gladly agreed to participate. We told her that the guides could be modified and adjusted to her lesson plan, and she selected the moment of implementation according to her schedule.

Initially, the project was formulated within a more traditional research scheme. The responsible researcher would come to observe the implementation of the guides and give feedback to the teacher after each class. In the second stage, the researcher became a co-teacher and the teacher a co-researcher, and they implemented changes to the design of the deliberative guides together. The educational approach that informed the research is extensively developed in another published article (Author, 2023).

Materials. The study was part of a larger research project that evaluates the effect of peer deliberation in the Unit of Climate Change in Science for Citizenship on learning and citizenship competencies. In Chile, the central government regulates the curriculum (Falabella, 2020). Science for Citizenship is a new subject in the Chilean mandatory curriculum, which is supposed to promote an interdisciplinary (Science of Life, Chemistry, and Physics combined in a school subject), collaborative, and problem-based science experience in which peer interactions and dialogue have a central role. Students had three weekly blocks of 45 minutes of Science for Citizenship, and the project was implemented during most of the first semester of the school year, from March to June 2023.

The curricular unit corresponded to climate change and involved six sequentially organized lesson plans (see Table 1), each organized around a problem to be discussed. Students were given scientific evidence for their discussions, and teachers were supported with back-up information and complementary resources. Each lesson involved individual work, peer collaboration in which students had to deliberate on the problem posed, and a whole-class plenary, in which the teacher orchestrated dialogue and reflection to reach shared conclusions. In addition, the case study included another four *as-usual* lessons that were not part of the larger project, to introduce students to basic concepts and skills that would enable them to understand deliberative cases (e.g., reading graphs and basic concepts of ecology). Table 1 shows the original design of deliberative guides before implementation.

The deliberative lessons were designed to scaffold deliberative ways of speaking, emphasizing the crucial role of the teacher in gradually appropriating them in dialogue in their classrooms (see Author, 2023). Through interdisciplinary work, materials were first designed by a team with biological, ecological, chemical, psychological, and science teaching backgrounds. Then, the materials were discussed in a teacher professional development program involving 20 teachers from different scientific backgrounds. Materials were then validated through a dialogical process by one teacher and a science teaching expert through implementing, observing, and reflecting on all of the lessons. All suggested changes were incorporated.

Table 1.

Overview of curricular material, lesson guides

Guide	Learning goal	Activities
1. Albedo effect	Understand the albedo effect and the transmission of thermal energy from a star on a planet like earth	They read a case about a hypothetical planet, without an atmosphere, inhabited by white flowers that

			affect its temperature. They choose an alternative that better explains the effect of the flowers on that planet.
2.	The role of atmosphere	Understand that the sun's impact on the earth is variable and that the atmosphere helps to regulate the planet's temperature	They read information and charts about the paradox of the rising sun. They elaborate explanations on how it is possible that, having progressively increased the luminosity of the sun, the earth's temperature has remained relatively stable.
3.	Greenhouse effect	Relate the behavior of greenhouse gases to climate change and the maintenance of thermal conditions of habitability on the planet	They read about ice cores and interpret data related to the gases that make up the atmosphere for 400,000 years. They explain how it is possible for small variations in CO ₂ and CH ₄ to be related to global temperature variation.
4.	History of global warming	Understand the nature of knowledge of climate change	They read about pioneering authors on climate change and their studies. They discuss why they did not have support from the scientific community at that moment in history.
5.	Mitigation	Evaluate alternative and individual greenhouse-gas-emission mitigation measures	They order a series of decisions or mitigation initiatives at individual and/or collective level that can be adopted to contribute to reducing

6. Effects of climate change on biodiversity	Understand that global change can produce drastic changes in the biodiversity of Chile's ecosystems and that these effects are already being recorded and predicted based on field studies and theoretical models	greenhouse-gas emissions, justifying their responses. They read a study on the effect of climate change on the Valdivian Forest. They analyze the conclusions and validity of the project.
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Data-production techniques. A total of 25 school visits were made over the course of a semester, in which the following strategies were developed to produce the information in the case study.

Video recordings of classes implementing deliberative lesson plans: Both the complete classwork and the group interactions were recorded. Although it was part of the case study, guide 6, *the effects of climate change on biodiversity*, was not used in the quantitative coding, because of the low attendance resulting from the influenza outbreak that affected the class that week.

Recording of classes (not videotaped) not implementing deliberative lesson plans: Class sessions that did not involve implementing deliberative lesson plans were recorded in the field notebook and through voice notes. The researcher registered small conversations with the students and the teacher, including personal reflections, descriptions, and feelings that emerged before, during, and after classes.

Lesson-planning meetings: The case study included five lesson-planning meetings, in which the researcher and teacher met to reflect on the implemented classes and prepare the following activities. Meetings were recorded in the field notebook and voice notes at the end of the meeting.

Interviews: An interview is understood as a face-to-face encounter of reflective subjects where a new reflexivity is produced (Guber, 2004). The data produced are, therefore, the reality constructed

and interpreted in the social relationship between interviewer and interviewee (Guber, 2004). Specifically, semi-structured interviews were used, which did not follow a fixed script or question structure, but instead employed a set of broad themes, axes, or questions woven into the flow of the conversation (Merriam, 1998). The goal was to respond to the interviewee's worldview, not to follow the interviewee's structure. The science teacher and five students were interviewed. The interviewed students were selected with the criteria of a purposeful sample (Merriam, 1998). We interviewed students from the groups that wanted to be interviewed in-depth (two of them asked to give their testimony proactively), enriching the observation process in relation to the research question. We interviewed a silent student in the groups, a student with ASD, another with behavioral problems, a student with a diagnosis of mild intellectual disability, and a student who often manifested low expectations of himself and the school.

Ethnographic field notes: Throughout the project, the principal investigator took notes in a field notebook about experiences, dialogues, feelings, reflections, and doubts. Likewise, the researcher and co-researcher recorded their conversations and reflections about the fieldwork in voice notes.

Analysis

The study combines qualitative and some quantitative data with qualitative ethnographic narrative as a main production strategy. In this context quantitative data should support the qualitative view, respecting the ethnographic narrative as the center of interest.

Ethnographic narrative. Fieldwork, class videos, voice notes, and interviews were transcribed. All material was read comprehensively and then coded using thematic analysis (Cohen et al., 2007) through inductive and deductive codes derived from the theoretical framework. Then, the codes were contrasted to create a chronicle-type text (Jha, 2018; Merriam, 1998) to describe the main

milestones of each of the sessions (classes and planning sessions), including the different voices of students, the teacher, and the main researcher. This comprised describing teaching strategies and interactions, milestones, anecdotes, relevant quotes, and the researcher's personal feelings and reflections at the end of each session. This long chronicle, session by session, was then recorded to account for the main milestones. With this, the final narrative of the experience was written, which is reflected in the results.

Analysis of group peer interactions. Videos of the group dialogues were transcribed, and all the material was read comprehensively. To codify the type of deliberative and non-deliberative dialogue, a guideline developed in previous research on Chilean students was used (Author, 2022). One of the authors and educational researchers developed this guideline and tested it in iterative meetings considering and adapting the analytical procedures of Felton et al. (2022) and Leitão (2000). The non-deliberative codes were constructed based on the proposal of transmissive and monological dialogue by Nystrand et al. (2003). This analysis allows us to understand how students talked about the problem: in a confrontational or non-deliberative way, or in a constructive and dialogical way, understanding that all conversations can have elements of both. The transcripts were coded with the guideline independently by the main author and by an external researcher (linguistics graduate, cisgender man). The codes were contrasted in iterative meetings until a consensus was reached. In this process, two new inductive codes were added: *mirroring* and *interrupting an argument*. Because each deliberative guide was the unit of reflection and design for the teacher and researcher, we quantified the codes by guide. Table 2 presents the codes, their definitions, and examples with dialogues of the case groups.

Table 2.

Codes for peer interactions

Codes (non-exclusive*)	Definition	Examples
<i>Deliberative codes</i>		
Withdrawal	The speaker makes a retraction with respect to a previously held point of view, motivated by a previous intervention of the partner.	<i>A: I answered C but, after what we talked about, I'm going to write B.</i>
Agreement	The speaker explicitly expresses agreement with the position, arguments, or counter-arguments held by an interlocutor. This agreement does not change over the course of the dialogue.	<i>A: I would say it's just like an extension of our earth's crust... It's like clothes... B: Yes, like a garment, a cape...</i>
Consideration (critical) of a point of view	This code can be observed in two ways: a) <u>Partial agreement</u>: The speaker considers the opposing point of view; although it does not lead to committing to the opposite position, it does lead to clearly modifying aspects of their original position. It can also occur when the speaker considers the opposing point of view by integrating the content of the counter-argument into their argument by adding exceptions or conditions to their original position, or when they add changes to the degree of certainty of the speaker's original position. b) <u>Follow-up</u>: The speaker considers a previous point of view to extend and elaborate on it.	<i>A: How could everything be recycled?</i> <i>B: There are things you can't, but <u>most things you can</u>... That thing (points to the ceiling). Can I recycle it? I think so.</i> <i>A: But there are a lot of things you can't.</i> <i>B: Most of them can.</i> <i>A: You can't recycle Styrofoam.</i> <i>B: You can't do that. It can be <u>reused</u>...</i> <i>A: About the car use, we didn't say much on it... Because we didn't say anything very blunt on it... B: Maybe it depends on how much you use it. A: And <u>they're not within the reach of all electric cars</u>.</i>
Anticipate	The speaker anticipates a position or situation in respect of which they are for or against a point of view. Imagine a response to something not previously said in the discussion.	<i>A: But how many times does one occupy a plane? <u>Has its use increased?</u> Yes, but only in Europe, and in countries like the United States.</i>
Argument	The speaker justifies an opinion or idea or provides additional information to support an idea that	<i>A: What happens is that although there have always been these processes (greenhouse effect), the</i>

	may be controversial, contested, or distinct. Also, it will be considered when the statement supports, justifies, or provides new reasons or evidence. There must implicitly or explicitly be a controversial context, that is a situation in which more than one position or way of thinking about an idea can be held.	<i>process was maintained... With pollution, it is as if he had been given I don't know...a manjarate [a sweet desert] to the thing and it started to go like this (snaps his fingers quickly)</i>
Counter-argument	The speaker formulates an argument that contradicts, weakens, or casts doubt on an argument (opinion plus justification) previously presented. It is understood that any counter-argument will be a follow-up, since it responds to a previously stated position (since they are linked to the same topic).	<i>A: Yes, well, because I can tell you a lot of things that can't be reused, and even if only one thing can't be reused, there are like 1 million other things that can be reused.</i> <i>B: The point is that they are useful things.</i> <i>A: They are useful...paint is useful.</i> <i>B: Yes, but... How much does it cost?</i> <i>A: But here they're not asking what the cost is.</i>
Require clarification	Require the partner to clarify a previous statement, to understand or comprehend the position of the other. To detect the will to understand, it would be relevant to observe the non-verbal language (intonations or gestures) and whether a genuine attempt is made to clarify or elaborate the argument.	<i>A: I think you encompass all, the planet, the atmosphere. I don't know if you cover water?</i>
Require to assess position	Invite other student to evaluate a point of view (it could be their own or someone else's). It will be considered when it is invited to take a position in the discussion between the speakers, as well as on the positions suggested in the case.	<i>B: But you've already heard the theory of A; which of the theories do you think is better?</i>
Deliberative goal	<i>Deliberative goal:</i> Intervention related to the deliberative dialogue itself, the participants, or the dynamics of the dialogue rather than its content (observe whether they are adhering to the deliberative goal or setting).	<i>A: I think it could be like A then...</i> <i>B: Do we have to find one?</i> <u><i>A: Maybe we can try to develop both a little bit and see which of the two we put (B nods).</i></u>

Recapitulate	Attempt to synthesize the established agreement or disagreement (review the progress of the argument).	<i>A: After some serious debate (laughs) (speaker B) explained that A says important changes but doesn't say what changes, while B explains more, so I think we're going to go for B.</i>
Uncertainty language	The speaker uses language that creates space for ambiguity or provisional/hypothetical meanings (it reflects that there is no absolute certainty of something, it opens up possibilities).	<i>A: (to speaker C) What do you think? C: I don't know, I don't know if I'm understanding. I think the warm-up...that global warming has to do with radiation... And here's a study on global warming that says recently with pollution the loss of energy has slowed down... But I don't know...</i>
Reflexivity	The speaker, in the same turn of speaking, unfolds a dialogue between positions, arguments, or counter-arguments. Through this dialogue, he reflects, condensing in himself what others think and his own thinking, as well as the doubts and inconsistencies arising from this dialogue.	<i>A: A, because (speaker C) is right, there's a part of the question that's missing here, but also A, because it does like a blanket effect. (Speaker A looks at them all.)</i>
Active search for arguments and counter-arguments	The speaker explicitly invites their interlocutors and/or themselves to look for arguments or counter-arguments that support either their own position or that of other opposites/alternatives. The active search for arguments fulfills the function of continuing the elaboration of a line of argument.	<i>A: But anyway, light bulbs don't generate anything (speaker B nods)... What will be more, the light bulbs or having a child? What generates more?</i>
Definition/notion	The speaker defines, clarifies, and/or specifies the scope of a given concept.	<i>B: I found something here... (silence). Here it says that without the ozone layer there would be no possibility of life...(she falls silent and looks at her cell phone, reading) ... Its function is more than anything else functions of protecting...or conserving oxygen (silence).</i>
Inductive codes		
Mirroring	The speaker repeats or paraphrases the other's opinion. They don't add new arguments.	<i>A: It's just that now it's only noticeable: winter and summer... Nothing else.</i>

B: It's just that... The other seasons are not so noticeable.

Non-deliberative codes

Codes (non-exclusive*)	Definition	Examples
Non- deliberative goal	Intervention related to persuasive dialogue or seeking rapid consensus. This intervention would be associated with the dynamics of the dialogue rather than its content (observing whether they are adhering to a persuasive objective).	<i>A: ... A (shrugs his shoulders as if to say, he's ready and starts shaking hands with the others, as if closing a deal). B: A. A: Yes. The first is the A.</i>
Uncritical concession or opposition to a point of view	The speaker agrees or disagrees without elaborating arguments or justification.	<i>B: OK... I agree with that. You joined me in the club!</i>
Rhetorical question	Questions that do not expect an answer from others, and do not express a doubt about the position or justification of others (such as requiring justification or requiring clarification), but whose function is to advance the arguments of one's own position or to suggest the weaknesses of opposite/alternative positions.	<i>But how many times does one occupy a plane? <u>Has its use increased?</u> Yes, but only in Europe, and in countries like the United States.</i>
Language of certainty	It is evidenced by the fact that the speaker already has and displays their own answer to the question asked by them. The speaker uses a mode of speaking that reflects the total certainty of the position or the arguments/counter-arguments held. The speaker formulates their utterance in such a way that they do not accept or visualize, in their language, the possibility of a legitimate alternative position/counter-arguments, or that the statement itself is, in some case, provisional.	<i>A: But! I'll give you the answer! One side is against it...is it true that it is the human being? Yes, it is true that human beings have initiated it... We are ready... That's it...</i>

Inductive codes

Interrupting argument

an The speaker does not allow an argument from a previous speaker to be finished; the argument remains unfinished.

B: I think it's C, because since 1950 human beings...

A: That doesn't explain why.

Results*Before implementation: meeting Mariela and first-class observations*

My first meeting with Mariela was at school, to introduce her to the project, organize the schedule, and discuss the general characteristics of deliberative teaching. My first impression of Mariela was that she was very willing, nice, and enthusiastic about the project. The original idea was for her to use the project curriculum materials to organize science classes, and for me to observe and support her with feedback after class. Mariela said I could observe two classes before starting with the deliberative guides so that the students could get used to my presence in class.

In observing those classes, I noticed a friendly atmosphere among the students. I was struck by the horizontality of the treatment of the teachers, both generally and in Mariela in particular. But my impression was that although Mariela welcomed and integrated students, it was not necessarily to promote challenging learning, as I recorded in the fieldwork notes:

The atmosphere is quiet in the room; there is little noise, and the students work on the guide. They laugh and seek to talk to Mariela. Mariela says they must complete the guide or “they’ll have a 1 [the lower grade in Chile].” She says it to a student; she doesn’t say it angrily; she says it as a normal thing. They must draw species they observed in the botanical garden. I wonder why students don’t do more challenging activities. Mariela leaves the room; the students don’t seem to notice. They sit in the same groups as always. They don’t do the activity; they talk quietly, sleep, or look at their cell phones.
(Researcher’s notebook)

A rough beginning

The first deliberative lesson was no different from the previous ones. The teacher attempted to carry out the deliberative activities mechanically, more focused on control and formal

accomplishment than achieving a dialogic pedagogical process. The curricular material did not seem to accomplish its goal of scaffolding dialogue and collaboration. Mariela encouraged student participation through assessment: if they participated, they would obtain good grades; and if not, or they misbehaved, they would be threatened with being reported. The students copied the answers from the guides to arrive at an answer as quickly as possible, or they randomly chose an alternative.

The students had a hard time reading the case and understanding the problem. Mariela let them work on their own without structuring or supervising the class. As I walked through the groups, I didn't hear any deliberative dialogue among the students; they were silent, and they asked me what to do. I explained to each group that they should read and try to think of different solutions to the question. In response to these instructions, students expressed very low expectations of themselves: "*We don't come here to learn, we come to pass*" (V́ctor, male student). "*We don't think. This is very difficult because we don't think*" (Ina, non-binary student). This class was very stressful for Mariela, who was very aware of the students' struggles:

Helena: And how did you feel in the first classes?

Mariela: I think I was in distress. I was afraid that maybe it was too much because I realized that children don't have a very high, very advanced level in science.
(Transcript of the second interview with Mariela)

From participant observer to co-teacher and the transition to deliberation

We talked after class and my notes reflected the following: *Mariela has very low expectations of the students, and the truth is that she sees them as students as somewhat lazy. That was her impression. And even though she says she values the diversity of the classroom, that's like a barrier that exists for her* (audio note of the researcher after meeting with Mariela).

Mariela, the students, and I were all uncomfortable, finding ourselves in a very stressful situation. We arranged a meeting with Mariela a couple of days later, and she told me we should lower the academic level of the materials. Instead of talking about the problems, the students first needed to learn basic skills such as reading graphics. I was sure they could talk about science, but I wasn't sure how to adapt the materials. We considered canceling the implementation instead of forcing the students to do activities that were not working. I also offered to support Mariela to apply the methodology. We agreed this could work because she had knowledge of the topic and I had experience in mediating group work, so together we could achieve better results with the students.

We talked about how the students were struggling with the guides. Mariela believed the individual reading of the guide was a problem because the students could not understand the basic concepts and got bored with the text. We agreed that we should adapt the materials to motivate the students and give them the basic skills, as Mariela had suggested. But we also agreed to challenge them to argue and dialogue, which was my concern. We proposed that before every deliberative guide, Mariela would teach them the skills and concepts needed to understand the problems (not the possible answers to the problems but basic skills such as concepts used in guides or abilities such as reading graphics). Mariela also said it would be better if we read the guides out loud instead of giving them to the students to read individually. I told her it was also important to connect the students with the problems and topics and to believe they could come up with possible answers. We needed to stop talking about grades and show them the wonder and relatability of what we were talking about.

From the beginning, my relationship with Mariela was based on trust, and I felt we were both genuinely interested in learning from the other. I always gave my opinions as suggestions,

and I asked for her opinions and feelings about my interventions in class. This can be observed in the following exchange in the second interview with the teacher:

Helena: (...) I've been afraid that you might feel like I was forcing you or trying to pressure you to adopt the deliberative methodology...

Mariela: Not at all, not at all. I feel you are a trustworthy person.
(Transcript of the second interview with Mariela)

From the second deliberative lesson, we adapted each guide and co-taught the classes. We talked briefly after each class, and before starting a new guide we evaluated the previous one and revised and edited the next guide, with the aim of using it to connect with the students, challenge them, and promote dialogue. We had five evaluation and planning meetings with Mariela and a final meeting in which we talked about the whole project. Our meetings lasted between 1 and 2 hours, and we shared our thoughts, feelings, and impressions about the project. Table 3 shows the editions and changes that we implemented. The changes from the first session were implemented in all sessions: cooperative reading out loud, explaining more complicated concepts, talking about motivations, and remarking on high abilities and learning as a dialogical process. We created a new guide (Guide 4) because we felt more confident about the students' responses to our changes. We also added a final session to discuss any problems we felt were still unclear and to create a space to share snacks and bring the experience to a close.

Table 3.

Adaptations of the original project's materials

Guide	Adaptations
1	No adaptation or changes
2	-We add a class to teach the students interpret graphics - We ask students to take turns to read out loud the problem in plenary - Mariela explained difficult concepts of the problem and read the graphics with the students in plenary

- Helena dialogue with the students about the beauty of the atmosphere and how it is related with their lives
- We explicitly remark the students' high abilities and the process of learning together
- 3 -We add an extra class to understand the composition of the atmosphere
- We start the problem talking with the students about their motivations and conceptions about the atmosphere
- 4 -We created a new different guide more relevant to the students' comments.
- We talk with the feminine and gender dissident students to encourage them to talk about different perspectives.
- 5 -We edited some parts of the guide to make it more accessible to the students
- We did a previous session to motivate the students and connect the problem with their experiences.
- 6 -Mariela did a previous class about basic concepts of ecology. The class was constructed with questions and answers.
- 7 -We created a final session to discuss about concepts that remained unclear, we share snacks, played games, and closed the project.

We agreed I would lead guide 2. Rather than deciding how many guides I would lead beforehand, we evaluated this following each class. In the end, I led guides 2, 3 and 4, and Mariela led 5 and 6. In the classes that I led, she provided conceptual support for the course, and I moderated the class dialogue in groups and in plenary. Mariela was very skilled in gently focusing the students on the task, and I learned from her how to connect with the students while refocusing them on the task. I was explicit about my high expectations of the students, and I talked with them about our motivations for the topic, which were very real, as I was learning with them about climate change.

We started the second guide with Mariela explaining that I would participate more actively in the classes. As planned, Mariela read the case out loud, taking turns with students, and we projected the guide onto a television that we took to the classroom so that everybody could follow. She explained concepts that were potentially difficult. The excerpt below shows how I introduced the plenary and motivated students to think about the case:

So, there's something here, in the atmosphere, that allows the temperature not to change, for life to arise on earth. And scientists have not been able to fully explain that still (...)

What things that you, who currently live on this planet, have seen, perhaps heard, may be influencing the earth's temperature to be stable even though millions of years have passed, and the sun has changed? Imagine, what is it in your environment, in nature, in the atmosphere, in space, that could help us explain this...that the atmosphere adjusts so that the temperature remains stable? (...) You have to imagine, if you were a scientist and you tried to explain this problem, what would you do? Think about it; I know you can imagine it and come up with an answer.

(Transcript of second guide video recording)

In every class we started talking about the connection between the class material and the students' lives or the beauty of the content, and the importance of dialogue. Here is an example from guide 3:

Helena: Excellent, we're looking at the temperature in the earth and the atmosphere, how the atmosphere regulates temperature. And why are we talking about this? What is the use of this? Or the beauty of it?

Pablo: To know the impact that human beings have on the planet and on natural processes...

(...)

Helena: Indeed... Today we are going to invite you to discuss the greenhouse effect; if we understand this, we will understand why climate change is so relevant and what it has to do with your lives or perhaps those of your children, if you want to have them. That's why we're going to invite you to have a discussion. We're not used to arguing, it's not something we always do at school, so it's something we're learning to do. To discuss, it is important to first think about one's own idea and then exchange ideas. When exchanging ideas, what is difficult is to listen to the other, if the other does not agree with you (...) I'm going to invite you to think this time, to look at the arguments, to try to respond to your group and achieve a dialogue between you, because in this way, we learn to think and, by talking with the other, we learn. You have been doing well, you have been advancing, but I am going to invite you this time to seek more dialogue, to say your ideas and to try to compare them with what the other is saying. Is it not necessary to agree on everything, right?

(Transcript of third guide video recording)

After this initial motivation, in the first classes I encouraged the students, one by one, to give their individual opinion, validating them. Mariela observed me interacting with the students. Then, the same question was discussed in groups, in which I went from group to group, encouraging discussion, accompanied by Mariela, who observed me and answered any science questions that arose in the group while reading the case.

Students responded to our changes

Mariela and I were surprised by the students' responses and motivation. Students with behavioral problems and learning disabilities who had never participated in class before, and even escaped the classroom during science class, began to participate. Here are some examples of Francisco, a student with ADHD who usually escaped classes, participating in a plenary:

Francisco (to Mariela): Did you know that each person a year generates more than 3.5 tons of CO₂ emissions into the atmosphere?

Evelyn: A lot...

Francisco: Even Evelyn produces that...

Mariela: Everyone produces...

Paul: And that's in general or...?

Francisco: You generate the same, even if you don't want to, bro...

Paul: But what if a person wants to reduce their CO₂ footprint?

Francisco: That person is still using electricity and water...

Francisco: Those who use a washing machine generate pollution of more than 700,000 microplastics that go directly into the sea... And it generates pollution because, in addition to wasting a lot of electricity, it uses a lot of water, and the water that comes out of the washing machine comes out with contamination, with ink...

Mariela: There are people who connect the outlet of the washing machine to their garden, but for that you need biodegradable detergent.

Francisco: There are people who connect it to the toilet.

Mariela: Yes, that's also an option.

These excerpts illustrate the participation of a motivated and curious student. Mariela said:

It was wow! When had I ever heard him argue something so well?! (..) He threw his freak data there in class; it was because he was interested in the subject, it made sense to him.
(Transcript of second interview with Mariela)

The students became truly engaged, not only in plenaries but also in group work, as can be seen in the excerpt of Table 4. Square brackets [] denote the codes presented previously in Table 2.

Table 4.

Peer interactions on guide 3, greenhouse effect

1.	Evelyn: When did the hole in the ozone layer start? Does anyone know? (Luna and
2.	Carolina shake their heads) ...What else, girls?... (silence)... It could be alternative A, it
3.	posits that there is in some way a "layer" that is kind of directly related with this

-
4. question... (looks at Carolina, Carolina nods, Evelyn notes in the guide... [Deliberative goal])
5. **Luna:** I found something here... (looks at cell phone). Here it says that without the
6. ozone layer there would be no possibility of life... (she falls silent and looks at her cell
7. phone, reading) ... Its function is more than anything else...functions of protecting...or
8. conserving oxygen (silence). [Definition]
9. **Evelyn:** So, without the ozone layer, we would all be dead and there would be no life
10. (Luci nods). [Reflection]
11. **Evelyn:** Did you have anything, Luci? (Luci looks at the phone and shakes her head.)
12. **Evelyn:** Because here it says, these gases chemically react with infrared radiation ... And
13. here (indicates guide) ultraviolet radiation is implicit...in B. [Definition] [Uncertainty language]
14. **Luci:** The B?
15. **Evelyn:** I think it could be A because it says that the action of infrared radiation could
16. play a role. UV can be dangerous... (Read and search on your phone). I think it could be
17. A then. [Argument] [Withdrawal]
18. **Carolina:** Do we have to find one answer?
19. **Evelyn:** Maybe we can try to develop both a little bit and see which one we decide.
20. (Carolina nods) [Deliberative goal] Luna, do you think that the A it is? (silence) [Require to assess position]
21. **Luna:** I don't know... (silence)... (She takes a pencil and tries to choose one option randomly) [Not deliberative goal]
22. **Evelyn:** Carolina, ¿what do you think? [Require to assess position]
23. **Carolina:** I don't know, I don't know if I'm understanding. I think the warm-up...that
24. global warming has to do with radiation... And here's a study on global warming that
25. says recently with pollution the loss of energy has slowed down... But I don't know... [Definition/notion] [Uncertainty language]
26. **Evelyn:** So, they may be related, but I don't know... I got confused... (Silence, look at their guides)
27. **Luna:** It's only that A... What I don't understand is that it says "important changes"
28. ...important like what? What "important changes", that's why I can't... I don't know how
29. to relate it. [Active search for arguments and counter-arguments]
30. **Evelyn:** Like it is, but is not that well written... The problem is that the two answers are
31. kind of related. [Mirroring]
32. **Carolina:** From what Luna says, it would be this one because it says what happens
33. (indicates the guide, answer B). [Mirroring]
34. **Evelyn:** It's kind of more explained (silence)... So that's it (silence). After some serious
35. debate (laughs), Luna explained that A says major changes, but doesn't say what changes
36. while B explains more, so I think we're going to go for B. [Argument] [Recapitulate]
37. **Luci:** I knew it! See? (ironic voice) I knew...
38. They write in their guides.
-

In the first group-work session the group barely talked and copied Evelyn's answers. Evelyn continued to lead the discussion, and she sought to ask open questions and illicit other

perspectives (lines 1, 2, 11, 19, 21). Luna also participated, and her disagreement with the group was important for the final decision (line 27). Likewise, the students actively sought studies that would enrich the answer (lines 5 and 16). Students were open to not understanding the problem and finding an answer through collective reflection. Although Carolina at one point tried to give up on reaching a consensus (line 17), Evelyn responded by inviting the group to think about both answers before deciding (line 18), which is a characteristic of deliberative talk. Luci was the least involved in the discussion, but she remained attentive (this can be inferred from her body language and how she reacted in line 37 when the group reached an answer). Thus, in the example, we see how the students had an open attitude to exploring, investigating, doubting, encouraging themselves, and enriching their answers through talk.

If we observe the output of the quantitative analyses of group dialogue (Figure 1), we can appreciate the change that occurred in the students' dialogue and how interactions (deliberative and non-deliberative) started to increase. The progressive presence of deliberative interactions is especially noteworthy, given the challenge that their emergence imposed on teachers and their scarcity in typical classrooms, according to the literature.

Figure 1.

Average of groups' deliberative and non-deliberative interactions by guide

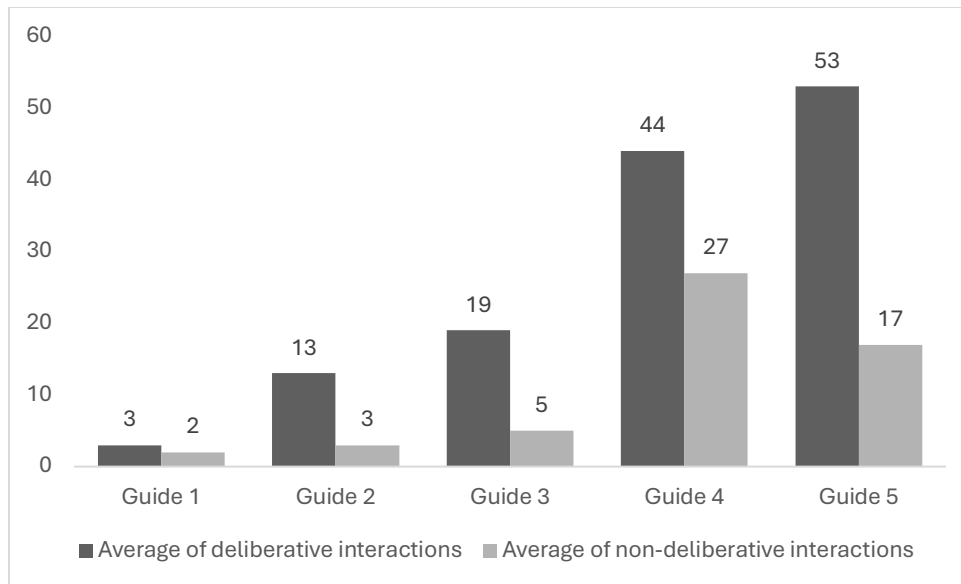


Table 5.

Code frequencies of deliberative and non-deliberative interactions throughout the guidelines

Type of interaction		Frequency
Argument		65
Counter-argument		55
Non-deliberative goal		37
Interruption to an argument		25
Uncritical	concession	24
Deliberative goal		21
Require	position	17
Definition/notion		16
Language of certainty		15
Mirroring		15
Partial	agreement	14
Require	clarification	14
Follow-up		11
Uncertainty language		9
Recapitulate		9
Active search for arguments and counter-arguments		6
Change of position (withdrawal)		6
Agreement		5
Reflexivity		3
Rhetorical	question	1

Table 5 shows the analysis of the group-work peer dialogue to capture deliberative and non-deliberative ways to approach problems (for a definition and examples of each concept, see Table 2). Arguments and counter-arguments were the most frequent deliberative codes found in the dialogue analyses, as can be seen in Table 5. But the students also struggled to enter the deliberative dialogue and often tried to go to a quick—and not dialogic—answer; or they tended to interrupt or agree with one another uncritically, as we see in the same table. The teacher mediation helped them to develop a way to talk to one another that constructed knowledge considering diverse points of view. An example of this is the following dialogue, where Mariela and I approached a group of students who were arguing loudly:

Mariela: But why so upset!?

Víctor (gesturing to Pablo): He's the one who's upset, the one who wants us to spend about 30 minutes on every question!

Rodrigo: Shut up! I said, it's four, he said four, he said four, and she said four... Logically, we won...

Helena: Yes, but you're only taking a vote, you're voting, not giving arguments about why... Because here the idea is to dialogue because we don't know what the other person is thinking...

Rodrigo: I think the son is more useful than this...

Helena: That's not an argument...

Mariela: Remember, you have to justify why you said that...

Rodrigo: This is what would help you the most not to pollute. This is the first thing, because it encompasses everything, it encompasses everything.

Helena: And you, Luciano, do you agree with that?

Luciano: Yes.

While the overall experience became more positive, two aspects are presented as difficulties in implementation:

1. Social construction of intelligence in groups. In the theoretical framework, we address the problem that teachers often hold fixed, individual, and inherent views of the intelligence of their students. In the class experience, we also see this in the students while they dialogue with one another, resulting in students with a diagnosis or students who were part of special programs often

struggling to be heard and validated by their peers. These students were able to participate through our mediations with them, but their opinions in the groups were often not recognized. For example, a student with mild intellectual disability, who we will call Cristina, commented that she participated when she “*talked to you*” (referring to the teachers). However, in group work they tended not to follow her contributions in the dialogues. This is reflected in the following dialogue in which students decided whether to go with Agus or Cristina’s idea about the problem:

Agus: According to me, it's more what I told. I think my theory is most functional.
Cami: Yes, because maybe...you know... You're kind of smarter... (looking at Cristina). It's not that you're not smart.
Cristina: Yes, yes, I know...
Cami: Agus knows a little more about the subject, you know?
Agus: Yeah well, keep talking...
Cami: You know more about the topic, and you are cleverer...
(Transcript of first guide video recording)

2. *Gender as a relevant category in the analysis of the experience.* The classroom was spontaneously grouped according to a gender criterion among the students. Students could get in groups of their choosing. Cisgender male students sat at the front and worked together, while female students and gender dissidents were grouped together.

The group of male students participated much more in the plenaries, and we had many more interactions with the male group than the female and dissident group. The male group members argued more, were more passionate about issues, escalated in discussions, and had more difficulty reaching a consensus and listening to one another. On the other hand, the women and dissident group members talked less, listened to one another more, and reached a consensus faster. This is congruent with quantitative data. Table 6 (below) shows that the male group had more interactions, but also more non-deliberative dialogue, than the female group.

Because we perceived male students to be more confrontational, we gave them more feedback so they could learn to listen to one another and argue without offending their group partners. This was also true in the plenaries, where cisgender male students tended to give answers and rebuttals more quickly. This meant we tended to give more attention to men than women in class. In the guide 3 video-recorded lesson, it was observed that during the plenary I turned my back on the group of female students and gender dissidents to continue talking to the male group for several minutes. We felt the female and dissident group members were self-conscious about our presence, and there were long moments of silence. Our interventions were generally shorter with this group, as we tried not *to intimidate them* with our questions. These gender differences were also mentioned by the students in the interviews, and this analysis enriched the educational experience. For example, we encouraged the feminine/dissident group to articulate their ideas even when they disagreed, and I realized I had to consciously make more eye contact with the feminine/dissident group during plenaries.

Table 6.

Comparison between male and female and gender-dissident group interactions

		Male	Female and gender dissidents
Total	deliberative interactions	111	86
Total	non-	31	23
deliberative interactions			
Total	group	142	109
interactions			

Mariela retakes the leadership and changes her perception of the class

As lessons 3 and 4 proceeded, I noticed that the students grew fond of me, approached me, told me about their problems, and told me they liked me as a teacher. I felt an emotional and intellectual connection with them. This gave me joy, but also concern, because my time with them was limited

to the project, and it was with Mariela that they should strengthen their main bond. We decided Mariela would summarize the leadership of the lessons in the next guide (lesson 5).

In these last deliberative classes, we felt more confident about changing and designing our own deliberative materials. Our meetings were always friendly and horizontal, but in the last ones, we developed more confidence, empowered by the progress we saw in the students. In one of these meetings, we had a surprising deliberative dialogue with another teacher who *did not believe* in climate change. The next excerpt of my audio notes of the meeting reflects how the process of creating new material emerged:

We were talking about how pleasantly surprised we were about students' argumentation and how the next topic was climate change when a male teacher that overheard us approached and started to argue with us about how climate change was an invention to manipulate the population. We started arguing with the teacher and the discussion was kind of entertaining. Then, when the teacher left, we talked about how we wanted the same thing to happen in the classroom. We were talking and we found it more interesting to create a new guide to introduce fake news with scientific information that is surely what they see on their social networks.

(Audio recording after planning meeting with Mariela)

In these final classes, where Mariela resumed leadership, I noticed changes. She taught based on open questions in dialogue with students. Although she had difficulty developing the discussions in the plenaries, in the last lesson, she managed to navigate the different views and tensions among the students. I saw an active and motivated class, which was also very challenging for Mariela because the students not only deliberated about the guides but also constructively criticized the class material and concepts. For example, we were asked to stop printing single-sided paper guides because of the paradox of discussing climate change while *using so much paper*.

Mariela seemed motivated in class; the atmosphere was active and participative. At the end of the last guide, she congratulated the students on their quick progress. And in subsequent interviews with Mariela, a change in her perception of the course was noticeable:

For me, it's the easiest course for me to teach, the 11th grade, more than even my own course, by far. It's a very engaged, respectful course, which is super important; they have problems like all kids, but respect in the classroom is still very important... They know how to work and do activities, which not all courses like...figure out how to focus on that.

The reflection skills that the 11th grade has, I think, are very good; I feel like they reflect a lot... It was a job they managed to reflect on, yes, but they totally achieved it.
(Second interview with Mariela)

After the project ended, Mariela told me she was still using group work in class, and our experience had allowed her to see it was possible to implement dialogic methodologies in her classes.

Mariela: I like kids to be like...that they search the answer, see things, not just copy... I think this project helped me to have more confidence in doing that...

Helena: How come?

Mariela: That this kind of methodology works. It can work quickly, leading students to search for the answers. I think now I can do that in another class...
(Second interview with Mariela)

This experience in a school science class was also a learning experience for the researcher. From Mariela, I learned how to connect with the students and gently focus them on the task. Mariela knew her students and gave key ideas about how to adapt the materials. For example, she suggested the strategy of reading out loud; she managed to get a TV (which the students helped us to carry up and downstairs) so we could project each guide and show pictures and videos. She proposed breaking down the problem with them, preparing them in the basic skills and concepts necessary to understand the deliberative problems. Without this scaffolding, the students probably would not have connected with the cases and problems in the guides. The students were also a

great source of knowledge. For example, they taught me about gender dissidence and creative ways of living gender:

Eric: No... Wait. Cisgender people are those who identify with the gender and sex they were given at birth; that's what they identify with.

Helena: I get it, I get it, I get it... It has nothing to do with being straight or not.

Eric: No.

Helena: That's another thing. I have learned so much from you guys; it's awesome...

(Eric, transcript of the second interview)

Along with that, they showed and taught the researcher that the key for implementing the activities was to connect with their interest and motivation:

Do you know the saying “in one ear and out the other”? This is similar. You read it but don't retain the information because it is not interesting to you. Because the information does not interest you, when something interests you, you retain it for a long time, perhaps your entire life. Interest, the desire to learn, and motivation are very undervalued things when it comes to learning... I have been studying in my life... How much? Half my life? And I don't retain much information about that...

(Victor, transcript of the first interview)

Discussions and conclusions

In this ethnographic case study, we present the experience of a science teacher and researcher/co-teacher (the paper's main author) implementing a curricular innovation project, *deliberative teaching*, in a diverse and underserved class. The research questions that guided the study were: *What is the process of implementation of deliberative teaching in an underserved science class with diverse students and low academic expectations? How can the teacher and researcher relationship implementing a pedagogical innovation promote—or not—peer dialogue?*

To answer these questions, we presented a specific and context-based narrative about how a teacher and researcher could work to promote such change. The teacher and researcher transformed the original framing of the project and worked together to think of ways to adapt the materials to the reality of the students without losing sight of the aim of the innovation. The

narrative of the process highlighted the need for a horizontal and flexible teacher–researcher relationship that considered the complexity of the context, without forgetting students’ potential to engage in dialogue and enjoy challenging learning and deliberation activities. Also, the case narrative was supported by the codification of peer interactions, which exemplifies the potential of deliberative teaching in complex contexts.

The title of the paper, “We don’t come here to learn; we come to pass,” includes a quote from a student in the first session of the project and represents a complex educational problem facing several schools that serve diverse and low-income students. For several reasons, such students are not expected to learn in a complex, challenging, and relevant way at school, and students not only know this but also identify with these labels.

As a complex problem, it has different points of analysis. The school was inserted in a high-consequence standardization regime and was labeled as low achieving, which impacted the academic identities of teachers and students (Falabella, 2020). Although the school project valued diversity and the school is known for its spirit of acceptance and respect, there was a tension between integration and academic challenge. Also, most of the students were part of governmental programs. The school received funds depending on diagnoses and labels that highlighted the lower expectations and were well-known by teachers and students (Shields et al. 2005). Understanding all these pressures and the hard work of teachers working with underserved students, Mariela tended to interpret the difficulties of the students from a deficit perspective. Initially, this perspective explained the activities’ more structured and rigid implementation. These factors could promote deficit identities that mask and reproduce structural inequities (Gorski, 2016). These identities have an impact not only on students’ academic results (the so-called achievement gap) but also on their subjectivities. And this is why it is called an identity debt for underserved students

in science (Ladson-Billings, 2006). For example, while solving a science problem, one student in the study said: “*We don’t think; this is too difficult because we don’t think.*”

Implementing an innovative deliberative curriculum in such scenarios is a challenge, and this was reflected in the case narrative. The first classes were difficult: the teacher thought the materials were too challenging for the students, and the innovation reinforced a traditional style of teaching. This is consistent with the case study of Lowell et al. (2024), where curricular innovations taken as scripts could strengthen traditional teaching. The beginning of the case study seemed to match the low-expectation-circle literature revised in the theoretical framework. Students struggled to understand the material, the teacher lowered the academic challenge of the project, and diversity was also mentioned as a barrier to accomplishing deliberation. The researcher even offered to cancel the study when she became aware of the stressful situation in class.

The problem with the low-expectation vicious circle is not only the structural problems of school educational systems but also how research university projects are designed and implemented. If this study design had remained as planned—with a non-participating observing researcher implementing a finished pedagogical design—the results would probably have confirmed that deliberation and collaboration are less suitable for marginalized students. Researchers should know that the designed projects are not necessarily the right intervention, and persisting with them could reproduce narratives of deficit (Tuck & Wayne, 2018). More than implementing a good teaching practice, the case narrates an attempt at a transformative alliance between teacher and researcher to promote equality, learning, and social justice (Penuel, 2007). This can be interpreted as a process of humanizing the practice of educational teaching and

research, taking the designs and implementation toward more participatory models of inquiry (Irizarry & Brown, 2018).

What Lowell et al. (2024) presented as two different approaches to innovations (one rigid and another with a flexible design) occurred in the same case in this study. For that to happen, *flexibility, horizontality, dialogue, and emotional connection* were key in the teacher–researcher relationship. Flexibility meant being aware that the implementation was not serving its purpose and they needed to try something else; the flexibility of the teacher being open to the researcher’s advice; and the flexibility of the researcher to change her role and the study design. Horizontality meant building a relationship of trust and risking a different approach. Dialogue meant understanding the problem from both educators’ perspectives and an emotional connection with the class, considering the feelings of both teacher and researcher about the project (especially when we felt uncomfortable about the project), and wondering about the reactions and engagement of the students.

All of these methodological features—flexibility, horizontality, dialogue, and emotional connection—are congruent with the model proposed by Ruby (2006), which highlights the importance of a flexible relationship between teacher and researcher, including feedback, cooperation, the need to adapt materials to the reality of each classroom, and co-teaching and modeling where necessary. In this study, however, we focused on how that mode of relationship can support dialogue in classrooms and practices that promote academic challenges among students rather than improving the standardized test. We presented data to support the counter-narrative of deficit and to show students’ progress in challenging and complex deliberative dialogue in groups.

The flourish of dialogue, questions, motivation, and joy among the students in class was surprising and empowered the teachers to carry on through the difficulties. The teachers started to create their own materials for the class inspired by the project materials and deliberative teaching, and the science teacher resumed the main role of teacher in the class. However, there were some difficulties. Having gender as a category of analysis (Lykke, 2011) made us realize what we needed to improve. The class was spontaneously grouped according to a gender criterion: cisgender male students were grouped together, and cisgender women and gender-dissident students worked together. And there were differences in how they dialogued: because the cisgender male students were more confrontational and active in conversations, the teachers tended to give them more time, guidance, and attention.

Another difficulty was the low expectations of not only the teacher but also the students, who were very aware of students' diagnoses, and the opinions of those with mild intellectual deficits were less validated. This is congruent with literature expressing that epistemic power plays a role in peer dialogue (Langer-Ozuna, 2028; Leftstein & Snell, 2014). So, it is particularly important to promote not only dialogue but also a safe space where students learn and practice how to listen to one another and build different worldviews (Author, 2023).

Considering Leftstein and Snell (2014), the study demonstrates the need to present the practice of deliberative teaching as a contextualized, complex, and imperfect activity that can arise in different settings. As an imperfect and human activity, there is always space for growth and learning. The study attempted a more flexible and participatory design, and more needs to be done when working with underserved youth, especially connecting with students' lives, communities, and problems. Even though the teachers tried to adapt the curriculum materials based on the interests and lives of the students, the direction of these changes was always from the materials to

the students. Looking back on the project from Freire's pedagogy's transformational and critical lenses, more could have been done to use the students' interests and communities as a starting point for designing the science activities. As Morales-Doyle's (2024) transformative science teaching model presents, it is possible to teach complex scientific concepts, especially climate change, in a way that addresses students' local concerns. A future challenge will be to codesign deliberative spaces that integrate students' views about environmental justice as central points. This implies that the parents and community should be included as relevant pedagogical and research design actors.

Finally, this study shows how students in underserved and diverse schools can engage in dialogue critically with one another in content-specific and challenging ways. Considering dialogue and deliberation to be privileges of the neurotypical upper/middle classes is dangerous for democracy. Following Freire (1968) and Dewey's pedagogy (1916), we see deliberative dialogue as a way to empower oppressed students. Part of that oppression could be the subjective damage to their identities as *deficient learners* and the neutral and androcentric discourse of Western science. This implies not only overcoming an oppressive system but also recognizing that everyone—teachers, researchers, and students—is part of complex power structures that intersect gender, sexual orientation, social class, race, ability, and intelligence in social practices. In that way, we can promote reflexive, critical, and connected citizens and a complex, diverse, and dialoguing science pedagogy.

REFERENCES ([click to link](#))

3. Article: Science identities of female students during peer group work: intersectionality, power, and knowledge construction in the science classroom

Status: Sent to journal.

Journal: Cultural Studies in Science Education (WOS/SCOPUS)

SCIENCE IDENTITIES OF FEMALE STUDENTS DURING PEER GROUP WORK: INTERSECTIONALITY, POWER, AND KNOWLEDGE CONSTRUCTION IN THE SCIENCE CLASSROOM

Keywords: science identity · intersectionality · power · peer interactions · gender

Abstract

To address complex global issues like climate change, public health problems, and genetic testing, we must prepare our younger generations to think collaboratively and scientifically, embracing diverse voices and identities. Collaborative peer group work has been shown to enhance learning in science classrooms, but the influence of student power dynamics on knowledge construction and the reinforcement of dominant identities, remain unclear. This is particularly relevant in the context of the so-called gender gap in science, which highlights the under-representation of females in the field. This study focuses on collaborative peer learning and the female gender gap through the lenses of identity and intersectionality. Using social practice and critical science approaches, we explored how an 11th-grade female student and her peers navigated their intersecting identities during dialogue-based science activities in a working-class school in Chile. The question was: How does the science identity of a female student unfold throughout a dialogue-based group experience, considering the narrative and in-practice intersecting identities of the student and her group peers? The findings capture the development of the student's science identity as the group leadership and dynamics changed, enabling more recognition and epistemic power. Gender, considered as non-binary, was a central social marker that organized the in-practice and narrative identities of the student and her peers, intersecting with their other identities. Fostering knowledge co-construction and inclusivity requires students, and particularly prominent science learners, to empathize, connect, and share power. This is essential for creating not only more

opportunities for marginalized identities in science but also more complex and richer group learning for all.

Introduction

In a context of political polarization, fake news, and critical socio-scientific challenges such as climate change, health crises, and vaccinations, to name a few, science classrooms must be transformed to create collaborative spaces where students learn to think scientifically and interrogate science, and construct knowledge together, considering different voices and identities. Science education is being framed as a social and discursive practice in which students solve problems and answer questions among peers in a context where scientific knowledge is seen as provisional (Evagorou et al. 2020). Efforts have been made to teach science through scientific inquiry and argumentation, using modeling and other scientific practices, and collaboration among peers (Mansour and Wegerif 2013). The underlying idea is to promote horizontal interaction among classmates, who, through dialogue, solve problems by proposing their ideas, explaining their reasoning, and grappling with their disagreements (Howe and Abedin 2013).

Dialogue-based approaches result into significant learning benefits when compared to traditional instruction (Howe and Zachariou 2019). Multiple studies have shown a clear and consistent effect on student learning (for review, see van der Veen and van Oers 2017) and developing reasoning abilities and language (e.g., Asterhan and Schwarz 2016). Studies specifically in science classes also reveal advantages of dialogue for learning (e.g., Larrain et al. 2019).

However, most dialogue-based pedagogies overlook the influence of power relationships among students in peer interactions, which shape who has a voice in group learning (Langer-Osuna 2018).

Although the frameworks that underlie dialogue-based studies acknowledge the value of socio-affective elements, student voices, and identities, such studies and the methods used in them tend to privilege cognitive dimensions of learning (for a discussion, see Mercer 2010). Perhaps this is based on an assumption that, because students are of a similar age and share the student role, explaining group norms is enough to foster students to participate equally (Barak and Lefstein 2021).

Nevertheless, considering the role of power relationships in science classrooms is crucial to understand how knowledge is constructed and whose identities and social worlds are validated and/or ignored in that process. This is especially important in cases of students with historically marginalized identities from science discourse (see Szostkowski and Upadhyay 2019). The so-called *female gender gap* in science has been a subject of international debate and cannot be explained by school academic achievement alone (UNICEF 2020). Focusing on cognitive learning and filling *learning gaps* do not address the complexity of the problem. Similarly, considering gender as a binary, as most science identity research does, ignores the variety of ways in which students live and perform gender as a spectrum of possibilities (Kroll and Plath 2021), and how their gender identities intersect with other social identities, positioning students differently within powerful social structures (Holland et al. 1998).

The aim of this study, therefore, is to explore from non-binary and intersectionality perspectives how gender, identities, and relationships intertwine in academic tasks when students work together in science classrooms. It is a micro-ethnographic case study in which we followed a female student, Luna, and her groupmates before and through a peer dialogue-based science class in an 11th-grade working-class school in Chile. The research question that guided this study is:

How did the science identity of a female student unfold in a class that centered peer-group work, considering power relationships and intersecting identities of the student and her group peers?

Research on peer-group interactions, identity, and gender in science class

Research on peer group learning, gender, and identity is building up in the science education field (see Varelas et al. 2025 for a review of such studies using positioning constructs). Studies on identities in science highlight the relevance of gender and race in classroom dynamics. Angela Calabrese Barton and her colleagues (2013) worked with US Black female students from a historically marginalized neighborhood for four years and studied students' identity trajectories and narratives over time. One student, who showed a strong interest and performance in science, felt excluded because of her race, class, and gender, despite her grades remaining strong and unchanged. Meanwhile, another girl, labeled average, gained confidence and positioned herself as an intellectual authority through an extracurricular science activity where she connected with peers sharing the same race. In an earlier study, Tan and Calabrese Barton (2007) followed two Latine students during one school year. One of the students, Ginny, identified herself as academically proficient, popular, intelligent, and successful in school activities. The other student, Amelia, was not popular among her peers and teachers. Despite these differences, the study showed how both students strengthened their science identities by integrating their interests into the science classroom, highlighting the interactional dimension of identity and the crucial teacher role, but similarly to the later study not focusing on peer interactions. In a more recent study, Kim (2018) analyzed class interactions and reaffirmed the importance of teachers in positioning students in ways that promote their science identities.

Heidi Carlone and her colleagues' (2014) longitudinal study of three students with diverse gender, ethnicity, and socio-economic statuses in fourth to sixth grade revealed how the

participants' science identities became weaker over time. Focusing on participants' narratives, each case showed how race, gender, and class in intersecting ways hindered the students' identity work through the positionings experienced daily in their classrooms.

Studies that analyzed micro interactions in science classrooms in which students worked in groups focused mostly on primary and middle school. For one year, Kane (2012) followed the work of a group of four third-grade African American students attending a school that mainly served Black families. The study showed how interactions and narratives were mediated by gender. One girl struggled to feel competent in science despite her active participation. She faced interruptions and criticism during group work but maintained her science identity using her drawing skills. In contrast, the boys dominated interactions and gained more recognition. This study highlights the impact of gender on interactions and identity development in early years schooling.

Exploring both positionings and narratives, Rebeca Gamez and Carolyn Parker (2018) focused on the cases of two third-grade newcomer Latine students in a science classroom where the teacher only permitted exchanges in English in peer groups and showed how this micro-world was influenced by class, gender, and race structures. For the participating students, being linguistically diverse was a central aspect of their group relationships. While the boy managed to position himself as central among his peers, the girl remained marginalized and excluded from group conversations. The study reveals how the group's interactions created a figured world that the teacher could not see.

Another study with third graders (Kumpulainen and Rajala 2017) analyzed the identities unfolding in the interactions within a dialogue-based science class but only focusing on whole-class activities mediated by the teacher. The study shows how identities can emerge in interactions

and are negotiated in context, allowing the identification as science learners. Active and reflective students had more chances to be valued and recognized in the class. This raises the question about how these dynamics unfold in group work where teachers have less control and awareness of student interactions.

Jeanna Wiesselman and her colleagues (2020) followed a group of fifth graders during a STEM project. The study's explicit focus on peer group interactions and gender revealed gendered ways in which students positioned and interacted with each other during the activities. Boys tended to be more active and control the materials and decisions during engineering activities. In contrast, girls tended to play a more passive role, such as taking notes and following directions. The study highlighted the need for careful design and implementation to promote the active engagement of female students in engineering and STEM. However, the study did not shed any light on how other students' identities associated with race and socio-economic status intersected in the students' interactions during the science activities.

Given the increased attention to peer-group dialogue as a key factor in learning science and the international calls to fill the so-called *gender gap*, exploring conditions and processes of identity construction that mediate learning in group work seems to be of value. However, most studies of science identity adopt a narrative approach (see Simpson and Bouhafa 2020 for a review), while studies of classroom interactions tend to focus on the early years of schooling (Kayi-Aydar and Miller 2018). Moreover, studies about power relationships during peer-group work tend to consider gender in binary ways. Thus, the invisibility of gender as a spectrum of possibilities in research has contributed to a narrow understanding of how students develop and enact identities in the science classroom (Kroll and Plath 2021), and how gender identities intersect with other essential social markers, such as social class and race, and science discourses. Further

understanding how students' multiple identities interact to produce (reproduce and transform) who identifies—or not—as a science person, especially at the high school level, which is a period when vocational choices are made, is a fruitful area of inquiry.

Theoretical framework

Intersectionality, gender, and epistemic power

The complexities of power inequalities in science increase when we embrace a perspective that considers the intersectionality of identities. Intersectionality is a construct introduced in the 1980s as a political and legal tool to understand and analyze structural violence toward Black women (Crenshaw 2006). Intersectionality has been evolving in different fields to explore the axes of sameness and difference across marginalized groups (Cho et al. 2013), focusing on how sociocultural and sociopolitical markers, such as gender, ethnicity, class, and nationality, interact, producing different kinds of inequality and unjust social relations (Lykke 2011).

Embracing an intersectional lens implies that there is not one female voice or one way of being a female (Troncoso Pérez et al. 2019). Feminist perspectives emphasize the specificity of contexts and recognize their influence on shaping a wide range of realities; this makes it possible to identify and examine the multiple positions and voices of what is considered female intersecting with cultural, racial, and class identities (Frost and Elichaooff 2013). Similarly, being feminine or masculine is understood as a social process of becoming rather than a binary essence (Butler, 1999).

An intersectionality lens necessitates that the problem of the gender gap in science be reconsidered as a historical identity debt problem (Ladson-Billings 2006). Though we must celebrate the progress represented by an approach to science teaching focusing on dialogue and

reflection about socio-scientific problems, we also need to acknowledge that historically, science is still strongly associated with white, middle-class, European, cisgender men (Kang et al. 2019). This means that in a dialogue-based science class, not all students have the same opportunities to contribute and be considered legitimate, valued, and consequential participants.

Miranda Fricker (2007) conceptualized this phenomenon as *epistemic injustice*. Power relationships embedded in social constructions of gender, race, class, and so on shape who is considered a legitimate knower (testimonial injustice) and whose experiences can be expressed and understood (hermeneutical injustice). This means that those with historically marginalized identities in science have a greater possibility of experiencing epistemic injustice. In other words, there is the danger that they will be denied as legitimate knowers of science and with experiences or problems that are legitimate enough to count as scientific.

To understand how epistemic justice, as a structural problem, unfolds in everyday interactional spaces, Machteld Geuskens (2018) proposed the concept of *epistemic power*. He defines it as “one’s ability to exert epistemic influence, that is, one’s ability to influence what comes to be regarded as knowledge and who qualifies as authoritative” (p. 147) Epistemic power is exerted on interactions as the ability to influence what others think, believe, and know, and as the capacity to enable or hinder others’ epistemic power (Archer et al. 2020). Analyzing epistemic power in group work in science allows us to understand who has access to explain and construct knowledge in a collective activity, whose experiences are considered, whose voices count as valid, and how interactions hinder and/or promote identity and knowledge co-construction in the science class.

Reframing the problem of the gender gap as an identity debt related to epistemic power underscores the central role of identity in the content learning process. Curricular reforms and

pedagogical approaches based on cognitive learning alone are not enough. This is relevant because identity is often considered “secondary to constructing knowledge or a residual product of developing (or not) a strong knowledge base in most science classrooms” (Varelas et al. 2012, p. 336). Reforming learning science entails an effort to transform historical relationships of power that have marginalized female and LGBTQ+ communities, non-white, and working-class students. This implies understanding that “science is related to who students and teachers are as social beings” (Szostkowski and Upadhyay 2019 p. 350), which could lead to a critical vision for science knowledge(s). Learning science is a socio-political and dialectical act with multiple dimensions: material, symbolic, cognitive, social, and emotional (Varelas 2018), where difference and diversity are not just dimensions to be considered but play a central role in science and science education.

Narrative and in-practice identities

In this study we consider identities from a social practice theory perspective (Holland and Lave 2009) that is centered on how people in social worlds become themselves, enact their agency, and are influenced by and influence social structures at different levels (micro, meso, and macro) (Holland and Lave 2009). Identity is a complex phenomenon, historically contingent, socially enacted, and culturally constructed (Holland et al. 1998), with processes associated with two dimensions of people’s identities: *in-practice* and *narrative identities*. In-practice identities are performed in interaction with others, in social worlds that Holland conceptualized as *figured worlds* (Varelas et al. 2012); narrative identities are stories we create of ourselves and of others. Dorothy Holland and colleagues (1998) argued that people are not only shaped by social structures, they also author themselves with a degree of agency.

In-practice identities and figured worlds. In-practice identities are enacted, created, resisted, and recreated in interactions within *figured worlds*. Figured worlds are contexts where identities are produced, which include socially and culturally constituted activities (Holland et al. 1998). Based on Mikhail Bakhtin's (1986) concept of *discursive genre*, Holland proposed that figured worlds are traditions of apprehension that bring us together and shape us; we work out our identity in them as our lives unfold in those spaces. A figured world is a narrativized or dramatized world as elements interact like in a story or drama (Holland et al. 1998). Figured worlds are the context of meaning for social encounters, giving different positions to people who play a character in that semiotic world (Urrieta 2007). Students inhabit and bring several different figured worlds when they speak to one another at school. For example, the figured world of a science class includes the micro-culture of a particular science class. This includes who has the authority to speak (the teacher, some students), who structures the conversation, the material ways of organizing the classroom that are expected and allowed (the distribution of chairs, tables, the presence of a blackboard, the spots for students, and the place of the teachers), what responses and bodily ways of acting are expected, appropriate, and allowed, and for whom (for example, what counts as a good student, good/bad behavior, smart way of talking). The specific ways of organizing each figured world are unique. However, social markers such as gender, class, race, and the science discourse that is played out in a space also structure figured worlds.

Figured worlds are the semiotic contexts in which people work out who they are and identities are enacted. Bronwyn Davis and Rom Harré (1990) define positioning as the discursive process that takes place as people interact and jointly produce storylines. In contrast to the construct of role, which focuses on ritualistic and formal aspects, positioning highlights the dynamic and power-related aspects of social encounters, stressing the active nature of producing

social and subjective realities (McVee et al. 2011). Positionings can be interactive or reflective. In interactive positionings, what a subject says positions another; in reflective ones, a subject positions themselves (Davis and Harré 1990). Positionings are not necessarily intentional as they constantly occur in the interactions that take place in the spaces we inhabit every day, including classrooms (Wortham 2005).

When students dialogue and construct knowledge together, they create different academic identities shaped by the students' figured worlds, emotions, and multiple identities (Salas and Larrain 2024). As a performative tool, language is a key component that intertwines knowledge, emotions, identities, and power relationships. When students work together on challenging questions, just recovering memories is not enough; they must actively imagine and relate the problems they attempt to find solutions for to their experiences and beliefs. So, the different figured worlds brought to the interactions act as landscapes of possibility to answer the academic question. Through this performative imagination, students think, explore possible answers, and enrich one another's thinking. Different voices bring about different opportunities to enhance points of view, analysis, solutions to problems, and opportunities to connect, to highlight different values, and to empathize with other worldviews and communities. Furthermore, multiple and diverse voices allow us to grow our consciousness and enrich our subjectivity through communication as a uniquely human capacity, amplifying what we see, what we think, what we feel, and who we are. In this way, as students work together, they engage in a transformative activity that propels them forward.

However, if the figured world of science is restricted to certain kinds of identity, monopolizing the epistemic power in interactions for only a few privileged ones, there are fewer possibilities for all involved to imagine and create through peer interactions, as dominant identities

get reproduced and canonical viewpoints of science reinforced. Language and other communicative semiotic tools are not neutral but part of social structures that order and give meaning often permeated by asymmetry and inequity even for students of the same age in the same classroom who have different gender, class, ethnicity, and academic identities (Salas and Larrain 2024). Discourses are constantly created, rejected, resisted, and recreated in classroom spaces permeated by the power that is involved in interactions (Foucault et al. 1999), and dynamically restrict and enhance the epistemic power and positionings of students involved. Over time, positioning patterns in a classroom may prevent students from developing their science identities, causing them to feel they do not belong in those spaces or may empower students' science identities. Understanding how students position themselves, what figured worlds they bring to their conversations, and how epistemic power is performed in their conversations is fundamental to creating generative science spaces where a variety of identities and figured worlds have equal chances to flourish in interactions.

Narrative identities and inner speech. Students are not just performative social beings; they also construct their subjectivity in personal reflexive dialogic spaces, where each student narrates the story of themselves and others. Through these stories, students give meaning to the interactions and have a range of agency to create and recreate who they are and what they believe about themselves. Thus, an analysis of in-practice identities should be complemented by narratives that people author about themselves. Narratives are not limited to representing reality in an individualistic and cognitive manner; a narrative is always practiced and experienced in a language community (Rudrum 2005). Thus, narratives do not simply represent a person; instead, they are the person acting at that time and in that place (Kane 2012).

Voice (Bakhtin 1986) plays a key role in both narrative and in-practice identities. Voice is the experience of a speaker in interaction with listeners as a semiotic act; thus, in-practice identities are constituted as certain voices call, reject, recognize, or silence other voices (Bertau 2021). In narrative identities, voice provides a tool to recreate, in an internal dialogue, one's positions and those of others in the spaces of cultural production and the figured worlds in which they interact (Holland et al. 1998).

People constantly try to make sense of spaces they inhabit in relation to spaces where they feel valued—a constant task of authorship of themselves and others (Holland et al., 1998). The figured world of the science classroom may or may not meet with other figured worlds of the students in the intersection of their multiple identities. As students make sense of the figured world of science by bringing elements from other figured worlds that are significant to them—for example, the figured world of their friends, hobbies, and everyday life—they are more likely to strengthen their science identity (Calabrese Barton et al. 2013).

Science identity

Science identity is a multidimensional, interactional, narrative, and constantly developing construct that becomes embedded in power systems in the figured world of science, in association with multiple social identities that people perform and narrate for themselves, framed dialectically within social structures. It is how students position themselves and are positioned by others as they become part of and interact with a community where science is practiced, such as a school classroom (Kane 2012). It cannot be unbound from how students behave, act, and are in the classroom in the context of the norms and expectations of structures that govern schools (Varelas et al. 2012). Identity is intertwined with the structures within which is being constructed and the person's agency (Holland et al. 1998; Varelas et al., 2015). Thus, science identity is how students

make sense of the interactions and author and position themselves as science learners (or not) and relate the figured world of science to their other identities.

Considering peer dialogue as a developmental activity mediated by language and other semiotic tools, we understand content learning, reflexivity, subjectivity, and identity as parts of the same experience and all mediated by power relationships (Salas and Larrain 2024). This perspective necessitates that educational experiences must be meaningful to students, and students need to feel that a part of their figured worlds is present in their science class. Embracing and learning from historically neglected voices enrich all student learning and development.

Despite the learning benefits and developmental potential of academic peer interactions, studies highlight the reproductive risk of asymmetrical power relationships in group work. Especially in science classes, the lack of identification with science coincides with historically marginalized students, such as females, LGBTQ+ students, students of color, and working-class students. Exploring how these students narrate and perform their intersecting identities and social worlds when working on science problems presents an opportunity to understand the complex dynamics that promote and hinder the development of students' science identities. Analyzing this holistically can lead to learning how to promote dialogic learning spaces that consider equity and the rich and complex intersecting identities and social worlds of learners. Therefore, the aim of this study is to explore, embracing an intersectionality and non-binary perspective, how gender, identity, and relationships intertwine in academic tasks when students work together in science classrooms. We asked: How does the science identity of a female student unfold throughout a dialogue-based group experience, considering the narrative and in-practice intersecting identities of the student and her group peers?

Method

Design

We conducted a qualitative *case study*. Case studies are characterized by “an intensive, holistic description and analysis of a bounded phenomenon such as a program, an institution, a person, a process or a social unit” (Merriam 1998, p. 13). The case study followed a focus student, Luna (all names are pseudonyms), and her groupmates during a dialogue-based 11th-grade science class throughout a semester. Case studies are guided by concepts, models, and theories that make it possible to illustrate, support, or challenge theoretical assumptions (Merriam 1998). They provide an in-depth understanding of a problem, and are oriented by theory to illustrate it, challenge its pertinence in context, and improve or refine these theoretical developments (Rohlfing 2012). This case study was guided by two complementary inquiry approaches: *micro-ethnography of classroom discourse* and *small stories*.

The micro-ethnography of classroom discourse is an interdisciplinary approach that analyzes multimodal conversations at important junctures and then builds an evidence-based narrative of the group interaction (Green et al. 2020). Student interactions in classrooms:

Create and recreate the worlds in which they live; purposefully struggle with each other over meaning, action, material, and social relationships; resist the imposition of unwanted control and fashion alternative ways of living their lives that eschew given structures and strictures. They retain the potential of agency even in situations in which agency is unlikely or typically absent. (Bloome 2005, p. 4)

The unit of analysis are the interactions between people acting and reacting to others and the focus is on events—a dynamic and creative series of actions in which people create, achieve, adapt, adopt, reproduce, and transform meaning. Although originally this approach attended to oral language as the dominant communication system, we consider communication to be multimodal and, therefore, explored not only the linguistic but other semiotic systems involved in interactions, such as gestures and body position, gaze, and movement (Jewitt and Kress 2003).

The small stories approach has been used in narrative and identity analysis (Bamberg and Georgakopoulou 2008) that focuses on “the social actions/functions that narratives perform in the lives of people: how people actually use stories in everyday, mundane situations in order to create (and perpetuate) a sense of who they are” (p. 378). The focus of small stories is on engaging in meaningful and creative possibilities in which characters are created and positioned dialogically. The shift to small stories highlights an effort to move away from narrative studies that privilege long, reflective teller accounts of past events. However, length is not the defining factor of the small stories approach: “Smallness encapsulates the fleetingness of stories in interactional moments, their embeddedness into local contexts, and the analyst’s attentiveness to the emergence of plots in the microcosm of everyday life experience” (De Fina and Georgakopoulou 2020, p. 95). The small stories approach examines, in group interactions or interviews, how the speaker presents the characters of a story, how the interactions unfold, and how the narrator or speaker establishes a sense of identity (De Fina and Georgakopoulou 2020).

Positionality of the researcher and reflectivity

In a study that seeks to analyze positionings, power relations, and identities, the researchers’ positionalities, subjectivities, and worldviews about research ought to be explicitly shared. Reflexivity contributes to rigor and control in qualitative research; consequently, understanding

the association between a study and the researchers' positionalities and experiences is an essential quality criterion (Berger 2015).

For the first author and lead researcher, identity, learning, and interactions make sense because as a cis woman, mother, part Mapuche, South American researcher, former public school student, and later an elite university student, she has experienced discourses in academic spaces where she has felt certain arguments and ideas were considered or ignored not because of their perceived value but because of the identities of the people sharing them. Although these experiences have strengthened her capacity to notice power and privilege, they were not sufficient. Therefore, as a criterion of rigor, constant reflection and dialogue were present throughout the research process. The lead researcher used a notebook to record her feelings, opinions, and analyses during data production and interpretation. These records were recursively revisited, re-read, and juxtaposed with the data to constantly reflect on her own viewpoints. Likewise, the analyses were conducted in constant dialogue among the three co-authors. Finally, after the first analysis, the first author shared the main findings with the study participants to solicit their feedback and refine the results.

As for the second author, she identifies as a South American researcher, a Spanish native speaker, raised in a culturally privileged environment: her family has attended higher education for at least four generations and has been part of the political history of Chile. Her great-grandmother was one of the first Chilean feminists, who translated *The Subjection of Women* by John Stuart Mill from English to Spanish. She has been studying the effects of deliberation and argumentation on learning in public schools. The third author identifies as an immigrant to the United States, a first-generation and working-class college graduate, a bilingual woman of Greek ethnicity, and with Greek as her first native language. She has been working for over three decades

with teachers to problematize and resist deficit perspectives, co-designing and studying approaches that center the brilliance, ingenuity, and learning of Students of Color in the United States.

Participants and case selection criteria

The study took place in an 11th-grade science class at a working-class school located in Santiago de Chile. The school was a subsidized institution that educated students who had been excluded from traditional schools, including students with histories of being bullied, underachievement, special education needs, misbehavior, or discrimination. It was an urban, secular, mixed-gender educational institution with 66% of the students facing socio-economic or educational challenges (JUNAEB 2023). The school had lower academic results than similar schools. According to the National Standardized Test, about 76% of students had an insufficient performance in math and 57% in language, with no gender differences (SIMCE 2022).

The study was part of a larger project that sought to explore the impact of climate change teaching through deliberative argumentation for sustainable citizenship. As part of this project, teachers had access to curricular and instructional materials to promote group peer interaction in collaborative activities, a practice with which science teachers in Chile are not generally familiar (Cofré et al. 2020)

The study took place during the first semester of a school year, in which Mariela (pseudonym, the science teacher) and the lead researcher worked together, co-teaching and adapting the curricular and instructional materials. The 11th-grade class had 25 students with an average age of 16 years old. Students had 3-weekly blocks of 45 minutes of science in which they typically had one session of group work and whole-class activities. The students could choose

which classmates to work with during the unit and were asked to work with the same group during the semester.

The group and focal students for this study were selected following the *maximum variation* criterion (Fryberg 2006)—selecting the *richest case* that allows the *deepest analysis*. We selected the school because of its interest in participating, the socio-economic status of its student body, and the diversity of the students, which meant we were more likely to have diverse identities historically marginalized from science discourse. Following the same criterion, we selected the student group for its diversity in historically marginalized genders in science (three cis women, one trans man, and one agender student), and because it had students of diverse interests and achievement levels in science. After observing the group and conducting the interviews, we selected Luna as the focal student because she expressed the most differences in her vision of science before and after the academic experience, and her pattern of participation varied the most during the group activities.

Curricular and instructional activities

The pedagogical approach was deliberative teaching. Deliberative teaching is a dialogue-based pedagogical framework that highlights the goal of sustainable citizenship in the classroom's deliberation experiences (Larrain et al. 2021). It engages students in carefully designed group and whole-class activities in which they discuss controversial problems, analyze different positions, and imagine a possible consensus and solutions. Deliberation is defined as:

A family of speech genres in which speakers carefully, critically, and affectively consider alternative solutions to controversial and dilemmatic open issues (whether practical or not). They do it through the persuasive and affective imagination, formulation, evaluation, and revision of

arguments and counterarguments, and to reach a shared (although plural) view on the matter. (Larrain et al. 2021, p. 9)

The curricular unit had six student guides, each organized around a socio-scientific controversial problem related to climate change, such as mitigation, the role of the atmosphere, and the greenhouse effect. The guides offered different ways to discuss the controversy, such as open-ended questions, selecting from among possible alternatives, and ranking information. Students were presented with scientific evidence for their discussions, and teachers were supported with additional resources. The problem was first presented to the whole class, and the students worked on it individually. Then, the students discussed the problem in groups, trying to reach a consensus. Finally, the problem was discussed in a whole-class setting.

Data collection and analysis

The data for this study consisted of video recordings of the interactions of the focal group and interviews with group members (i.e., the focal student and two of her groupmates) on three occasions: before, during, and after the curricular unit. There were video recordings of six sessions of group work, each lasting 30 to 45 minutes, recorded with stationary cameras on tripods, capturing the group activities. An interview protocol identifying broad themes and suggested questions that guided the conversations was used. The themes and guiding questions focused on the students' perspectives and feelings about science, their general interests, and their deliberative group experiences. The interviews also included photo elicitation, a technique that complements interviews and includes a group of photos to stimulate conversation during the interview (Azzarito 2023). Students were asked to bring three photos of important objects or places to describe who they are, evoking deeper meanings associated with their various identities.

To analyze the data, we first focused on the interviews that were transcribed and read thoroughly several times. Then, a thematic analysis (Cohen et al. 2009) was developed with inductive and deductive codes derived from the research question and theoretical framework. The first round of coding allowed us to capture the main themes and the small stories present in the interviews, such as how they perceived their relationship with their peers during the deliberative activities or how they see themselves in and out of school. These themes and small stories are further elaborated in the Findings section of this paper. Then, we recursively interpreted the coded data by asking: How do students portray their group peers and themselves? How are these characters and figured worlds brought into the participants' stories when they talk about themselves and their groupmates? What are the interactions in these small stories and their positionings? How is epistemic power distributed? What identities are brought by the students to describe themselves and others, and how do they intersect with social markers such as gender, race, socio-economic status, and conceptions of science? The objective was to achieve dense descriptions of the science identities in intersection with their other identities portrayed in the interviews. Dense descriptions are an ethnographic tool of analysis that involves the researcher's interpretations in a comprehensive effort grounded in the data. Dense descriptions employ metaphors, keywords, or central moments to disentangle and describe how participants see, feel, and interpret the world (Geertz 1992).

To then analyze the group interactions, we watched all the videos at least twice, transcribed them, and read the transcripts thoroughly. We created notes to summarize each encounter, highlighting the group interactions and knowledge construction moments with a particular focus on Luna, the focal student. We then selected the richest three class discussions during the semester for deeper analysis. Then, we came back to the video recording of the three episodes selected to

analyze the interactions moment by moment looking at both the transcript and the video recording to bring into our analysis the embodied ways the students communicated during the verbal exchanges, such as rolling their eyes, smiling, or nodding. We also tracked the development of ideas for the collective answer, noting what was shared and who the author was. To analyze the in-practice identities, we used the three levels of analysis of small stories.

Level 1: Characters in figured worlds. We noted which characters were brought into the conversations. For example, sometimes, students responded to each other ironically, taking on TV characters, gesturing and imitating their voices. Verbal and non-verbal clues were coded for which character a student had taken on and which figured world was brought into the exchange. Other times, the exchanges were in the context of the figured world of science class in which the students were interacting. For example, students positioned themselves as a joker, an indifferent person, or a smart student, which we then analyzed in terms of the norms of the figured world of the science class.

Level 2: Interactions. We considered how students organized the collaborative task and who positioned themselves as a leader, for example by giving instructions, organizing speaking turns, planning, or proposing a way to approach the problem without giving a concrete answer, and noted whether the leader position was accepted by other groupmates and how. We also coded whether groupmates' contributions were accepted or rejected, and the impact on the subsequent knowledge construction. In this way, we paid attention to how epistemic power was distributed in structuring the group dynamics, considering if different perspectives and ideas were brought up, whether they were listening to one another flexibly, and whether they were attending to diverse voices and authorships of ideas. We considered that a student was positioned with some epistemic power when the group considered their contribution, even if the group eventually moved toward another

idea, so that we could capture different levels of epistemic power negotiated within the group. We also noted moments when a student who had previously been positioned with some epistemic power positioned another student with epistemic power by acknowledging their contributions, rephrasing or accepting their ideas, and asking and valuing the other student's contributions.

Level 3: Intersecting identities. To engage in this level of analysis, we critically interpreted Level 1 and 2 codes and considerations, asking questions such as: How do interactions and positionings relate to gender identities and their intersections with other identities? How are interactions and positionings connected to what counts as science and the relationships with gender, social class, race, and ability? How is epistemic power given, distributed, blocked, and negotiated across intersecting identities? We also considered the student interviews and attended to the degree to which interactions shaped by the multiple social worlds students inhabited and brought to the interactional space were captured in the students' narratives and intermingled with the collective knowledge construction.

After the first pass of all analytic processes, the lead researcher conducted an additional interview with each of the students to get feedback on the main interpretations, clarify any doubts that emerged in the analysis, and conclude the research process with the participants. For example, questions asked included: Can you tell me more about X? I'd like to know what you think about this [reading an interpretation]. You told me this [reading a transcript of an interview], and I wrote this [showing her how I interpreted]. Do you agree with how I see it? Remember this time when you were working in your group about X. Do you agree with my interpretation of the group dynamics? Why or why not? The findings presented below were informed by the students' feedback.

Findings

Narrative identities

Luna was a 17-year-old cisgender female student. She described herself as “a typical/traditional/stereotyped woman, so to speak, especially with the things I like, like fashion, which is an area where I really like to explore what’s very feminine” (Luna, I:4, paragraph 115). She lived with her father and mother in a middle-class neighborhood. Her parents were musicians. She had arrived at the school about a year before, in the middle of the school year, having previously been in a well-known public school in a middle-class neighborhood. Luna shared that her previous school “has won first place several times in SIMCE” (Chile’s standardized test) and that she left that school because “it was very demanding,” referring to the academic load. She repeated 8th grade and was about to repeat 10th grade, so she transferred during mid-year to the present school, which she viewed as less academically demanding. She noted that she had not regretted changing schools because the teachers “are all cool.” Even though the school is known for being inclusive, she shared that she had seen very challenging cases of bullying, although not directly aimed at her.

Luna positioned herself with several intersecting identities—a female identity intertwined with a strong artistic identity, an academic identity marked with deficit, and a science identity that is part of the academic world of failing. Luna has many artistic interests and abilities. She enjoys playing the piano and drums, along with drawing. For Luna, a sense of aesthetics is very important in her life:

I kind of like to draw like thoughts I have, things I feel, or just that, like dresses, or things I find beautiful. (Luna, I:1, paragraph 63)

I always take this type of notebook to school, so I have several from different years. So, when I review them, I kind of remember things I felt at that time of my life or the things I liked, so I kind

of left a little of myself in the notebook, with my drawings, and later I can review and remember. (Luna, I:1, paragraph 65)

Luna was very attuned to aesthetics, and the beauty of the everyday world brought her joy and happiness as the photograph of a sunset (Figure 1) that she shared underscores:

I like [this photo] because, like ~³ it's not like a meaningful memory because it's like, it's not like a moment that I remember, like "Oh, that time the sky was beautiful." It kind of happens more times, but it's like a, a little moment of happiness, even if it's like, I don't know, maybe I feel sad that day, and if I see the beautiful sky, it's like, a little bit like "Oh how beautiful, I'm going to take a picture." (Luna, I:1, paragraph 81)

Figure 1
Luna's photograph



When referring to her academic identity, Luna explained that she tries really hard to achieve good grades, and "It is difficult for me to concentrate." Luna viewed science as a complex subject,

³ ~ indicates a pause

which requires calculations and many concepts that are difficult for her to understand and are not enjoyable.

[Science] kind of requires calculations or mathematics. I generally don't like it because it's hard for me to understand, has too many concepts, or things that must be memorized that are also difficult for me. It always has been hard for me, I think. (Luna, I:1, paragraph 103)

1. Interviewer: Do you think science is important in your life or future?
2. Luna: Honestly, I don't think it helps me that much in my life.
3. Interviewer: Why?
4. Luna: Because it's not an area that interests me very much, I think, or it's not that, it's that I'm interested in other things more than that.
5. Interviewer: Of course, the artistic part. Have you ever related science to that part of your life, such as drawings or art?
6. Luna: No. I don't think so, not that I remember. (Luna, I:1, paragraphs 112-117)

Luna viewed herself as engaged and competent in art, leading to a strong identity as an artist. Luna finds joy in her life by observing and registering ephemeral moments and engaging with them in a profound aesthetic experience. She knows she can excel at drawing, taking pictures, and playing music. In contrast, her academic identity seems damaged. Luna is very conscious of the academic prestige of her previous school, and she seems to have identified academically as a deficient student. She criticizes herself several times, and her science identity is part of the academic world of failure. Science, for her, is complex and unreachable, impossible to relate to or understand, with calculations and definitions, far from the world of art, nature, and music.

By the end of the semester, Luna shared that the experience of working in a group, without the pressure of being evaluated, allowed her to feel differently in the science class:

1. Luna: I think it was different [the classes], because it wasn't like a lecture on the subject, then writing and evaluations. It was like, eehee, much lighter, I think.
2. Interviewer: Lighter, how?
3. Luna: Like less stressful, maybe, or I don't know, like there wasn't much pressure. And since it was done in a group, there was always a little help. (Luna I:3 paragraphs 24-26)

Moreover, Luna started to recognize what science was rather than declaring her lack of connection to science and her deficit positioning relative to science. "I think [science] is like something that allows you to know how some things work in the world...how those things work

at a more specific, small level” (Luna, I:2, paragraphs 18–20). Moreover, science seemed closer to her aesthetic appreciation of the beauty of the world:

1. Interviewer: And does that [science] sound interesting to you?
2. Luna: Yes, yes, I think it’s even beautiful.
3. Interviewer: Really? Beautiful? Why?
4. Luna: Because I don’t know very well how to explain it, but I don’t know, I think it’s kind of interesting to know how things work, like all the things that you see on a day-to-day basis, and you don’t think about them much, maybe they’re just there. Instead, someone who studies science, maybe they can understand it more, maybe they see them, they also see things from another point of view. (Luna, I:2, paragraph 21–24)

For Luna, science was becoming interesting and “beautiful.” Luna’s artist identity was centered on the discovery of beauty in everyday situations, including the sunset photograph that she had brought into the conversation, and she was starting to associate science as being closer to her artist identity. She also shared that she associated her science learning in that class with being able to understand more deeply ideas she already had knowledge about—“I learned more about, I don’t know, pollution or global warming, maybe more in-depth, because well, maybe they’re things that I knew about that, but more in a superficial way” (Luna, I:3, paragraph 18). Luna was seeing herself as a person with some science knowledge that school helped her deepen—a different positioning than the one she originally offered about herself in science.

Luna worked in a group with four classmates who considered each other as friends, including her boyfriend of the time. Luna and two of her groupmates described each of the four friends referring to their academic, gender, and social class identities in the figured worlds of romantic relationships, friendships, and school. To protect confidentiality and not jeopardize the friendship of groupmates if they ever read this study, we purposely anonymized students’ statements when referring to one another and referred to the data sources with a letter and not the contributor’s pseudonym.

Daniela, a cisgender female student, was positioned as the group leader with the highest science abilities and the one who participates more in group work. Daniela was portrayed as a responsible leader “who takes the initiative and tries to include everyone” (A, I:3 paragraph 46).

Daniela was like the one who led the group, like she asked, she also talked about the problem, she showed the guide’s answers and wrote. She was like the one who wrote down. She asked each of us what we thought and things like that. (B, I:3, paragraph 148)

Erick, a trans man and Luna’s boyfriend at the time, was described as a leader, but he was seen as less inclusive and academically focused than Daniela. He was described as someone capable but not goal-oriented compared to Daniela.

I would say that, usually, in our group work, Daniela is the one who takes the initiative, and Erick usually or almost always, like, if he doesn’t feel like doing it, he doesn’t do anything. But if he’s in the mood, like ~ he’s capable, it’s not that he never does anything, he’s like ~ he’s capable of helping and contributing, or, I don’t know, giving tasks to others. But like, if he doesn’t feel like it, he’s not going to do it. On the other hand, Daniela is, like, always responsible and is, like, the one who starts doing things. (A, I:3 paragraph 72)

Eric ~I feel like, maybe, I don’t know, sometimes he takes the initiative, but perhaps he doesn’t always include others. (A, I:3 paragraph 46)

Erick and Daniela’s positionings were congruent with gendered narratives. Daniela was a persistent, responsible, and caring female leader. Erick was capable, but only when he found motivation, and his leadership was not inclusive.

There is also an additional dimension of Erick’s identity in relation to Luna’s race that Erick himself brought up. According to Erick, skin color seems to play a role in the figured world of romantic relationships. Luna was whiter than Erick and this positioned him as “Black” by others that he considered only as “teasing” and “not racist.”

1. Erick: They said to Luna, “and why do you date the Black?!” and I like eh ~ Like saying ~ to my friend, I would say back, “Hey, and you like them darker than me, dude!” things like that, like ~ but it’s not racist, but she really likes people between dark and dark brown like me (...) So, they tell me that just because she [Luna] is whiter and I am more, like, more ~ tan. They say, “No ~ you are Black,” and so on.

2. Interviewer: But being Black can have different connotations, so I'm trying to understand its connotation here.
3. Erick: Oh no, it's not negative; for me, it's not racist.
4. Interviewer: It's not racist; it's not an insult, let's say.
5. Erick: No.
6. Interviewer: Do they say it to you in an affectionate way?
7. Erick: Yes, or they are teasing me with that. (Erick, I:3, paragraphs 136–143)

Although this was the only time that students brought up explicitly a race-related idea in the conversation, it shows how, in the students' minds, skin color intermingled with racial identities.

Lilian, a cisgender female student and Daniela's best friend, did not participate much in group work. Her groupmates described her as someone who struggled more with academic tasks. Her low participation was attributed to academic ability more than social skills:

It is difficult for her to understand certain things. I'm not saying that she has a learning ~ disability, but it is like it is difficult for her to understand, ehhh, what is explained sometimes. She can be asked if she understood, and she will say yes, but she did not understand a thing. (C, I:3 paragraph 28)

More than out of shyness, it was because of insecurity that she [Lilian] did not give her opinion so much (A, I:3 paragraph 66) ~ and she also struggles at school quite a bit. (A, I:3 paragraph 73)

Carolina, who self-identified as an agender student with a female gender expression (which is congruent with her assigned birth gender), was not a part of the core group of friends because she usually was with her boyfriend during class time, but she had a good relationship with this group. Usually, they invited her to work on academic tasks. Carolina was described as someone with short participation but a credible source of information. Carolina was the only one in the group who was a part of the science elective class, and that may have given her more epistemic power.

In group work, it is like ~ Carolina says if something is right, or when they ask her opinion, she says it ~ But it's not like she contributes more than that. It's like very short answers. (B, I:3, paragraph 62)

Carolina is ~ quiet, Luna too, and ~Lilian has difficulty understanding, so she keeps quiet. (C, I:3, paragraph 26)

This last statement illustrates how Carolina and Luna were positioned as quiet, but in contrast to Lilian, Carolina and Luna were perceived as having no problems understanding. They had some epistemic power that Lilian did not.

Carolina had reflected on gendered positionings and shared that many of her insecurities came from how she was positioned as a female. She shared that being considered somehow an “attractive” female student among her classmates had endangered her academic identity and epistemic power. She noted being bullied by classmates whom she did not want to go out with and being shunned whenever she spoke in class.

It happens that when I say something, and they look at me like, “That’s wrong,” I feel that it is only because they can’t believe that I ~ like, I don’t know, a feminine person says something like that. (Carolina, I:3, paragraph 70)

When I have, like, an opinion on an issue. I don’t know, for example I’m arguing with someone and I~ it always happens to me that ~well, it used to happen to me more ~ that they tell me that this had never happened and that I am making it up. So, then, that’s it ~ outside and inside the school, it’s like, uh ~ makes one quieter inside. (Carolina, I3, paragraph 90)

1. Interviewer: And do you think the same happens to men in your class?
2. Carolina: Eh, no ~ in class, I don’t believe that’s true. In fact, [two cisgender male classmates] usually say the same thing that the teacher says, but in other words. It sounds like a new idea, but it’s the same, and I feel that they don’t question anything they say. Like they’re being congratulated for saying the same thing the teacher said. (Carolina, I:3, paragraphs 95–96)

Returning to Luna, her groupmates positioned her academically like Carolina, describing her as “reserved” and “quiet,” and embarrassed to talk, but did not attribute this to her abilities, like in Lilian’s case. Unlike Carolina, Luna did not consider that external factors had compromised her participation and confidence. In her narrative, Carolina was insecure about her ideas due to systemic discrimination, such as machismo, that had weakened her potential. Luna did not seem to consider other factors besides her own traits and abilities.

1. Luna: I feel that perhaps I am the one [in the group] who is most embarrassed to talk to other people ~ I feel like maybe I can say something dumb or something unnecessary, like, I don’t know.

2. Interviewer: Are you afraid of not contributing or making mistakes?
3. Luna: Both. (Luna, I:3, paragraphs 52–54)

Luna also shared:

I don't know. I think I really feel that if, already, for example, B, who is the one who usually starts to give her opinion, if she says something and the others agree, and I maybe I'm not very sure, but no one said anything, I say, "Ah okay, okay, it doesn't matter," as if perhaps I don't take it as so important." (Luna, I3, paragraph 80)

In her narrative, Luna positioned herself as someone with ideas that were not important and who could say "something dumb." She undervalued her ideas and abilities in the figured world of school.

In-practice intersecting identities during group activities

Luna's narrative identity shift connected to the positions she took and was given during group interactions and the ways in which her epistemic power was negotiated in the peer group. Three episodes capture the ways in which Luna's in-practice identities were constructed during group work in which the intersecting identities of the peers unfolded through various figured worlds brought to the academic conversation.

Episode 1: The authoritative teacher, the prince, and the princess who didn't want a pony. During this episode the group worked on the student guide entitled "The atmosphere's role." In a prior whole-class activity, the teachers introduced the paradox of the rising sun, and then the students individually had to explain how it is possible that, although progressively the sun's luminosity has increased, the Earth's temperature has remained relatively stable. After that individual activity, the group work began. The students were encouraged by the teacher to work together, hear everyone's ideas, and orchestrate a group answer.

Daniela started leading the group. With her right-hand index finger extended and the other fingers tucked in, she pointed around her group members while smiling. She looked and pointed

at Erick, Carolina, Lilian, and Luna. Then she came back, pointed at Erick again and shook her hand twice. Everyone was attentive and followed her hand with their eyes. Erick reacted to her gesture:

1. Erick: Here? [looks at Daniela's hand and touches his student guide]
2. Daniela: Yes.
3. Erick: I said it was like the ozone layer.
4. Daniela: [pointing to Carolina] Carolina?
5. Erick: [to Carolina] What did you write on?
6. Carolina: [in a very low voice] I wrote the increase in temperature ~ it has been due to the ozone layer being damaged by technology.

Daniela's gesture of power on her index finger, was used to interrogate her peers and exert her epistemic power on others. Daniela collected ideas from each group member, and all in the group accepted Daniela's leadership position, as Erick appeared to facilitate it (unit 5).

7. Daniela: [looking at her guide] Lilian?
 8. Lilian: [pointing to herself with a pencil, with a loud and secure voice] I say ~ [Lilian looks at Daniela and bursts out laughing loudly]
 9. Daniela: [Laughs, looking at Lilian, imitating Lilian's voice and gesturing in a distorted, cartoonish way]: I say!
 10. Lilian: [Laughing and mirroring Daniela's imitation of her] I say! Ok ~ [softening her voice, almost inaudible] I say that it had to do with the atmosphere and the ozone layer.
- [Interruption; a student from another class arrives to ask what they did over the weekend.]
11. Lilian: Yes, I wrote that it was because of the hole in the ozone layer. That. [She throws her pencil away and laughs briefly.]

In unit 8, Lilian declared her authority ("I say") but also looked at Daniela as if seeking her approval. Daniela imitated Lilian while laughing. Lilian, noticing Daniela making fun of the authority she tried to portray, switched to her usual self, providing her thoughts in a soft and insecure voice.

After that, Daniela pointed to Luna, who shared that she did not know (unit 13), and Daniela moved on to read the answer she had written down (unit 14):

12. [Daniela points to Luna and runs her hand through her hair.]
13. Luna: [smiles, ashamed] I don't know.

14. Daniela: I wrote it on the other page [she laughs and turns the page] Ok. I wrote [with a confident voice, reading] because the atmosphere forms this layer that regulates the Earth's temperature, and due to the components and forms of absorption that they had.

Each groupmate had a different level of epistemic power throughout these interactions, which was played out in the multimodal exchanges through Daniela's pointing to the other students, Erick's being the first to be interrogated, Lilian's internalizing Daniela's making fun of her, Luna's sharing with an ashamed smile that she did not know, and Carolina's soft voice.

Then, another character entered the story: the cameras. In her role as an authoritative teacher, Daniela asked Lilian to read the question. While Lilian was doing that, Erick asked someone outside the group to change the cameras' positions to fully show Luna.

15. Luna manipulates the camera not to be seen.]
16. [A student from another group refocuses on Luna.]
17. Lilian: [pretending to be a TV reporter]: Hello! [Laughs].
18. Lilian: [quietly, reading.] In a group, reach a consensus on the stability of the Earth's temperature. Remember to give arguments and counter-arguments.
19. [Erick ignores Lilian, looks at Daniela, and gestures for her to move the camera angle to show Luna fully.]
20. [Daniela looks at Luna, smiles, and moves the camera to show Luna.]

Although Luna had clearly stated she did not want her full body to appear on the video, only a small portion of her face, Erick and Daniela conspired to go against Luna's right to determine the extent to which she wanted to be recorded (units 19 and 20).

21. Daniela: [to Luna, taking her pencil case and checking it] Do you have a highlighter?
22. Luna: No [redirects the camera].
23. Erick: [passing a highlighter to Daniela] I have a yellow one.
24. Daniela: What were you saying, Lilian? Sorry, I didn't hear you.
25. Lilian: [cries like the El Chavo del Ocho carácter] pi pi pi pi pi.
26. Lilian: [reading the guide]: In a group ~ reach a consensus on the stability of the Earth's temperature. Remember to give arguments and counter-arguments to evaluate your positions critically.
27. Daniela: I think we all have the same thing, which is related to the atmosphere and plants [she points to Erick while talking].
28. Erick: And with the ozone layer!

Daniela and Erick positioned themselves as social and epistemic leaders. Daniela maintained her role as a leader/teacher, giving Lilian instructions (unit 24) and establishing her answer as everyone's answer (unit, 27), which was contested by Erick (unit, 28). Luna was positioned as someone with much less epistemic power. Erick and Daniela transgressed her personal space by not only exposing her to the camera but also opening her pencil case (unit 21), which was very precious to Luna because she loved to draw. Erick's and Daniela's voices were prominent in the answer. There were no cisgender males in the group, but Erick embodied dominant heteronormative male behaviors, conspiring with Daniela to intimidate Luna.

Lilian used personification to contribute to the group. The way Lilian laughed in unit 25 was distinguishable and similar to *El Chavo del Ocho*, a traditional Mexican TV character who is popular across Latin America. "El Chavo is clumsy and not very intelligent, although on some occasions he has very witty and comical outings" [translated from Spanish] (Fandom 2025). By being in character instead of herself, Lilian may have felt more comfortable contributing to the group work since any potential mistakes could be attributed to the character she was personifying. As for Carolina, she remained quiet, looking at her student guide and then to Daniela and biting her nails.

After a while, the teacher stopped by the group and asked them to share what elements they were thinking would regulate the Earth's temperature. Daniela brought up Erick's response (the ozone layer), her idea (the atmosphere), and Carolina's idea (the technology). When the teacher asked for an example of how technology could regulate the Earth's temperature, Daniela did not ask Carolina to explain her original answer, but instead she replied that solar panels could change the atmosphere's temperature. When the teacher turned to Luna and asked about her opinion regarding Daniela's reply, Luna shyly said, "I don't know how solar panels could affect the

atmosphere; I don't see how it could be connected." Validating Luna's response, the teacher asked the group to look for more reasons and left.

Daniela and Erick continued to lead the creation of the group response. After Daniela asked Carolina to elaborate on how technology was impacting the Earth's temperature, Daniela wrote down in her student guide the final answer:

We believe that it is the atmosphere, plants, and technology that regulate the Earth's temperature. Plants absorb solar radiation. The atmosphere is the protective layer between the Earth and the sun. Technology creates elements that allow temperature regulation.

This answer included only Daniela's opinions, did not include Erick and Lilian's contributions about the ozone layer, nor Luna's questioning that solar panels are linked to the atmosphere's temperature.

- 29. Daniela: [showing her written answer to Carolina] And there it is, the answer.
 - 30. Erick: Luna didn't believe that [smiling ironically].
 - 31. Daniela: [raising her voice and arms to Luna] Luna! She is gone! [Taking a pencil from her pencil case] Luna and her modern pencils.
 - 32. Erick: [to Luna] You didn't want a pony for Christmas, did you?
 - 33. Daniela: A pony?
 - 34. Luna: Nooo.
 - 35. Daniela: For a moment, I imagined Erick like that, with a pony as a gift, and he says [Daniela puts her hands on her waist, chest inflated, and talks in a pretend masculine deep voice] "Hello my love, here is your gift!" Yes, I imagine it. [to Lilian, showing her guide] Did you copy?
- [All groupmates write in their student guides, and the academic task is finished.]

Erick made fun of Luna's inability to understand how solar panels could be linked to a change in the atmosphere's temperature, and Daniela noted Luna's "modern" artist tools that others probably did not have. Moreover, as the dominant partner in their relationship, Erick, playing up Daniela's positioning of Luna as having access to better goods than others, ironically asked Luna if she wanted a "a pony" as a Christmas gift. Luna was positioned as a spoiled princess with no epistemic power when it came to the academic task at hand.

Episode 2: When Daniela smiles at Luna and changes her leadership. This episode occurred when the group was working on the next student guide focusing on the greenhouse effect. The students had to choose between alternatives to explain how small variations in CO₂ and CH₄ can be related to global temperature variation. Erick was absent that day, so only Daniela, Carolina, Luna, and Lilian were in the group. The group work began with one of the teachers intervening:

1. Teacher: [talking to the group]. One thing I want to tell you girls~ That I was observing you, and Daniela is the one who, in general, has, ehhh, as she always takes ~ takes the floor ~ Then you also need to try [pointing to the group] to say your ideas ~ You think different things, and maybe you have different arguments ~ It's ok ~ It's not bad that Daniela speaks more, but it is also important that you all talk and give your ideas. Everyone's ideas are important. That's what I want to tell you.
2. [Daniela makes an exaggerated face of surprise like a meme, looks at the group like she is searching for someone to look back, but no one is looking at her, and then she nods.]

The teacher left the group, and the groupmates started working on their answers. As Erick was not there, nobody seemed to respond to Daniela's surprise, so she ended up taking the teacher's guidance more seriously and nodded in agreement (unit 2). After the teacher left, Daniela offered her idea and then waited for others to talk, but nobody was going for it. After a long pause, Daniela smiled at Luna and tried something new, asking everyone to explain their ideas and not simply say what they had written down.

3. Daniela: It says that pollution generally produces CO₂ and methane, but it doesn't directly address the question.
4. [~ ~]
5. Daniela: Is the B ~ because it is related to everything ~ [Looking at Luna and smiling] Luna, can you explain the B? We had like the same.
6. Luna: It's just that ~ like, I didn't understand the A or, like, I didn't find much sense in it ~ So, B is kind of a better answer ~ B makes more sense to me.

By smiling at Luna in a caring way, Daniela created a welcoming environment for Luna to contribute. Daniela also shared her epistemic power with Luna, acknowledging that they "had like the same [idea]," building Luna's confidence that she would not be judged.

7. [to Carolina] What did you understand about Carolina [laughs, then correcting her misspeaking to] A?
8. Carolina: I mean ~ I also did it by discarding because I didn't understand the others, and...I related to it because it says the word "radiation," and that's why it seems to me that it could have more to do with it. [Carolina looks at the camera, opens her eyes, and looks back at her guide.]
9. Daniela: Can't we write both? ~ Because A, Carolina is right, it answers an important part of the question ~ and B too, because it speaks of this effect as a blanket ~ Then we should select both.
10. Lilian: So, A was correct.
11. Daniela: Yes, it was correct! I also read it and said, "It's B," and then I understood [Daniela begins to write down in her guide, and the others follow her].

Daniela had the same inclusive attitude toward Carolina, although Carolina disagreed with Daniela's initial answer. Daniela tried to integrate both answers, changing her original argument. Then, the teacher returned to the group and checked if everyone had participated. She asked the students if they all had the same answer, to which Daniela, smiling at the teacher, said "no." The teacher encouraged them to search for information on their phones to add more ideas to the conversation.

12. Daniela: [looks at her phone] It says it has to do with radiation.
13. Luna: [very soft] Here I found something ~ Here, it says that without the ozone layer, there would be no possibility of life ~ [remains silent and looks at her phone] Its function is more to protect ~ or, like, to conserve oxygen. [Silence]
14. Daniela: Did you have something, Lilian?
15. [Lilian looks at the phone and shakes her head, indicating "no."]
16. Daniela: [smiles and says in a motherly tone] But Lilian!
17. Lilian: I was searching, but ~
18. Daniela: I was searching, too, but it didn't download the page ~ to search. So [in a voice of dictation], without the ozone layer, we would all be dead, and there would be no life, and then, it is like a layer that reflects solar radiation.

Although Daniela continued playing a leading role, she was positioning her groupmates differently. She still positioned herself as the teacher but in a more caring and horizontal way. She structured the conversation to include others' ideas, and Luna found the confidence to talk. This was the first time Luna contributed to the group without being asked by Daniela or the teacher to

do so (unit 13). Daniela eventually took Luna's idea (the ozone layer is fundamental for life), her idea (it acts like a layer), and Carolina's idea (it reflects solar radiation) and formulated the group's answer (unit 18). Daniela even justified Lilian's lack of information by noting how slow the internet was for her and that could have been the reason why Lilian could not contribute to the groupwork.

Episode 3: The drama, the director, and the actress who walked away. This episode took place while the group was working on the student guide entitled Mitigation. On that day, Carolina was absent, and Erick returned to work with the group. The students needed to rank different strategies according to their impact on mitigating climate change. Before starting the discussion, Erick commented on camera and in front of the group that he had had problems in his relationship with Luna. Luna seemed very uncomfortable and did not make eye contact.

1. Daniela: OK. Let's see which numbers are closer to each other, and from there, let's compare ~ At number 1, I have...
2. Lilian: I have the same ones as yours.
3. Daniela: Avoid taking a flight to another continent, and Luna has to live without a car.
4. Erick: Luna!! Oh my god, you ranked following a vegetarian diet almost last!
5. Luna: [mumbling] I didn't know that you...
6. Erick: [interrupting Luna] Do we have only to answer this?
7. Daniela: I also ranked it almost last but ~ Because I wanted to put it a little further forward, but the others are like ~ Do not use the dryer...
8. Luna: It's just that it's complicated anyway, I wasn't so sure, but ~
9. Erick: No wonder we broke up. Luna doesn't understand a thing [changing the tone to a fake] ...But it's for the camera, for the drama!
10. Daniela: And then, Luna faces the camera and says [changing to a fake tone]: "Ah, well, then we're done," and then she's gone [laughs]. [Singing] The camera! Just kidding!!
11. Lilian: We've been telling the story of why they broke up for 4 minutes.

In these interactions, the students intertwined the figured world of relationships with knowledge construction mediated by power relationships and epistemic authority. Erick was probably hurt by

the break-up, as during the interviews, he frequently commented on how important it was for him to have a relationship with Luna, and expressed his anger toward her publicly on the cameras, behaving in a masculine way. In his narrative, Erick shared that Luna was *too white for him* in the figured world of relationships, which positioned him at a disadvantage. Erick was now positioning Luna with limited ability and as someone with no common sense or understanding (units 4 and 9), interrupting her (unit 6) when she tried to explain her answers.

However, unlike the time Erick posed the pony gift question to Luna, Daniela did not side with him. Instead, she defended Luna's epistemic power (unit 7), comparing Luna's answer to hers. Erick and Daniela used fake voices to mark being in another figured world. In unit 9, Erick brought in the figured world of drama television to legitimize his aggression. Daniela responded to him in that same figured world, positioning herself as a director who gave lines to Luna to respond as an empowered actress (unit 10). Instead of being a spoiled princess, Luna was positioned by Daniela as an independent actress who walked away from a challenging relationship. Lilian ended the scene noting that they were not discussing mitigation strategies but rather focusing on the story of Luna and Erick's break up (unit 11).

After that, Daniela acknowledged all of Luna's contributions almost immediately, and the three female students seemed to form an alliance to construct a response, ignoring Erick's contributions.

12. Daniela: Is this repairing, recycling, and reusing things like ~ mitigating? ~ [Luna nods.] We would like to rank these repairs, recycle, and reuse things first because that's~
13. Lilian: The 3 Rs! [Referring to recycle, reuse, reduce]
14. Daniela: Exactly!
15. Daniela: Justification?
16. Lilian: Because the 3 Rs are important!
17. Daniela: I want to paint my nails.
18. Luna: It's just that it is
19. Daniela: It's just that it doesn't affect that much.
20. Luna: I think the first is between living without a car and avoiding taking a plane trip.
21. Daniela: Let's see how much each one of them pollutes more.
22. Luna: Because you remember what we did yesterday?
23. Lilian: I think the plane pollutes more.
24. Luna: This same thing, but together, and that also came out.
25. Lilian: The plane.
26. Daniela: The plane.
27. Luna: And the second one, I think, is the car.
28. Erick: I wrote 1, 4, 6, 3, 2, 7, 8, 5.
29. Lilian: Bingo!
30. Erick: you *#%! She thought quickly!

Luna dissented from Daniela's idea in unit 18, and Daniela did not need a justification from Luna to agree with her and complete her counter-argument (unit 19). In unit 20, Luna shared that she was between two options, and Daniela and Lilian helped her to organize her answer. Lilian started offering her ideas, contributing to the group answer without making jokes (units 16, 23, and 25), even though Daniela once ignored her contributions (unit 17). When Erick wanted to counter-argue by giving his answers, Lilian used a quick and clever prank to block him from the conversation ("Bingo!" unit, 29). The female students seemed to stand together, resisting Erick's aggression and giving Luna more epistemic power as they were co-constructing the answer.

Luna's science identity transformations

Luna's science identity transformation over time was shaped by various factors inside and outside the science class. What stands out regarding this transformation is that, over time and with the support of Daniela and her peer group, the deficit positionings associated with her academic

identity diminished. The epistemic power that Luna received in her peer group gave her the opportunity to form connections between the science class and her other identities.

However, Luna made sense of these changes as happening in her personal space, and not how she saw herself and acted in school. The deliberative experience along with the broader context of that class triggered reflections on what science could be beyond school.

1. Luna: I have made these reflections outside of school, but I do not discard that, that moment [peer group work] , has affected my thinking. (Luna, I4, paragraph 104)
2. Interviewer: (...) you managed to reflect on how science, which was somewhat distant, could have something to do with your world?
3. Luna: Yes. It may be that at that moment [the group work], I felt more comfortable expressing myself, or it may also be that I saw an opportunity, perhaps because of the topic that was just touched on, for which I had an opinion. (Luna, I:4, paragraphs 109–110)

Luna indicated that she “had an opinion” for the topic (i.e., climate change) and that motivated her to participate. Reflecting on what she had learned, she declared that pollution and global warming are topics that she had prior knowledge about and could learn in more depth during the activities. Luna’s science identity was being constructed as she was gaining the epistemic power in group discussions, had an opportunity to engage with topics she cared and knew something about, and was given the space for her introverted way of connecting and making sense of her experiences. Although after the deliberative activities Luna continued to believe that school was a place of failing, what science meant to her was changing.

Yes, now that I think again, I think that, above all, science is something that allows you to see the world from another point of view. I believe that everyone builds their world based on what they know. So, we all have different truths, which does not mean that some are false and others are not; they are just different, and as we all have different worlds. Knowing science allows you to build your world based on that knowledge. (Luna, I:4, paragraph 99)

Luna was coming to see science as a possible tool for making sense of and, as she said, building her world on the knowledge she already had and she was developing.

Discussion

In this case study, we presented the narrative and in-practice identities of a focal female student, Luna, and her group of friends in a working-class and diverse Chilean high school science class. We were interested in understanding the complex ways in which students construct science knowledge together, performing and bringing in intersecting identities in figured worlds where interactional dynamics block or enhance (and anything in-between) epistemic power (Geuskens 2018). Understanding these dynamics could broaden our knowledge of the so-called gender gap, reframing it as an identity debt in science for marginalized identities (Ladson-Billings 2006).

According to canonical science discourse (Stroupe et al. 2024), at the beginning of the dialogue-based activities, Luna perceived science as something distant from who she was, complex, objective, and full of intricate concepts. Her academic and science identity resonated with the consequences of standardized educational regimes (Falabella, 2020). She was aware of the prestige of her previous school based on SIMCE (the Chilean standardized test). She attributed her low achievements to herself rather than the educational system, positioning herself as someone who failed school and struggled to learn and concentrate. At the same time, the world of art and aesthetics remained a rich personal space and place for her (Tuan 1977; Varelas 2018), away from her narratives of academic deficit and away from science.

At the end of the group-based science activities, as her epistemic power as a science learner improved in the group work, Luna's narrative identity shifted. She began to change her position on science, starting to narrate science to herself in a way that was more connected with her aesthetic curiosity and appreciation of nature. Through inner speech (Vygotsky 1999), she recreated an internal dialogue about science and her world. Her reflections continued to evolve after that work, reaching sophisticated conceptions of science as a way of constructing subjective realities.

The direction of this shift in her narrative identity allowed her to embed how scientists understand the world into her art and aesthetic identity. Still, the figured world of school remained a space of failure and demands. Although she had more epistemic power as time went by, she did not have the experience of bringing the figured world of art or other relevant social worlds to the science class, so the experience remained a trigger of reflections that were becoming a part of her narrative identity without any change in the identity-in-practice she was constructing in the classroom. After years of experiencing academic failure in an educational system, her academic and science identity were profoundly damaged in a way that a limited experience of participation could not fully heal. All of these point toward the need for consistently building learning environments that support students in bringing their interests and social worlds in a science class as valuable tools for understanding science and experiencing epistemic justice (Fricker 2011) to heal the identity debt for female and other marginalized students.

Although it is not possible to generalize based on this case study, the value of this study lies in the dialogic nature of its data (Stake 1995). The contribution of the case is never limited to itself; rather, the process occurs actively on the reader's side since they also reconstruct and interpret the case and try to make sense of it by bringing it closer to their context (Yazan 2015). Accordingly, what we have presented through the stories of Luna and her group illustrates how power relationships are intertwined with knowledge construction and intersecting identities in a concrete and contextualized way. The shift in Luna's science identity points to the relevance of dialogue in the science classroom and opens up a discussion about healing of marginalized identities.

Gender as an axis for intersecting social identities

Aligned with Wiesselman's (2020) study, gender was a central social marker that organized the in-practice and narrative identities. Our study extends those findings showing these dynamics from an intersectional and non-binary conception of gender, illustrating how female and male ways of being are performed in dialogic interactions.

Luna and Carolina interacted with the group in stereotypical female ways, using soft voices, making insecure contributions, and adopting a passive style as they mostly waited to be asked to respond. Unlike Luna, Carolina's reflections on gender norms partly provided a cushion for her science identity as she attributed her insecurities to her positioning as female, not to her abilities. Luna, on the other hand, constructed her passive style and insecurities as mostly related to her abilities.

Even though the group did not have cisgender males, male and female ways of acting were performed in relevant figured worlds that interacted with the students' intersecting identities. For example, Daniela, a cisgender female student, used masculine (actively looking for the right answers and blocking anyone who dissented) and feminine ways (looking for consensus and everyone's voices) to lead, and brought the world of heterosexual relationships (with the pony and the prince metaphor) to block Luna's epistemic power. Erick, a trans man and Luna's partner, embodied heteronormative masculine ways of acting in the classrooms. He performed as a confident, uncompromising, and non-inclusive class member, especially to Luna in the third episode, in which he attempted to block her epistemic power by interrupting her and criticizing her abilities vis-à-vis the academic task to justify their break-up.

In the figured world of the collaborative discussions in the science class, students acted and interpreted, bringing in and performing their lived social worlds, in masculine and feminine ways

that need to be further contextualized. Erick positioned himself using a more active and aggressive tone with his peers but, as a Brown trans man, he had been subjected to gender and racist violence himself, and enacted a repertoire of male characters that he had lived with for most of his life. Moreover, he brought up his “darker skin” and that his friends called him “Black” in the figured world of romantic relationships as he positioned himself differently than “whiter” Luna. Although he did not relate his darker color to race, skin color is one of the markers associated with racial identity, considering race as a sociocultural construct. In Chile, migration status, gender, and race intersect in complex ways (Bonhomme, 2023), so it is possible that Erick's Chilean and masculine identities prevailed, protecting his epistemic power in the group without cisgender men. Gamez and Parker (2017) demonstrated that gender dynamics intertwined with students' identities as immigrants, shaping their scientific identities in practice, realized in groups. However, further studies are needed, especially in Chile, to understand how immigrant students access epistemic power in intersection with their other social identities.

Figured worlds, epistemic power, and identity debt in science

Historically, schools have upheld science as white, positivistic, heteronormative, masculine, and as an objective and unbiased way of discovering universal truths about the world (Stroupe et al. 2024). Daniela had a central role in structuring the interactions and constructing knowledge in the group, enacting an authoritative teacher and recognizing this as a valid way of constructing scientific knowledge. Erick also exerted epistemic power as a valid way of contributing to the task. They both used power to shine individually, reflecting canonical science practices that working-class students have historically experienced in school (Freire 2014). Daniela's first leadership position (where she pointed to peers who had to provide answers) was enacting a teacher focused on interrogating more than thinking, who listened to students' ideas only to give the correct answer,

and who wanted to control their students. As the deliberative experience unfolded, however, Daniela found a different way to lead and construct knowledge with others.

Lilian was the student with the least epistemic power in the interactions, rarely contributing to the collective answer and being positioned by her peers as the one with the least academic abilities in the group. Despite this, she managed to participate in the interactions through off-topic jokes and characters of the figured world of TV that challenged the image of an unwitty student. However, her characters and jokes were not acknowledged as a valid way of constructing scientific knowledge, and her participation in the science task was more marginal. Carolina's and Luna's ideas received greater acknowledgment, especially in the last episode for Luna, but both Luna and Carolina were generally quiet and insecure, and neither of them brought other figured worlds into the group interactions.

Given that students make sense of the figured world of science by bringing elements from other figured worlds that are significant to them (Calabrese Barton et al. 2013), we wonder: What would happen if Luna had an opportunity to bring the figured world of art to answer the questions? Could it give her more epistemic power over her peers? What if Lilian could use her acting and humor as a recognized way to construct scientific knowledge? What if the science activity had allowed Carolina to relate science problems to her reflections about gender and patriarchy? We consider these as relevant questions for reframing the gender gap as an identity debt (Ladson-Billings 2006). Marginalized students need to be explicitly positioned by themselves and others as capable science doers in ways that construct solid connections among their many identities (Varelas et al. 2012). In this regard, teachers play a relevant role as mediators of interactions and designers of science spaces that open opportunities up to enact figured worlds not traditionally

associated with science, which are usually overlooked in what are often dismissed as off-topic student conversations (Langer-Osuna 2018).

Group leadership and power

Kumpulainen and Rajala (2017) discussed possibilities and tensions that emerge in peer dialogue as spaces for identity negotiation and the relevance of teachers' mediation to generate more equal conversational spaces. With this study, we add to this understanding by examining small-group interactions that are more inaccessible to teachers. Although the teacher was not present all of the time, Daniela, in episode 2, responded to the teacher's move toward a more inclusive way of structuring the activity, changing from a perspective of exerting her power over *others* to constructing *power with others* (Bloome 2005). Daniela's leadership, reflection, and emotional connection were central. As she enacted more connected relationships, for example smiling at Luna, considering Carolina's different perspectives, and giving Lilian support, she contributed to a more inclusive environment and enhanced the academic task. Her distribution of epistemic power allowed the group to think more deeply, evaluate possible answers, and co-construct more complex answers.

This analysis posits the importance of working with epistemic leaders in classrooms and in groups to teach them how to distribute power. The fact that the groupmates in this study were also good friends may have contributed to Daniela being able to change without such explicit attention, as their friendship nurtured a level of care that is needed for such power distribution.

The interactions in our study revealed that when students care for and empathize with one another, they are able to construct more nuanced responses while incorporating diverse voices and identities. For this to be achieved, peer dialogue needs to be considered as a holistic developmental activity in which knowledge is inseparable from identity construction and emotions (Salas and

Larrain 2024) (Salas & Larraín, 2024). In a society marked by individualism and competition, it is essential to teach students that power can be exercised not only to excel and shine individually, but also to enhance collective learning and enrich shared experiences. This approach is crucial not only for fostering inclusion and deepening learning, but also for preparing new generations to collaboratively address urgent global challenges—challenges that demand consensus and recognition of the multiple identities and worldviews involved.

REFERENCES ([click to link](#))

CONCLUSIONS

The aim of this research was to study peer interactions within the new curricular context of collaborative and dialogue-based science to better understand how female science identities are promoted or restrained. The general objective of the research was to understand the development of science identities among female high-school students during peer interactions in Science for Citizenship group tasks. We presented three studies: a theoretical framework about peer interactions as developmental experiences, a case study narrating the pedagogical experience in an underserved science class that prompted peer dialogue, and a micro-ethnography of the peer interactions of a group of students during science group work.

To understand how each of the articles in the compendium is integrated into the general objective, and how it responds to the specific objectives and research questions sequentially, we proposed the metaphor of a tree.

First, the roots of this tree would be the theoretical framework represented mainly through the first article. We wanted to theoretically understand how and why peer-group tasks can be a space for identity development. This theoretical inquiry responds to specific objectives 2 and 4 of the thesis and the following research questions:

2. To relate female students' positionings in peer interactions to knowledge construction in the group task

- How and why does peer-group dialogue transform not only intellectual processes but also emotional and identity dynamics?

4. To associate the narrative and in-practice science identities of female students from an intersectional gender perspective that considers the figured worlds mentioned by them

- What is the relationship between the science identities that female students narrate for themselves and those that spring from their group interactions in science class?

The trunk represents the case study in which we analyzed a pedagogical situation for the story to unfold. This trunk emerges from the theoretical roots, but on a more concrete level, with a specific design, and in a particular science classroom. The pedagogical situation was analyzed mostly through the second article and responded to the specific objective 1 of the thesis and the following research questions:

1. To describe the pedagogical situation within which peer interactions and group tasks take place
 - What are the pedagogical conditions to promote peer collaborative dialogues in science as developmental activities?
 - What are the complexities and affordances of promoting dialogue-based group work in underserved classroom contexts?

Having both conditions, the theoretical roots and the pedagogical trunk experience, we could see the flourishing of in-practice and narrative science identities, which are represented in the leaves and flowers. The development of in-practice and narrative identities was empirically analyzed mostly through the third article and responded to specific objectives 2, 3, and 4, and the following research questions:

2. To relate female students' positionings in peer interactions to knowledge construction in the group task
 - How do female students position themselves, and how are they positioned in peer-group tasks?
 - How are positionings in group tasks related to participation in knowledge construction?

3. To characterize the development of the science identities narrated by female students throughout the pedagogical situation
 - How do female students narrate themselves and associate their science identities with their present and future lives?
 - How do female students experience the figured world of the science classroom, how do they feel it, and how does it connect with other relevant aspects of their lives?
4. To associate the narrative and in-practice identities of female students from an intersectional gender perspective that considers the figured worlds mentioned by them
 - What is the relationship between the identities that female students narrate for themselves and those that spring from their positionings in dialogues among peers?
 - How does the development of narrated and in-practice science identities intersect with female students' experiences of gender, social class, or race/ethnicity?

Just as all the tree parts are related and work as a living organism, the different articles can also be read in relation to one another, and together they can illuminate answers that each one cannot do alone. Considering that the article research questions have already been discussed in each of them, these conclusions emphasize the value of the research as a whole. Finally, as trees are always connected to their environment and live in collaboration with the forest, we will conclude this thesis with a discussion about future questions and implications for the pedagogical practice and public policy.

The roots: The potential of peer-group dialogue as developmental activities

Specific objective	Research questions
2. To relate female students' positionings in peer interactions to knowledge construction in the group task	How and why does peer-group dialogue transform not only intellectual processes but also emotional and identity dynamics?
4. To associate the narrative and in-practice science identities of female students from an intersectional gender perspective that considers the figured worlds mentioned by them	What is the relationship between the science identities that female students narrate for themselves and those that spring from their group interactions in science class?

In article 1, we interpreted Vygotsky and other relevant sociocultural scholars, and we propose that, to answer how learning, emotions, and identity are intertwined, it is fundamental to reframe language as a sociocultural tool in use. The implications of understanding language as sociocultural are radical because the mind and consciousness are conceived not as individual, representational, and grammatical processes but as social, dialogic, and always contextual.

To understand how and why subjectivity emerges from dialogue, we proposed that Vygotsky's conception of *inner speech* is pivotal. So, when children are immersed in language, they are not only socialized but also become historical subjects. Children are immersed in a material way of enacting social experiences from the collective experience, with socio-historical ways of feeling and being, opening the biological to cultural transformation. The transformation from dialogue to consciousness is caused by speech. Adolescence, triggered by sociocultural expectations and ways of interacting with others, allows the development of a more abstract way

of understanding concepts, emerging complex feelings, and identity. This way of abstract thinking allows the adolescent to think beyond their concrete context, to develop new ways of feeling, and to narrate themselves, as a dialogic self-anchored in a historical context, but with a degree of authoring and subjectivity.

Paper 1 not only re-reads Vygotsky's psychological contributions but also extends and reframes them to the present challenges of group-based dialogue in the classroom. We proposed that the developmental potential of peer-group interactions lies in the opportunity to participate in diverse and purposeful ways of using language, which will push forward ways of thinking, feeling, and being, from a dialogic interaction to a dialogic inner speech, and vice versa. The more diverse are the uses of language that a group acknowledges and uses, the more diverse are the ways of thinking (learning), feeling, and being (identities) that are available to grow for the group.

On that basis, and integrating the theoretical findings of paper 3, we can say that the relationship between the science identities that female students narrate for themselves and those that spring from their group interactions in science class is dialectical and mediated by speech and inner speech. Also, this implies that science identities are mediated but not restricted to social discourses of gender, race, class, and canonical science. Peer-group talk can reproduce and resist the voices that have historically had epistemic power in science problems.

To understand these micro-dynamics and their relationship with meso- and macro-structures, our theoretical contributions extend the concept of Holland's figured worlds (1998), reframing them as important speech tools to exert epistemic power in peer-group interactions. When students collaborate on challenging questions, they actively relate the problems to their own experiences and beliefs. Bringing figured worlds can reproduce who has epistemic power but could also be a landscape for exploring other ways of imagining science questions. This imaginative

process enables students to think critically, develop solutions, and enhance one another's understanding through language.

So, according to our theoretical framework, language reproduces and transforms not only knowledge but also identities, ways of being affected, and dispositions, among others. If female students had the opportunity in peer dialogue to be acknowledged as valid science learners with valid figured worlds to bring to the science classroom, if they experienced epistemic power, they would have more opportunities to develop narrative science identities through inner speech and to contribute to diverse ways of thinking, feeling, and being when they solve science problems with their group mates.

We think these theoretical findings have three clear and relevant implications in theoretical inquiry in science identities.

1. It critically examines and reinterprets the mainstream framework of stereotype theory to explain the female gender gap in science.

The female gender gap in science has mostly been explained through stereotypes and self-representation. Although these cognitive theories consider sociocultural variables, their focus on changing individuals' representations rather than people's interactions is just one part of the problem. Using a stereotype theory, the main recommendations to close the gender gap in science are initiatives such as promoting role modeling and learning about the biographies of female scientists, using unbiased teaching materials with equal images of women and men scientists, and lessons to logically dismantle gender stereotypes with evidence (e.g., see UNESCO, 2024). Our framework agrees on the problem and the need for such initiatives, but it reframes it socially, arguing that those recommendations are not enough.

Our perspective highlights that the subject construction and developmental potential are not in the individual representation mechanism; instead, they are in the contextualized interactions unfolded through inner and outer speech intertwined. It offers a perspective in which the individual is not the focus of attention, giving relevance to how female students are positioned and position themselves in a dialectical process. This does not mean denying the existence of moments in which female students may experience self-representations; rather, it means not giving those moments the centrality that stereotype theory gives. Also, we understand those moments as an inner dialogue, in which logical premises are not the ones that structure how we think and represent ourselves. Instead, we propose that social structures are present in speech as the material in which our consciousness emerges. Speech is more than the representation of an outside world; it is the material that embodies historical ways of feeling, thinking, and being in a certain time and space.

Although this can be read as something abstract, it has radical consequences for how we understand and act about the female gender gap. Without denying the existence of macro-discourses (or stereotypes), we need to pay attention to how female students interact in the spaces where they experience science in their lives. This implies attending to how they are positioned by others and how female students have access not only to learning about science but also to contributing to knowledge construction as valid science knowers with experiences and ways of being, thinking, and feeling that are acknowledged as scientific, especially when they don't match the stereotypes. It is more than presenting evidence to students so they can logically refute stereotypes to build an individual self-image: it is an interactional process of creating diverse and inclusive epistemic communities of science knowers through dialogue.

2. It challenges the focus on academic learning as the gold standard of curricula and research success, even considering the benefits of group interactions for academic learning.

Our theory agrees with critical theory in science education, such as Varelas (2012) and Calabrese Barton (2013), which emphasizes that if learning is intertwined with identity development and feelings, then focusing on learning outcomes to measure the success of an educational innovation is not enough. Our theoretical inquiry extends that work with an explanation of why and how that process is sustained from a sociocultural approach, which can contribute to research frameworks, especially those that focus on dialogue and peer interactions.

This is important because, even in sociocultural research, the focus has been on academic learning in a way that considers identity research to be opposite to learning research. We agree with Neil Mercer (2010) that research in classroom talk is divided between those focused on identity/cultural variables and those focused on educational outcomes. However, we disagree with his recommendations that the focus of sociocultural studies should be the latter. With our theoretical perspective, it is possible to argue that these two sides of research cannot be treated as binary but as part of the same process in human development. Our framework supports the idea that defining the success of peer-group work in terms of curricula accomplishment alone risks reproducing unequal social discourses, which is far from the basic aims of school. Instead, we need to think about and research learning, emotions, and identity as part of the same process.

3. It proposes connections between relevant theoretical constructs in science identity research to deepen their explanatory power.

Our theoretical framework helps to build connections with existing relevant frameworks in science identity. First, it connects the identity debt theory (Ladson-Billings, 2006) and intersectionality

(Crenshaw, 2006) with a sociocultural explanation that deepens how and why processes unfold together. From our interpretation of Vygotsky, we proposed that the science identity debt is related to the historically unequal participation of females in dialogue. This inequality implies hindering their possibilities of creating, being listened to and acknowledged in conversations in science, and imagining and authoring their own subjectivity in relation to science through inner speech. The inequalities are structurally reproduced from socio-historical constructions of gender, race, social class, and science to become dialogical ways of enacting language in social spaces (such as classrooms). These ways are dialectically related to how female authors construct their subjectivity in their inner dialogical spaces, ultimately reproducing the socio-historical subject of canonical science. We believe that connecting these frameworks helps to deepen the identity debt theory, supporting the relevance of identity and dialogue in the process of learning science as part of the multifaceted issue.

Another framework that we theoretically and methodologically connected with science education theory is epistemic justice (Fricker, 2007). We are not the first researchers to mention the relevance of epistemic processes in the field of science. Relevant research in the field was mentioned by, for example, Edna Tan (Tan & Barton, 2007; Tan et al., 2019) and David Stroupe (2022). However, our theoretical contribution is integrating epistemic injustice in the field of science identity and peer dialogue inquiry. It is relevant because it supports efforts to conceive science as a discursive practice, dismantling traditional views that are still prevalent. Specifically, it sheds light on understanding who has access to explaining and constructing knowledge, whose experiences are considered, and whose voices are seen as valid. It therefore advances our knowledge of how interactions may hinder and promote co-construction in the micro-level of peer interactions.

Other models have been used to understand the processes of micro-interactions and identity development, especially in the field of math. We started our research inspired by Langer-Osuna's works (e.g. 2011), in which she integrates gender, identity, and group work in math. Langer-Osuna and Randi Engle published a model to analyze peer interactions (Engle et al., 2011). We agree with the model about the relevance of power relationships, notions of privilege, and the relevance of intellectual authority. However, it focuses on capturing how each individual contributes to the conversational floor and therefore determines who has more influence in the group task. As we were building our framework with a conception of science as a dialectical co-constructed field, we needed a framework that focuses on not just individual power relationships but also how power can be used in a transformative way, to construct with others, share with others, as developmental activities. In other words, Langer-Osuna's framework allowed us to capture the *winners* and *losers in the conversational floor*, but we also needed to focus on the process of co-construction of knowledge as a collective activity.

Our theoretical and methodological framework draws on the conceptions of epistemic justice with notions of power in/on others from Bloome (2005) to highlight that power is not just exerted individually, from one individual to another; it can also be transformative, in collaboration and exerted with others. Also, with the notion of *episteme*, we highlighted the multiple ways of understanding and giving meaning to a scientific phenomenon, considering different worldviews and identities.

The pedagogical trunk: *dialectical relationships and design for promoting diversity of voices in peer dialogue*

Specific objective	Research questions
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1. To describe the pedagogical situation within which peer interactions and group tasks take place	What are the pedagogical conditions to promote peer collaborative dialogues in science as developmental activities? What are the complexities and affordances of promoting dialogue-based group work in underserved classroom contexts?
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Having the theoretical roots of peer dialogue as a developmental activity that intertwines language, emotions, and identity, we wondered about the possibility of designing pedagogical activities that could foster this kind of peer dialogue, especially in underserved contexts in which different social discourses of gender, class, race, and others intersect with canonical conceptions of science. If we wanted to develop science identities in female students, it was necessary to understand the pedagogical situations that can foster them, especially because Science for Citizenship is a new subject in the Chilean curriculum. And although the promotion of peer-group, dialogue, and argumentation is highlighted, the lack of pedagogical orientations to carry out the curriculum has been criticized by the Chilean Society of Scientific Education as a weakness of the curricular innovation, potentially creating confusion and uncertainty at schools (Cofré et al., 2020).

The broader case study –as we called it– presented us with a complex reality documented in previous research, in which structural inequities reinforced deficit thinking, low expectations, and canonical science (Rojas & Liou, 2017; Shields et al., 2005). Paper 2 contributed to that research by analyzing the pedagogical conditions to promote peer collaborative dialogues among students from those contexts. We wondered about the possibilities of fostering deliberative teaching in a specific Science for Citizenship classroom, despite research showing that dialogue-

based learning does not produce the conditions to flourish with disadvantaged students (Maia et al., 2023)

Paper 2 narrates the obstacles and affordances that the teacher and researcher/co-teacher went through to achieve and promote deliberative interactions in group work, and the joy and satisfaction when students started to respond to their approach. The key in the article was how the change in the relationship between researcher and teacher, and between teacher and students, promoted changes in the way students start to approach science problems with one another.

Having paper 2 as the main source, but including some findings from paper 3 and paper 1, we can say that, in our case study, deliberative teaching was designed and enacted through pedagogical relationships at different levels that promoted deliberation and the conditions for developing diverse voices in the science classroom. Like the collaborative forces of gear wheels, there was empowerment between the different pedagogical relationships of the case study, which allowed the deliberation reported in paper 2 to be launched. If we overlap paper 2 and paper 3, which were part of the same pedagogical experience, we see that movement more clearly on at least two levels, as follows.

Teacher–researcher–design relationships

In our case study, the flourishing of deliberation evidenced in paper 2 was preceded by a dialogical collaboration between the teacher and the co-teacher/researcher about the pedagogical design. This is congruent with the study of Ruby (2006), who argues about the importance of a flexible teacher–researcher relationship, including feedback, cooperation, co-teaching, and modeling when necessary. Our study agrees and confirms the need for a relationship of collaboration and flexibility between university researchers and teachers; it also highlights co-teaching as a strategy to overcome difficulties. However, our study differs in how interventions are problematized, enacted

methodologically, and measured. Ruby's study centers on overcoming learning and curricular gaps, mostly from a deficit perspective, on improving standardized tests as the golden standard for school success. Our study centers on a critical view of deficits in students and teachers, paying special attention to giving relevance to the identity and voices of the students, conceiving dialogue as a way of promoting academic abilities to fulfill curricular gaps, but also critically questioning who should belong in science.

A study that uses deliberation and co-construction to measure the success of a dialogue-based experience is Maia et al.'s (2023) research, which shows that disadvantaged students benefit less from deliberative teaching. In fact, the results of the study show that deliberative abilities decreased among disadvantaged students after their deliberative project. They attributed this decrease to the lack of prior knowledge and logical competence of the disadvantaged students. Our study allows us to critically enrich the possible explanations of those results. Paper 1 not only shows different findings (with very similar criteria to define deliberation) but also questions their interpretation of the results. Paper 2 shows that the capacities of the students in an underprivileged context are not the only explanation for the success or failure of a deliberative curriculum. We stated how the content of the activities, the adaptation of the material, the university and school relationship, and the deficit perspective may have an important role in those results. Maia's study did not mention adapting the materials, their connection to the lives of the students, a critical view of the concept of capacities and deficit, or inclusion of the school's local teachers in the design and enactment of the deliberative activities. Our study claims that attributing the failure of a dialogue-based activity to the capacities of the students is not just simplistic; it can also contribute to reproducing the designated identities of deficit in marginalized students and schools. Papers 1

and 2 demonstrate that it is possible and desirable to bring deliberative teaching to underserved contexts.

This connects with another important finding of paper 2, the dialectical relationship between the teaching material, carefully designed and provided by the main university project, and the perspective of the teachers on how to present and adapt it to the needs of a particular Science for Citizenship class. Our findings support Valentina Guzmán's (2024) proposal about deliberative teaching as a new language form in comparison with transmissive traditional practices and the need for curricular material that can help teachers to enact that new genre. Our case study extends that work, highlighting the need for those materials to be appropriated dialogically as well, especially in underserved contexts. This implies that, without losing the objective of deliberation as a genre that should be carefully guided by teaching materials, it is necessary for the teacher to dialogically work on those materials to scaffold the pedagogical needs and include the interests and social worlds of a specific group of students. Sometimes, especially with novice teachers and in underserved classes, as in our case study, interpretation of the materials by the teachers alone was not sufficient to guide them to those pedagogical and relationship changes –indeed, co-teaching could dialectically facilitate this transition.

Just as paper 1 highlights that peer dialogue has the potential to become a developing experience if we intertwine learning, emotions, and identity, curricular innovations can be configured as transformative experiences if we understand them as dialectical experiences between researchers, designers, teachers, and students that are always open for growth. From paper 2, we can argue the need to imagine and enact relationships that challenge the traditional model of professional development based on academic gaps, deficits, and hierarchical relationships, which still predominates in science education, as reported in Bancroft and Nyirenda's systematic review

(2020). Our case study illustrates a counter-example narrating a dialectical experience based on a relationship of trust, horizontality, high expectations, help, and mutual care.

Teachers–student relationships

The findings of paper 2 emphasize fostering teacher–student relationships characterized by trust, emotional connection, and mutual respect with the students, showing a genuine interest in the students’ opinions and lives. If we combine the findings of papers 2 and 3, we see that teacher–student relationships were dialectically related to the way students started to interact in the group. If we overlap the broad and the core case study, we can see that as the figured world of the whole class changed to being more horizontal and trust-based in paper 2, students in the focal-group interactions started to perform a more horizontal and trust-based way of talking as a group, as evidenced in paper 3. This exemplifies one of the conclusions of paper 1, in which we claim the crucial role of teachers in designing learning spaces as ethical communities, helping students to frame relationships with others, and to care about the consequences of what, and how, students talk to one another.

This highlights the relevance of teachers as epistemic and ethical leaders of their classrooms, connecting with but also reframing the traditional notions of teachers as role models to fulfill the gender gap in science. The process highlighted by our studies focuses on interactions rather than individuals changing their mindsets or students imitating the teacher’s behavior. We propose a set of inquiries focused on the relationships, narrating how changing the roles that students and teachers play in the classroom through dialogue can help different voices and identities to flourish in the science classroom. This reframes role modeling to a learning paradigm that is closer to communities of practice (Lave & Wenger, 2009), in which learning is always participatory, relational, and grounded in identity. Our results contribute to that paradigm,

highlighting the role of teachers as epistemic leaders in these ethical communities that can promote power with others (Bloome, 2005) in peer dialogue.

The epistemic power of the teacher can foster peer dialogue that resists, challenges, and proposes alternatives to the structural positions promoted by canonical science. We agree with Langer-Osuna (2018) about the need to design classes and relationships that can help students to resist gendered reproductive positionings in classrooms. Our findings extend that work to the field of science education, showing that even in short interventions that reframe teacher–student positionings during a semester, we can see more horizontal ways of constructing knowledge in science flourish, as evidenced in paper 2, and the enactment of group leadership that challenged traditional ways of talk in science, as evidenced in paper 3.

Similarly, paper 3 and the chapter that is annexed (see annex 1) demonstrate the relevance of promoting group interactions in which students feel safe to be themselves and are not afraid of being ridiculed when they are wrong or disagree in academic discussions. What’s more, a piece of pedagogical advice for future implementations is to let students work in groups of their own preference, in which they feel free to express themselves. This is especially relevant for students with marginalized identities in science, like female students with a salient feminine gender expression, non-binary, or trans students, for whom peer dialogue could have been hurtful and related to traumatic experiences of sexism, bullying, and harassment. For these students, working in small-group activities among friends might provide the only space where they can express their opinions in science classes.

Leaves and flowers: intersectionality, epistemic power, and knowledge construction in peer-group dialogue

Specific objective	Research questions
2.To relate female students' positionings in peer interactions to knowledge construction in the group task	-How do female students position themselves, and how are they positioned in peer-group tasks? -How are positionings in group tasks related to participation in knowledge construction?
3.. To characterize the development of the science identities narrated by female students throughout the pedagogical situation	- How do female students narrate themselves and associate their science identities with their present and future lives? -How do female students experience the figured world of the science classroom, how do they feel it, and how does it connect with other relevant aspects of their lives?
4. To associate the narrative and in-practice identities of female students from an intersectional gender perspective that considers the figured worlds mentioned by them	- What is the relationship between the identities that female students narrate for themselves and those that spring from their positionings in dialogues among peers? - How does the development of narrated and in-practice science identities intersect with

female students' experiences of gender, social
class, or race/ethnicity?

As the sprout of leaves and flowers emerges from existing structures, the peer interactions and science identity development that we demonstrated in this case study emerged from the theoretical roots and the pedagogical trunk design and enactment. Paper 3 comprises the core objectives of the thesis, but they could not be completely understood without the other parts of the research. The core case study—as we call it—analyzed the interactions and narratives of a group of five friends during the broader pedagogical experience of Science for Citizenship to understand the development of the science identity of a female student in the group.

The conclusions emerged mainly from paper 3, and its objectives contribute to, and can be discussed in, two main sections: connections and contributions to science identity in case studies at the school level, and intersectionality and knowledge construction.

Connections and contributions to science identity in case studies at the school level

Case studies focused on narrative science identities. On the one hand, our findings agree with previous case studies, such as Calabrese Barton (2013), which illustrated how narrative identities are dynamic and mediated by social structures such as gender, social class, race, and abilities. Also, they align with evidence that emphasizes how science seems to be disconnected from female students' lives, and the need to connect the science class with their social worlds. However, the findings contribute to these case studies by connecting with dynamics that emerge in micro-levels in peer-group interactions and can be dialectically related to those kinds of narrative: dynamics of inclusion and exclusion, of voice and being silenced, which connects with how female students feel and think about science as a tool for reflection and sense in their life. The findings also identify

shifts in a narrative identity in a shorter period of time than the previous case studies (6 months instead of more than a year), mediated by changes in the curricular activities and relationships.

Case studies focused on all-class interactions. Previous case studies, such as Kumpulainen and Rajala (2017), demonstrated how students negotiate their science identities through the social architecture of classroom discourse, mainly mediated and orchestrated by the teacher. Our case study in paper 2 confirms the role of the teacher in designing and enacting the architecture of relationships that can promote or restrict the development of science identities. However, we also consider the spaces where the teacher does not have direct control or sight, in peer-group interaction. We saw in paper 3 that in those group spaces the teacher can still have epistemic power through short interventions; but our analysis also showed that in small-group conversation the role of students as leaders can have a critical role in framing interactions and organizing which voices are heard and who is acknowledged in a particular science class.

Peer-group positionings and identity in Chilean group interactions have been less explored, but our study helps to connect the dynamics we analyzed in previous studies with all-class interactions in Chile. Previous research evidenced that, in all-class talk, regardless of the teacher's gender, educators asked increasingly complex questions to boys, giving more feedback to them than to the girls (Espinoza & Taut, 2016; Ortega et al., 2021). Our results illustrated that masculine voices also predominate in group talk between peers in science small-group talk, away from the gaze of teachers, even with no cisgender males in the group (this last point is addressed in the next section).

Case studies focused on peer-group interactions. Although peer-group interactions are a less explored area in science identity research, our case study contributes to that emergent line of inquiry. For example, Wiselmann and her team's (2020) analysis of positionings and gender in

group work on a curricular STEM challenge found that boys tended to dominate discussions and manipulation of materials, disregarding girls' contributions. Our case study had a different curricular context, in which building artifacts and manipulation of material were less central than contributing to a group discussion. But it also found gender to be a relevant social structure that can organize who contributes to knowledge construction, with a predominance of masculine voices. Our work also extends Wiselmann's results with a broader notion of gender and including intersectionality in the analysis of the interactions.

Case studies that analyzed in-practice and narrative identities. Previous studies have analyzed the connection between in-practice and narrative science identities, and our study can contribute to that, connecting with those results and emphasizing aspects that previous research did not focus on. To our knowledge, we can connect with three previous case studies that focus on science identities in school experiences. On the one hand, Kane's study (2012) followed the group interactions and juxtaposed them with the narrative identities of 3rd-grade African American students. As in our case study, she found consistency between how students narrate themselves and their in-practice identities. Also, she found that gender, along with race, was relevant in shaping the identities of the students, highlighting that black students are structurally positioned as deficient students. Although race was less explicitly present in our study than in Kane's, we found that, in our context, social class shaped the designated identities of deficit among the students, and gender was an axis in framing the interactions. Besides the theoretical contributions mentioned in previous sections, our case study illuminates aspects that Kane's study did not focus on, and extends those results. Kane's study is more focused on analyzing consistencies between narratives and interactions, highlighting identity as a dynamic process, but without explicitly evidencing that process of change. In contrast, our case study shows shifts in the narrative science

identity, contributing to evidence of the dialectical relationship between in-practice and narrative identities.

Continuing this line of inquiry, Carlone et al. (2014) followed three students from fourth to sixth grade, analyzing student narratives and interactions. In contrast with Kane's study (2012), their findings highlighted how their science identities dynamically changed over time. The study showed how race, gender, and class hindered the students' identity work through the positionings that they experienced daily in their classrooms. Also, the narrowing of school science pedagogy and curriculum to a more traditional-based teaching pedagogy and a canonical science curriculum in middle school also contributed to problematic science trajectories, particularly for non-mainstream students. Our findings connect with most of the findings of this research, especially in the focus on intersectionality, and the analysis of how students narrate and interact with one another and with meso- and macro-structures dynamically. However, we extend their findings, showing how pedagogical changes can help to strengthen scientific identities and the co-construction of knowledge, and complexify the notions of gender to a broader conception.

The third case study that was previously integrated into in-practice and narrative identities is that of Gamez and Parker (2018), which focuses on Latino newcomer immigrant students, but it has similarities with ours in terms of how peer-group dynamics and teacher interactions were relevant in shaping student identities. Aligned with our study, gender was relevant for the in-practice identities of the students, and it shows how the positionings of the students shaped their narrative identities. We contribute to this case study by analyzing in more detail how students with marginalized participation in science peer-group work can also resist and find micro-moments of alternative ways to participate in knowledge construction. For this, the analysis that focused on off-topic conversations, and on what metaphorical figured worlds brought to the conversations,

was relevant and helped to give more complexity to the analysis of the inclusion–exclusion dynamics in peer-group dialogue.

Intersectionality and knowledge construction

Our research is part of a group of critical lines of inquiry that aim to reframe the focus on individual learning gaps and deficits in students to explain the so-called female gender gap. This line of inquiry sustains alternative explanations and analysis through the lens of identity and power relationships that highlight that canonical science has historically marginalized women, non-white races, and the working classes (Kang et al., 2019). This implies that society has an identity debt with those students (Ladson-Billings, 2006) that needs to be repaired by relating science to who students and teachers are as social beings (Szostkowski & Upadhyay, 2019), acknowledging intersecting oppressive structures (Crenshaw, 2006), as well as the agency that students can have in those structures (Varelas et al., 2012).

Our research can contribute to that line of inquiry, illustrating with a concrete example what other authors have reflected more theoretically and politically (Ladson-Billings, 2006). Papers 2 and 3 showed how, in a concrete working-class school, canonical science is practiced and reproduced every day. Our findings initially showed a figured world of the science classroom performed mostly as a masculine and canonical space, whether in the all-class setting, in which the teacher had a more directive, deficit-based, and authoritative way of structuring the class, or in the group work, in which students led discussions competing to exert epistemic power over others, and searching for one correct answer. Science seemed to be a space in which uncertainty, diversity of opinions, caring, and co-construction of knowledge—in other words, deliberation—had little space.

As social practice theory suggests (Holland et al., 1998), and micro-ethnography of classroom discourse (Bloome, 2005), it was not just reproduction of broader social structures that unfolded during the interactions and narratives of the case study. Papers 2 and 3 also contribute by illustrating, through a concrete experience, how the classroom can be a space for resistance, creation, and change. Despite social structures that root inequalities (Gorski, 2016) and the subjective effects and pressures of a high-consequence standardization regime on educational systems like Chile (Falabella, 2020), teachers and students also demonstrated authoring resistance and changes in meso- (classroom figured world) and micro-levels (group interactions).

Besides illustrating and exemplifying, our perspective on intersectionality responds to previous research (Wiselmann et al., 2020) and revisions (Varelas et al., 2024) that claimed the need for that perspective, which brought insights to the identity debt in science.

First, it complexifies the traditional binary research in science identity, opening up new perspectives and challenges. Through the lens of intersectionality, we perceived not just a female identity debt but also a diverse spectrum of gender identity debts. Paper 3 illustrated that the multiple ways students identified and expressed their gender identities positioned them unequally in knowledge construction in the science classroom, replicating and reproducing canonical science. This implies considering genders assigned at birth, but also that gender cannot be congruent with gender identity, and gender expression can also differ in students with the same gender identity. For example, a student who we can perceive as feminine, who uses a feminine name and pronouns, and who presents herself as female in her legal documents, can have a different gender identity, such as agender or non-binary, which implies a difference in how she reflects and performs gender in the science classroom compared with a cisgender female student. Also, a student assigned female at birth can have a different gender identity—trans man or non-binary, for example—with

a different way of expressing gender, such as masculine, neutral, fluid, or feminine. This implies a display of multiple ways of identifying and expressing gender that intersect with different social structures associated with masculinity and femininity, which complexifies research that has traditionally focused on the binary of girls/boys. Maybe because most research is focused on the first years of schooling, these nuances are less predominant than when research is focused on adolescent students, as in our study.

Second, even cisgender female students can use masculine voices in dialogue and lead conversation in a canonical way; gendered voices are performed in interactions. Regardless of the gender identities and expressions, masculine and feminine voices are social discourses that students take and perform in conversations. Paper 3 illustrated these complex dynamics by focusing on how the group was originally led by a female cisgender student in a masculine and canonical way; and how that same female leader student adopted a more feminine and inclusive way of leadership, giving voice to students with marginalized participation. In group interactions with no cisgender men, the masculine voice and power predominated in the trans man student in the group, who identified himself and expressed his gender in a masculine way. However, his masculine voice had less power when he interacted with cisgender masculine peers. This last point is analyzed in detail in the annexed chapter and shows some of the struggles of LGBTQ+ student voices in peer dialogue. Those voices are practically invisibilized in science identity research.

Third, our research highlighted heteronormativity as a powerful figured world that restricted access to feminine voices in group interactions. Several figured worlds brought metaphorically by the students showed gendered heteronormative and binary romantic relationships as a way to exert epistemic power on others and restrict access to knowledge construction in groups to female voices. Also, our analysis interpreted some of these statements in

relation to racist standards of beauty. One student narrated how there is an implicit rank of beauty related to whiteness, brownness, and blackness. However, this analysis is not fully connected to the data in the interactions. More studies, with different student identity configurations, especially considering diverse nationalities, are needed to understand how race and immigration status intertwine with gender and knowledge construction.

Fourth, intersectionality in our case study showed how students acknowledge and marginalize access to epistemic power using fixed notions of abilities and intelligence. The broad case study in paper 2 analyzed the relevance of gender identities intersecting with notions of abilities and intelligence. Also, in paper 3, the epistemic leader of the peer-group interactions not only enacted masculine ways of answering the science problems at the beginning but was also positioned as the student with the most academic abilities according to the group narratives. These findings were highlighted by previous studies showing how notions of abilities shape peer-group interactions and science identities (Calabrese, 2013; Kane, 2012) and how fixed notions of abilities in teachers can marginalize the participation and performance of students in dialogic pedagogies (Lefstein & Snell, 2014). However, our research extends those findings, evidencing those dynamics in narratives and micro-group interactions, weaving with an epistemic power perspective and a more complex way of understanding and performing gender.

Overall, our research evidenced the complex and dialectical processes between pedagogical changes in the science classroom, peer dialogue as a developmental activity, and shifts in the way students narrate their science identities as reciprocal processes. The development of our focal student's identity did not completely heal her deficit-assigned identity (Varelas, 2012). As with previous research that we revised at the beginning of this section, gender-mediated interactions, power, and science identity are processes that begin with the first years of education,

and our study reaffirms the need for sustained and inclusive educational experiences throughout school life to transform science classrooms as spaces for multiple voices and heal the diverse gender identity debt. We maintain that, through changes in interactions and in pedagogical relationships, we can promote diverse identities connecting with science as a way of understanding their own realities and seeing science as a possibility that makes sense in their future vocational life choices.

The forest: implications for practice and public policy, limitations, and future research

Just as the life of a tree is in a collaborative relationship with the past, present, and future of the forest, this thesis is part of a community of research and theoretical models. We connected our conclusions with a community of previous research and theories in the preceding sections. Now we will conclude this thesis by connecting our tree with the present and future of the forest, exploring the implications for pedagogical practice and public policy, acknowledging its limitations, and opening questions that we hope will be developed by future research.

This thesis can help teachers and educational practitioners. Our broader case study offered a situated, richly contextualized narrative of the design and enactment of a pedagogical innovation in an underserved school. Acknowledging that our single case study cannot be generalized, because it is not in the nature of case studies, we agree with Shulman (2002) that the value of our case is in linking the theoretical principles developed in paper 1 with a concrete expression of those in action in papers 2 and 3. We think this is valuable for practitioners because paper 1 may be too abstract, theoretical, or even ideal, in line with the criticism of dialogic teaching (Lefstein, 2010). The enactment of dialectical principles and relationships that our case study narrates in a complex and imperfect school context can also be read dialectically for teachers and other practitioners in relation to their own complex and unique realities.

However, we acknowledge the need to complement our concrete and specific findings with future case studies that analyze narrative and in-practice science identities with other groups of intersecting identities to confirm, refute, and extend our findings and illuminate aspects that our research cannot. Future case studies may include cisgender males in interactions with female students and diverse gender students with different configurations of gender identities, expressions, and social classes. We need further studies to better understand what metaphorical figured worlds bring to other students when constructing knowledge together, and if they are consistent with the heteronormative and gendered experiences demonstrated in our study. Also, it is necessary to clarify how race and ethnicity can play a more salient role in other identity configurations or social classes, for example if the group of students includes immigrant or Indigenous students (such as the Mapuche in Chile).

Our study showed a dialectical relationship between epistemic power in peer groups and the science narrative identity of one student, but she nonetheless continued to narrate the figured world of school as a space of demands and failure. The limited time frame of our project did not allow us to follow the reflections and interactions in the science class beyond that particular project. Although valuable insights emerged from our findings, longer studies are needed to follow the transition of the science identities of students, and to support longer pedagogical innovations beyond one school grade, to fully understand how science identities and pedagogical changes can be developmental and transformative experiences in underserved communities if sustained over time.

Quantitative research designs can also complement the limitations of small sample studies and can complement qualitative studies in our line of inquiry. Our findings highlighted the use of off-topic figured worlds as powerful tools of reproduction, resistance, and transformation of micro-

power relationships in connection with content construction, and more studies are needed to continue that emergent line of inquiry. Understanding that large-scale studies risk losing the contextualization and richness of each narrative, quantitative studies can contribute by giving a broader picture of the phenomenon, identifying significant patterns that need to be explored with new qualitative studies. We therefore need non-binary quantitative science studies that can complement the qualitative data on a large scale.

Future quantitative and mixed-method studies can contribute to answering questions such as: What are the more common figured social worlds in the life of the students? How do students see friendships, relationships, opinions, and social media? These studies should focus on how students experience heteronormativity, standards of beauty, gender diversity, intellectual abilities, social class, race, immigration, and voice, to better identify what intersecting figured worlds students are performing to access and restrict epistemic power.

Our case study can also contribute to understanding how educational research can join with teachers in underserved contexts to break narratives of deficit. We therefore illustrated the need for flexible and open pedagogical designs, establishing horizontal relationships between teachers and researchers based on trust, and being open to changing our roles and methods in response to the educational needs of each context. Co-teaching was, in our case, a valuable way of overcoming the difficulties we faced at the beginning of our pedagogical experience. However, we acknowledge the limitations related to the fact that this flexible design was more reactive than organized in advance. We believe there is more to be reflected and found here, so future studies are needed to systematically organize a dialectical model of collaboration between researchers and schools in underserved contexts to promote dialogue and diversity of voices in science throughout school years.

Related to that, some questions that arise from our pedagogical inquiry are: How do other dialogue-based approaches, like *thinking together* (Mercer et al., 2019) or *accountable talk* (Michaels, 2018), connect with the diversity of identities? How can we also adapt dialogue-based teaching with multimodal approaches that connect the curricular science content with the relevant social identities of the students, such as popular culture, Indigenous knowledge(s), arts, and community?

As in all studies, a possible limitation is our own positionalities. I sympathize with female students in underserved schools, especially when feminine voices are not heard in interactions. This motivated me to pursue this research, but it could have influenced my interpretations of the results. As a researcher and co-teacher of the study, I remained aware of my own positionality when interpreting the data, which I constantly reflected in notes and audio recordings about my feelings and perspectives at different stages of the research. Also, dialogue was a central strategy to integrating alternative interpretations of the data. For that, my thesis committee, especially my research adviser, helped to dialectically discuss codes, interpretations, and conclusions. Also, I had the opportunity to discuss the main results with the school teacher and the students who participated in paper 3, which gave me valuable opportunities to enhance different perspectives and clarify doubts that emerged during the interpretation process. However, more studies from other positionalities are needed to dialectically confirm, extend, and challenge our findings. We believe a future challenge of this line of inquiry in Chile is to connect with other local researchers to dialectically form a group of researchers in science identity across different spaces where science is performed.

As this case study narrates a concrete experience of a teacher enacting Science for Citizenship innovative curricula, it illustrates how a public policy is concretely enacted. This

research presents data that supports the concerns of the Chilean Society of Scientific Education about Science for Citizenship (Cofré, 2020): teachers need more pedagogical support to carry out the objectives of this curriculum. The concrete curricular materials developed by the university team were relevant, but in the context of our case they were not enough. The use of materials became mechanical, reinforcing a monological education. We believe that what we observed in our case could resonate with what other teachers may be facing with this new educational public policy, and more quantitative and qualitative studies are needed to support this statement.

Also, our study can contribute to public policy and NGOs' concerns about the so-called female gender gap in science, especially in the new science educational orientations that encourage peer dialogue, such as Science for Citizenship. Considering our results, we summarize our suggestions as follows:

- *Acknowledge the relevance of identity, intersectionality, and interactions in the process of learning science.* Understanding learning as something not only cognitive but also primarily a human social activity rooted in dialogue. This implies considering emotional and identity processes as part of learning and being aware of the different intersecting identities of students. Having more balanced and diverse voices in the science classroom could promote better knowledge construction and the connection of science with the lives of female students.
- *Understand the female gender gap in science as multiple gender identity debts.* Moving from binary ways of understanding gender would allow us to appreciate that what we call female students hides diverse ways of identity and expressions of gender, who relate differently to knowledge construction in science, especially in adolescence,

in which student reflections about who they are and how they express themselves are more central than in the first years of schooling.

- *Reframe science classes to promote diverse identity connections.* If science learning is linked with identity development, the curriculum, design, and enactment of science classes should promote a connection between science and the diversity of student lives, interests, and experiences. This also implies changing a vision of science from an abstract and objective discipline to a way of seeing, acting on, and appreciating the beauty, problems, and concerns of the students as social and gendered beings.
- *Design structured and consistent opportunities for peer-group developmental learning.* Small-group work is a powerful learning tool and has the potential to become developmental, transformative activities in which diverse voices can flourish and connect with science. However, this process is not guaranteed just by grouping students; it is necessary to consistently promote constructive ways to talk between peers, framing what is expected of the interactions, promoting emotional connection, and mediating their conflicts. Teachers need supportive curricular materials for group discussions and ways of transitioning from traditional teaching strategies to a dialogical classroom environment.
- *Allow students to work with friends in small-group interactions.* Peer-group work is important for inclusion and could be the only space in which some students have the confidence and trust to talk about science, make mistakes, empathize, or change their opinions, and—in that way—connect with science. Grouping students with friends or others who they can trust is therefore a relevant strategy.

- *Promote diverse ways of expressing, thinking, and feeling science in small groups.*

Micro-classroom interactions can reproduce macro- and meso-structures of power, but they are also spaces for authoring, creation, and resistance. A way of promoting the latter is fostering pedagogical relationships in all-class activities in which teachers relate with students in a horizontal, connected, trust-based way, explicitly transmitting high expectations and scaffolding when necessary. Also, the teacher can enact, promote, and acknowledge more balanced masculine and feminine ways of talking about science, regardless of the gender of the speakers. Also, it is important for teachers to observe how students solve group tasks, integrate different opinions, and exert leadership, mediating when necessary. Small contributions by the teacher can balance the power relationships in the group.

Overall, this study aimed to contribute to and connect with past, present, and future research that seeks to balance historically unequal power discourses, science identities, and relationships. We think that contributing to that community (or forest) of research is relevant because canonical science identities risk being reproduced at school, even in innovative science and dialogue-based curricula, such as Science for Citizenship.

But it is more than that. At the end of this research, we feel and think that holistic theory, transformative pedagogical relationships and designs, and peer-group dialogue are powerful tools. We hope to encourage a critical appropriation of an innovative pedagogical tool with remarkable evidence for learning—peer-group dialogue—as a developmental activity in which students can co-construct knowledge and grow together.

This is a special urgent objective of education and society, in which we need our newest generations to learn better than us to dialogue and reach a consensus about complex global,

political and socio-scientific problems, considering different identities, feelings, and opinions. We hope that, by contributing to a community of researchers, teachers, and practitioners seeking to transform classrooms into small and secure spaces for deliberation and connection with diversity, we can help to reconnect with the purposes of human education. In a world increasingly endangered by polarized political discourses, racism, exclusion, hate speech, and sexism, we see teachers' and researchers' efforts to design transformative science spaces where students can dialogue in groups—connecting their diverse knowledge(s), identities, and feelings about complex problems—as micro-acts of resistance, creation, transformation and hope.

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ANNEX

Annex 1. Book chapter for Springer Book series in Social Interaction in Learning and Development.

Annex 2. Overview of curricular material, lesson guides

Annex 3. Interviews guideline

Annex 4. Codes for peer interactions (broad case study)

Annex 5. Main codes by level, with examples (core case study)

Annex 6. Letter of approval from the UAH Ethics Committee

Annex 7. Consent letters

Annex 1. Book chapter for Springer Book series in Social Interaction in Learning and Development.

Does classroom deliberation promote gender equity? Understanding pedagogical affordances of peer dialogue

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Abstract

Collaborative peer argumentation has been shown to be beneficial at both conceptual and skills levels. Deliberative argumentation among peers—argumentation that emerges in a problem-solving context where the communicative goal is to understand and find the best possible solution to a controversial issue—is considered a key pedagogical practice in contemporary democracies. However, affordances of peer deliberation about gender equity are still underexplored. On the one hand, we still do not know how power unfolds within deliberative discussions. How women and gender minorities benefit from these discussions, and whether deliberations change the way students think about gender issues, are open questions. On the other hand, whether peer deliberation can foster educational spaces that are less polarized in terms of gender differences is another open question. The aim of this chapter is to explore these questions through two case analyses of secondary students (16 years old) who were learning climate-change science and citizenship education through a deliberative pedagogy. The interventions lasted between 4 and 6 weeks, and we analyzed interviews and classroom discussions that were audio recorded. The results show how deliberative discussions change the organization of power according to gender, in terms of both empowering speakers and also their political positions in gender controversies. We discuss the results considering socio-cultural and dialogical theory.

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Deliberative pedagogies can be thought of as pedagogies organized around the critical discussion and argumentation of open problems. These pedagogies are aimed at critically, seriously, and respectfully exploring the different perspectives and interests in place in relation to a problematic issue in order to reach possible understandings (Larrain et al., 2021a). Deliberative pedagogies have mainly been developed and evaluated in the field of political education (Andersson, 2015; Hess & McAvoy, 2014), and they are based on the promotion of in-classroom deliberation of situated socio-political problems, in both whole-class and peer-to-peer interactions. However, it is an approach that gives peer interaction a crucial role: the idea is to offer students authentic experiences of equal and inclusive participation and the exercise of citizenship.

Deliberative teaching in this tradition emerges when contrary views are expressed and discussed through argumentation, with the goal of reaching a consensus while attending to differences. Tolerance and acceptance of others' views also characterize this way of teaching, in addition to the possibility to question traditional views and the opportunity for students to communicate with one another with less teacher control. Englund (2016) is explicit in viewing deliberative communication as “when conflicts, controversies, confrontations or different views on any issue arise or are observed and pointed out in the classroom” (p. 67).

Existing evidence based on self-reported measures shows that deliberative teaching in social science contexts prompts student engagement and motivation (McAvoy & Hess, 2013; Latimer & Hempson, 2012), interest in politics (McAvoy & Hess, 2013), willingness to participate (Andersson, 2015; Díaz, 2014), political competency (Andersson, 2015), and fewer divisive attitudes in diverse political settings (McAvoy & McAvoy, 2021).

Other lines of research show how peer deliberative argumentation, when carefully designed and embedded in the school curriculum, can foster students' deep conceptual understanding and knowledge (Asterhan & Schwarz, 2007; Asterhan & Babichenko, 2015; Felton et al., 2009; Iordanou et al., 2019; Larrain et al., 2021b; Michaels, O'Connor & Resnick, 2008) and argumentation/reasoning skills (Kuhn & Crowell, 2011; Garcia-Mila et al., 2013; Iordanou et al., 2019). For a detailed review, see Larrain et al. (2021a). Deliberative argumentation is typically defined as engagement in critical thinking, elaboration, and reasoning so that students “can build up a shared understanding of the issue at stake instead of merely convincing or changing their own and each other's beliefs” (Noroozi et al., 2013, p. 60).

Classroom peer deliberative argumentation and equity

However, different authors (see for instance Michaels et al., 2008) have also stressed the possible risks entailed in classroom deliberation and its tacit promise of inclusiveness and equality (see Chapter 5). The assumption that every deliberative pedagogy takes as its starting point an ideal of deliberative democracy results in authors pointing out the possible over the rationalization of learning experiences that may benefit some groups of students over others (Ambrosio, 2019;

Barton & Ho, 2023; Tammi, 2013), leaving women, in particular, in a disadvantaged position to participate and learn from the experience. As classrooms are socio-political spaces of power (Langer-Osuna, 2018), peer encounters are not horizontal and neutral spaces where every student has the same opportunity to be heard and listened. Powerful social discourses intersect to create barriers and facilitators based on cultural constructions like gender, race, and socio-economic status, and local interpretations of each classroom world can affect how power is distributed among students (Wortham, 2005).

Studies have reported that although women are more willing to deliberate, men exhibit dominating techniques that may hinder women's participation (Afsahi, 2021). Evidence shows that anonymous environments may foster participation (Clark et al., 2015). Nonetheless, classroom deliberation should not be easily identified with other forms of deliberation. In fact, Claes et al. (2017) point out that classroom deliberation may be more appealing for students who prefer the informal discourse of more intimate networks over the formal discourse that is typical of political settings, and that these experiences may foster the perception of an open classroom climate. Authors have argued for collaborative approaches to deliberation (Journell, 2023—see Chapter 10) acknowledging the role played by emotions and positionings (Ambrosio, 2019) and the key facilitating role of teachers (Journell, 2023). Moreover, deliberative dialogue entails not only a cognitive but also a developmental dimension (Zittoun & Perret-Clermont, 2009) that includes personal and identity growth (Salas & Larrain, 2024; Wortham, 2005), which might not work in adults deliberating in formal political settings in the same way as it does in students deliberating at schools. Students are not only performative beings: they tell themselves their own stories and encounters, making them authors of who they are and how they are positioned (Holland, 1998). Therefore, classroom deliberation should not be viewed as a mechanical transfer of political deliberation out of school, simply assuming, without systematically exploring, that power differences will be reproduced.

Can classroom peer deliberative argumentation prevent school violence associated with gender?

There is a legitimate question about whether classroom deliberation can offer transformative spaces for students, independent of their personality (see Chapter 9) and identity, especially gender. This involves not only women but also gender-creative people that challenge the dominant binary heteronormative western culture. A growing body of research shows that LGBTQ+ students face extenuating challenges at schools. They are at greater risk of becoming victims of violence and harassment because of their gender, appearance, and sexual orientation; they tend to perceive a more negative school climate; they usually have more mental health issues associated with experiences of rejection and victimization; and they have higher rates of absenteeism (Knutson, 2019; Sulimani-Aidan et al., 2024; Russell et al., 2021).

Considering the everyday reality for LGBTQ+ students, there is an urgent need to cultivate schools that can offer protective and learning spaces for them. The State of LGBTQ+ Youth, Health and Wellbeing Symposium highlighted the need for more studies about how LGBTQ+ students' intersecting identities affect their school experiences, and how curricular activities can be designed and delivered to ensure better socio-emotional and academic outcomes for this underserved population (Johns et al., 2019).

Interestingly, some studies suggest that peer deliberation can be a way to promote safer spaces at school. As mentioned, gender has been shown to be a risk factor for school violence (Turanovic et al., 2019). Meta-analytical studies suggest that peer violence can be effectively prevented by interventions focused on peer dialogue and communication (Gaffney et al., 2019; Gaffney et al., 2021; Guzman-Host et al., 2022; Polanin et al., 2020) and that peer interaction among diverse students can promote the development of complex identities and social inclusion (Aronson & Bridgeman, 1979; Graham, 2018). Specifically, studies have reported positive effects of school deliberation on school violence prevention, although not necessarily focusing on gender-related violence (Dube & Hlalele, 2018; Guimarães-Iosif & Schultz, 2015; Padrós, 2014; Shultz, & Elfert, 2018). Therefore, it is imperative to explore the question of whether peer deliberation of gender controversies could lead to less polarized and more inclusive learning environments.

The aim of this chapter is to provide exploratory evidence on: (1) how classroom peer deliberation is experienced by gender-diverse students, and its possible academic and personal outcomes; and (2) whether classroom peer deliberation may promote shared reflections on gender controversies, resulting in a less polarized and more socially inclusive environment. We consider these two aspects of peer deliberation, the political–gender dynamics and outcomes, as two sides of the same coin. Hence, we explore them both by analyzing two different case studies, each one focused on each question (case 1 in question 1; case 2 in question 2). Both involve interventions in which a deliberative curriculum was implemented by regular teachers with students in their last 2 years of school education (16–18 years old), although they differ in the focus of student deliberations: in the first study students discuss climate-change-related controversies, and in the second study they discuss gender controversies. Moreover, the first case is based on student interviews and the second on the analysis of student discussions, giving complementary perspectives on the issue.

Case analysis 1: the experience of peer-group deliberation of three LGBTQ+ students

Context. We present a case study that focuses on the experience of three students. The question that guided the case was: How do LGBTQ+ students experience deliberation with peers?

The students were part of the same school and the same 11th-grade class (16–17 years old). The school is an urban, secular, and mixed-gender establishment in a working middle-class area of Santiago, Chile. The school is privately subsidized, meaning it is run by private individuals with public funds. The school educational project emphasizes inclusion and respect for diversity, and it is locally known for receiving students who have been rejected or bullied in other schools.

The case study was part of a broader research, which sought to evaluate the effect and understanding of the conditions of teaching climate change through deliberative argumentation for sustainable citizenship. The case unfolded during the implementation of that curricular innovation, and the deliberative activities were developed during a school semester, twice a week, in the mandatory curricular subject of science. The teacher and one of the co-authors of the chapter co-taught the class to promote peer dialogue about socio-scientific problems in the Climate Change Unit—the teachers received a set of deliberative materials that were adapted to the class. The curricular activities were divided into four key moments: introducing the socio-scientific problem on plenary, individual work, small-group peer work, and whole-class plenary.

Methodology. Instrumental case studies seek to illustrate in-depth a particular phenomenon to shed light on a general complex problem (Merriam, 1998). Understanding that the stories that we unfold here are not generalizable, we want to illustrate the complexities and entanglements of the life of three LGBTQ+ students to be read as frameworks of dialogue and understanding of other unique contexts of LGBTQ+ youth. This is especially important considering that most gender research is designed in a binary way, which can overlook the experiences of students who live and perform gender in creative and non-binary ways (Kroll & Plath, 2021).

Participants. The case study illustrates the experience of three LGBTQ+ students: Erick (trans man), Cami (non-binary), and Carolina (agender student). We respected the preferred pronouns expressed by the students and selected pseudonyms that matched them. In Erick's case, his pronouns are masculine (he/his), for Cami they are neutral (they/their), and for Carolina they are feminine (she/hers). We selected the three students based on their different gender identities to illustrate in a richer way the LGBTQ+ student spectrum of identities.

Instruments and analysis. The instruments included interviews, group-work recordings, and participant observations. We interviewed each student on three occasions throughout the academic unit. Also, we observed and recorded the group activities during the semester. The interviews, observations, and recordings were transcribed and analyzed using thematic analysis (Cohen et al., 2007). The aim of the analysis was to create thick descriptions of how students narrated and experienced the curricular activity (Jha, 2018; Merriam, 1998) in the framework of their gender identities and life experiences. The main themes that emerged in our analysis were the students' academic and social stories related to their gender identity, how they felt and interacted in the deliberative groups, and how they perceived the academic content and learning.

Ethical approval. The Institutional Review Board of Universidad Alberto Hurtado approved the project. The principal, teacher, students, and parents signed consent letters, and the characteristics of the research were explained to them. After we wrote the first draft of the results, we again contacted the three students in the case study and discussed the results. They gave us feedback about our analysis and consented to the content being published.

Insights

Socio-emotional struggles: a life history of harassment and discrimination

The case study focuses on the experiences and stories of three LGBTQ+ students who were part of the same science class. Erick defines himself as a heterosexual trans man. He explains, "*I was born a woman, but I identify myself as a man.*" (first interview, line 144). His pronouns are masculine, and he is in a relationship with a female cisgender peer. Cami defines herself as non-binary. Cami was designated female at birth, but when they were 13 years old, they discovered "*that I don't like being, like, super feminine*" (third interview, line 83) and changed how they dressed to an androgynous style. At 15, they had a short haircut, which was liberating because it allowed them to feel like they were in a "*safe place.*" (third interview, line 83). Carolina considers herself an "*agender person*" (first interview, line 21) because she strongly believes gender is a social construction. She does not feel identified as a non-binary person because she perceives that non-binary is a label that entails a specific way of dressing and being (androgynous). Her pronouns are feminine, but she is comfortable with other pronouns as well, and she has chosen to dress femininely at this moment of her life (which is congruent with her assigned gender at birth).

Even though Erick, Cami, and Carolina had different gender identities and participated in different ways during the group deliberative activities, they all had stories of socio-emotional struggles in and out of school related to their gender positions. Their stories were marked by experiences of discrimination and mistreatment, with not just peers but also teachers and other adults. Also, the three of them expressed that they had mental health issues related to experiences of rejection and were in mental health programs in and outside school.

During the interviews, Erick talked about being mistreated and receiving unfair, unsolicited comments and suggestions about his appearance as a trans man. Random adults in public spaces had said that “*no one is ever going to like him*” or that he dresses that way “*only to reveal to his mom.*” (second interview, line 126) The police also unfairly took him during a strike that he wasn’t taking part in. Although he feels his schoolteachers are more respectful in this school than in other places, “*they usually get confused a lot with my uh...names and... Especially like we had to go for a school trip, and they were saying my legal name.*” (second interview, line 138). Erick is part of a trans youth integral health governmental program, but he feels that even in those spaces his gender identity is not fully recognized. Doctors said that he should wait to change his social name:

Interviewer: And can you change your legal name?

Erick: Uh, I must wait until I'm 18, but now I need to go with uh...someone who... I must bring witnesses, and I must...go with one of my parents.

Interviewer: Ok.

Erick: But the doctors at the hospital kind of insisted that I don't do it now.

Interviewer: Why?

Erick: Because they told me it was kind of too much of a hassle right now and because maybe I wasn't sure.

Interviewer: And what do you think of that?

Erick: I found it super lame because it's like...and they keep questioning me...

(Erick, second interview, lines 144–8)

Cami’s life has been marked by peer conflicts and mental health problems in school, although out of school, their life is quite the opposite. Cami changed schools recently: “*I really had a lot of problems with most of my peers, and I really didn't feel good in that school.*” (first interview, line 20). They say that in their current school, they feel more accepted, especially by their teachers, but they still have some problems. During the interviews, Cami expressed they are having problems with their classmates. In class, they said they wanted to be interviewed but not recorded in the peer-group activities because they felt overwhelmed by personal problems and with their peers. Cami, at that time, was working on these problems with the school psychologist and in private sessions.

However, Cami seems to have a parallel life outside school, which they enjoy with a scout group. They feel appreciated by their friends. Cami talked enthusiastically, and even their voice sounded different when they referred to outdoor and environmental activities and arts. They enjoy cleaning activities on the beach, taking pictures of nature, and painting. But for Cami, the school has nothing to do with who they are:

“So I don't, at least I don't feel like it's related, the school with my personal life...”

(Cami, first interview, line 143)

In Carolina's case, her story is not necessarily marked by her being directly mistreated as an agender person. As she dresses and presents herself in a feminine way, if you don't talk to her and know her gender position, it is easy to confuse her with a cisgender woman. Still, she is very aware of the hurtful heteronormative jokes and dynamics in her class. Also, related to her feminine gender choice, she has felt harassed by some male classmates who were attracted to her:

And with me, he didn't... he was more [annoying] because he liked me then, so I think he had this dynamic of annoying those who he liked. Because everyone said that he liked me. And he told me several things like that, and from there, I didn't like to participate in anything.

(Carolina, second interview, line 52)

Also, she finds the transphobic and sexual jokes she has witnessed from her male peers shocking. More than once, she refers to gender attacks she has observed:

It was hurtful the other day. They [a group of male classmates] were making very transphobic comments (...) But it was like denying his identity and, moreover, sexualizing him, and then they said that it was...as if he was a friend, but I don't think that any of that group had any good feelings toward him. But it was shocking...

(Carolina, second interview, line 68)

Carolina, like Cami and Erick, were receiving mental health support at the time of the study.

Insecurity in expressing their opinions and the need for a trusted and friendly space for dialogue

Knowing their stories of marginalization and rejection by their classmates, it makes sense that engaging in dialogue about academic tasks is especially difficult for these students. Even though they had different ways of expressing it, for the three of them, dialogue-based activities are emotionally triggering, and they said that to really be involved in a deliberative dialogue, they need to work with a group they trust.

Erick seemed secure about his opinions during the deliberative activities, but he said he only achieved that because he was in a group of trusted friends. However, in plenary activities, he remained silent and self-conscious. When asked why he didn't participate in plenaries, he said:

Erick: Because I'm afraid of being wrong, like... I feel like they're going to...like in their mind...they're not going to say it, but in their mind...they're going to think, “Oh, this guy is such a jerk.”

Interviewer: And in the small groups, does that happen to you? When you were with your friends?

Erick: No. Because they already know that I am, but...

Interviewer: What do they know you are?

Erick: A jerk...

Interviewer: Ha ha ha ha.

Erick: So, like...it's like, "Oh, it doesn't matter what they think". That...I know them, and I know they don't really think that way but...is that...

Interviewer: You have more confidence with that; you need to be with people who are more in your trust to be able to say [your opinion].

Erick: Yeah.

(Erick, third interview, lines 202–10)

If Erick were forced to group with students he doesn't trust, the experience would be very stressful and emotionally triggering for him. He is especially suspicious of a group of only cisgender males in the class, expressing that he "*dislikes them all*" "*because of their personality and the things they say*" and that "*they treat women badly.*" (second interview, lines 276-280). Erick explains that with people he doesn't know, he is normally very rude and tough:

Erick: It's just that I don't get along with people.

Interviewer: Really! I find you quite the opposite, very friendly...

Erick: What happens is that I can be very friendly, but it's very easy for people to dislike me.

Interviewer: You are very selective with people.

(Erick, third interview, lines 240–43)

Carolina, like Erick, never took part in the plenaries, but she had brief interventions in the group activities, and her classmates seemed to appreciate her ideas. The student said that when she started in this school, she used to participate very enthusiastically in class, but she was bullied, so she stopped.

Carolina: Before the pandemic, I participated a lot, but they told me it bothered them, so I stopped doing it.

Interviewer: Who told you that?

Carolina: A classmate of mine.

Interviewer: What did he say?

Carolina: That when I participated, he couldn't find a moment for me to shut up.

Interviewer: Did he tell you that you participated a lot...that you talked too much?

Carolina: Yes, he was waiting for the moment I would shut up.

(Carolina, second interview, lines 44–50)

Carolina doesn't like working in groups because she is afraid of saying something wrong and has to give her opinion to people she may not trust much. She said she was selective about who she worked with, and it is very important to be in a group with classmates she trusts:

Carolina: I am kind of selective with the people I talk to, and I feel that every time I work with a group that includes Diana or Luna, Lili, and Erick, I feel I am much more comfortable than with another group.

Interviewer: And why? How?

Carolina: Because they do things well, they don't get distracted and include everyone.

(Carolina, first interview, lines 59–61)

In Cami's case, they didn't feel comfortable in their group. Cami was experiencing personal problems that interfered with them participating in class and felt pressed to give opinions:

Interviewer: How did it go for you as a group?

Cami: Eh, it was difficult because, for example, I, sometimes... I didn't always have the answers, or I didn't like to work a lot because I had problems at school and other issues, and Pancho [a group mate] forced me to say an idea. I don't like to be forced to do things I don't like, so we had mini-fights with Pancho about that.

(Cami, third interview, line 19)

After the first weeks of the group activities, Cami asked not to continue participating and to finish their work alone because they *didn't feel good with the group activities because of personal problems*.

How they engaged in deliberation

Carolina and Erick chose to group together with three other friends. Cami was new at the school and was with a group of two peers they were recently getting to know. In the deliberative activities, Carolina remained mostly silent during the interactions but seemed attentive and followed the discussion. When asked for her opinions, she struggled to express her ideas, even though her peer group seemed to consider her opinions. The next example is an excerpt of how Carolina engaged in the deliberative group task:

Diana: The plants first absorb solar energy. Why the atmosphere? Because it is a layer that is between the earth and the sun...(silence, they write). And about technology, we still have to work on it... What did you write?...In technology...what could we say?

(Silence...they review their guides.)

Carolina: I feel there are other words that we have to use; we have to name the elements that are in the atmosphere.

Diana: Could it be that technology affects the elements in the atmosphere, among other things? They write in their guides. Diana finishes and shows it to Carolina.

(Carolina continues writing, but she does not respond to Diana's gesture.)

Erick: (to Carolina) What do you think about the answer?

Carolina: Ahh (silence)... I like it.

The dynamics of Carolina's group, of which Erick was also a part, were generally very polite and horizontal. Even though Diana used to structure and guide the conversation, she constantly checked for other's opinions and tried to incorporate them in the final answer. In the previous excerpt we see how Carolina gave an opinion. Diana accepted it, but Carolina struggled to confirm it with her. She only answered when Erick asked her directly.

Erick, who was part of the same group, was more active in the group interactions and seemed secure about his opinions. He generally responded when someone disagreed with his ideas and tried to contribute his ideas to the group response.

Erick: The car goes second...let it second (to Diana).

Lili: Aah? Living without a car? Living without a car.

Diana: It's only that... Never use a car...never use a car...and a person drives, on average, for at least 30–35 years.

Lili: I'm confused; which one are we talking about?

Erick: I live without a car... I ride a bicycle (Lili laughs)... I really...I ride a bicycle.

Diana: I also live without a car... I'm poor...

Lili: (to Erick)...but once you went to drop Luna off, and you went by car, dude.

Erick: But it was my mom...not me...

In this excerpt we see Erick confidently talking with his peer group. Even though Diana questioned his idea, he brought his personal experience to convince the group about the impact of living without a car as an important action to mitigate climate change.

Cami had a very different group experience. The exchanges of their group were in a joking tone but with underlying aggression and mixed with some on-topic content. Cami seemed less focused than Carolina and Erick and used to respond with jokes and off-topic exchanges when asked for their opinion:

Pancho: Stop plundering other people's lives, and let's do our work...(...)

Cami: You're looking for a boyfriend for Christina...

Pancho: Shut up.

Cami: You shut up.

Cristina: (she points to the camera)...it's recording.

Cami: (to Pancho) You've been saying crazy things all the time.

Pancho: (singing)...Crazy, crazy, crazy in the head...

Cami: I once said that to someone, and he told me, "I'll shut you up with a hit"...

Pancho: It depends on how you take it...why? I think the ozone layer protects us greatly because it makes the sun's rays bounce off, right?... I've repeated it like four times...

Cami:...I think we should put more of your theory than Cristina's...

In this encounter Cami brought to the dialogical space the voices of male aggression they had received before (“...and he told me, I’ll shut you up with a hit”). It is shocking how this aggressive content is apparently completely ignored by Pancho, who comes back to focus on the content task. Also, Cami finally agrees with Pancho’s ideas for the class activity despite the confrontation with him.

A horizontal and equitable deliberation space

Besides the need for a group of trusted friends to explore their opinions and engage in dialogue, the students said it was very important for them that the group dynamics were inclusive and horizontal, without strong leaders or rigid ideas.

When Cami was asked what they would change to have a better experience in group dialogue, they said they were very uncomfortable with Pancho’s strong leadership:

Interviewer: Would you have liked your participation or that of another person in your group to have been different?

Cami: Mmm, Pancho may not have been such a leader in the group because he told me and Cristina what to do.

Interviewer: He kind of bossed you around a lot, mmh?

Cami: Yes, if he had changed his personality within the group, it would have been better.

(Cami, third interview, lines 69–71))

Like Cami, Erick also said he didn't feel comfortable with peers who have "great personalities," and if he had been grouped with his male classmates, he "wouldn't have given a damn about the activities" or he "would have worked alone." (second interview, lines 475-480).

Erick: I don't like their personality [the male group], I don't like people who are "too active," let's say (...) Like people who are very...like a sun.

Interviewer: I see.

Erick: I hate them, I don't like them.

(Erick, third interview, lines 276–80)

Carolina appreciated that "no answer was 100% certain" (second interview, line 32) in the activities because she prefers to work on non-competitive tasks. She doesn't like other dialogue-based tasks such as debates, so she appreciated that the emphasis of activities was co-construction:

I remember that in a guide, like the questions were not so...like good or bad; they were more like interpretation questions, and then, as each one had his own interpretation, one could share it with his group and see which one went the furthest and that.

(Carolina, third interview, line 30)

Cami also said that, even if they did not have a great experience with their group, they like to engage in conversations where participants can change their points of view. But Cami perceived that their classmates "were stuck in their ideas like they wouldn't let someone else take away the idea that they had."

(Cami, third interview, line

45)

Despite these difficulties, the deliberative activity was significant to them

Even though dialoguing with peers was challenging and sometimes overwhelming for the students in the case study, they valued different aspects of the activity, especially the opportunity to talk about different positions in a small group.

Erick's opportunities to dialogue in small groups of friends allow him to feel relaxed and learn in class; he mentioned he could investigate and reach conclusions. He felt he could better understand the class content as time passed working in groups:

Erick: Like we weren't afraid to write on the blackboard or things like that or, let's say, very rarely, and we could work together, which we can't always do, like making guides or things like that.

Interviewer: Did you like kind of getting out of the traditional structure of the class?

Erick: Yeah, it was kind of...relaxing (...)

Interviewer: And did you feel any difference from the beginning to the end?

Erick: I felt like I could kind of give other answers.

Interviewer: How is that?

Erick: Like... I understood better...

(Erick, third interview, lines 424–6; 433–6)

The group activities were less significant for Cami than they were for Erick. Cami ended up working alone and struggling with personal problems and problems with their classmates. Although the objectives of deliberation with peers didn't occur, the content of the guides interested Cami and allowed them to engage and get better results in science class:

Cami: I didn't pay much attention to the other schools in class. So, I did poorly in science everywhere, but now I've done better this year.

Interviewer: And...what do you think you have done? What is it... What has been better for you this year?

Cami: I don't know, concentrate more, and be...like...much more interested in the subject (...)

Interviewer: Ah, you are more interested... What things have interested you?

Interviewer: I don't know, like the subject itself.

(Cami, third interview, line 36–38)

Carolina also appreciated the content of the guides. Even though she usually doesn't like working in groups, Carolina valued “*creating a dialogue between us and our peers*” (third interview, line 22) in a protected space of friends. She highlighted several times the uniqueness of not having just one certain answer, which surprised her:

“In almost all subjects, it is all about whether it is good or bad. Instead, here it was like broader...of being able to see your own point of view and that...maybe it wasn't right according to the data, but you were still given the opportunity...and you could...like to say something.”

(third interview, line

32)

In summary, even when for Erick, Carolina, and Cami dialogue-based activities are emotionally triggering, they valued the deliberative activities when they unfolded with peers they trust as they fostered respect and recognition for different opinions. This points out to the importance of task design and teachers' group management. However, the case shows how gender-based classroom violence is experienced by LGBTQ+ students and how important is to talk about it in order to prevent it. Can peer deliberation contribute to the latter?

Case analysis 2: Peer deliberation for the transformation (and depolarization) of gender issues

Context. The second case study illustrates deliberative peer dynamics when discussing gender issues that are potentially conflictive. The question that guided the case was: To what extent does peer deliberation promote shared reflections on gender controversies?

The case is part of a larger study conducted in 2021–22 with the aim of promoting deliberation about social and political issues in secondary classrooms. First, design-based research was carried out to develop a curriculum material for deliberative teaching associated with justice and human

rights dilemmas. The material was co-designed with classroom professionals and teachers with diverse areas of experience in a collaborative, dialogic, and iterative way. The co-design process and the results of this material are published in another research article (see Guzmán et al., 2023). The material contains seven classes with dilemmatic cases that propose controversies with no easy solution (the topics are related to the right to justice, hate speech, freedom of expression, and discrimination, among others), along with instructions for group resolution to organize the best possible conditions for listening and deliberation among students. It also contains all the educational features that the literature recommends to support its implementation, as well as deliberative group activities around the discussion of human rights cases that resonate with students' current reality and context. Then, to evaluate the potential of this material to transform classroom dialogue spaces, a qualitative case study was carried out in 2022 to obtain an enriched understanding of the process of implementing this material and to assess the type of discourse favored in whole- and group-classroom interactions.

Methodology. A group of students was selected to assess the extent to which the curricular material (group activities with dilemmatic cases) promoted deliberative dialogues between students within the groups and to analyze the quality of discussion that emerged in group work.

Participants. The whole study involved a teacher and her 34 12th-grade students (17 and 18 years old) from a girls' public school in Santiago de Chile. All were native Spanish speakers and ethnically homogeneous. The secondary school institution has historically been anchored to feminist identity mobilizations in the context of the rise of feminism and the fight for sexual dissidents' rights (2018) in Chile and abroad (Palacios-Valladares, 2020). Specifically, for this case, we followed only four students. The criterion for selecting the group was the one that presented the greatest stability regarding the composition of its members throughout the classes (compared to the rest of the groups).

Instruments and analysis. While implementing the curricular material, the researcher observed the classes in which the material was implemented. All classes were recorded using video cameras (whole classroom) and audio recorders to capture the interactions of the student groups. Then, the classes were transcribed, including interactions between group activities and the whole class.

Ethical approval. The ethical procedure involved requesting written informed consent from the teacher and written authorization from the school principal. An information letter was sent to parents asking for their consent and the young people's permission. The students from whom consent or permission was not obtained did not participate in data collection techniques or the analysis of audiovisual recordings.

They were discussing a situation about the extent to which freedom of expression of feminist discourses could exclude or discriminate against others. Specifically, the hypothetical situation describes a student who arrived at her school wearing a t-shirt with a message that said “#aworldwithoutmen.” The case forced them to decide whether they agreed (or not) that the student could wear this t-shirt.

Gender dilemma case: freedom of expression

Andrea is a student at the high school you attend. A few weeks ago, everyone started talking about the t-shirt she was wearing. Andrea's t-shirt has a slogan that says "#aworldwithoutmen." Andrea has worn the t-shirt several times, and several teachers have told her that some people might feel offended. The school principal spoke to her about the school rules and said that although she is free to wear casual clothes, she cannot wear a t-shirt like that. However, the student says, "I can wear any t-shirt I want as long as it doesn't hurt anyone. They can't censor my thoughts." The situation is currently at a standstill. Imagine you are a student at the same high school as Andrea, and one day the school principal asks you if you have any ideas about what can be done. They say, "You have just studied democracy and human rights. What do you think we should do with Andrea and her t-shirt?" "Why?"

Insights

In the following excerpt students discuss whether they agree with the problem about Andrea's t-shirt.

- A1: Well, I agree with Andrea [the student in the case who wears the t-shirt]. I mean, if a guy walked around with a t-shirt that said, "A world without women," honestly, I wouldn't care. Because it's obvious that women are never going to stop existing. This morning, Rocío and I already saw like 20 pregnant women.*
- A2: You know what, I don't care, it's like if a gay person wears a gay t-shirt, no one cares that they're gay. It's like...*
- A4: So, what should we say then? That as long as she feels comfortable...*
- A3: But still, it's kind of messed up for someone to have a t-shirt like that. I mean, "It's not like you give a shit, right?"*
- A2: I try to put myself in the situation, and maybe for us, we don't care because...*
- A1: Honestly, it doesn't bother me. She must have a reason for wearing it.*
- A3: Yeah, but I think if it were a guy wearing a t-shirt that said "No more women"...*
- A1: I still wouldn't care.*
- A4: But no, we're talking about high school here.*
- A2: The thing sounds like genocide, wait a minute, I haven't really read the question well.*
- A2: Okay, it says: "What do you think we should do with Andrea and her t-shirt?"*
- A1: I don't know, the t-shirt is kind of out of place...*
- A2: But the thing is, the point is what the t-shirt says. Are we okay with her wearing a t-shirt that has that on it?*
- A3: No, but if the situation were reversed, all the women would say, "Oh no!"*
- A2: But it doesn't matter if it were the other way around because I don't see it like that. I mean, okay, you might not like men, but it's not like you need to wear a t-shirt like that...*
- [...]*
- A4: So, does that include gay men too?*
- A1: What?*
- A2: Now you're going off in a different direction.*
- A4: Well, gay men are still men, right?*

A3: So, just men in general.

A2: Yeah, so yes.

A4: So, it's homophobic too.

A1: It's also transphobic.

A3: Yeah, it is.

A2: So, everything it says is wrong.

A4: It's messed up, it's messed up, cancel it.

A3: I don't know, I think this just incites hate.

A4: Exactly, because it encourages hate.

A1: People are making a big deal out of it; it's just a t-shirt at a school.

A2: But by ignoring it, you're also supporting hate, if you think about it...

[...]

A3: The problem is ignoring it. I mean, Nadia, ignoring something like that is kind of weird.

A1: Look, free speech is fine, but she's wrong too. I don't know...

In this extract, we can see that—initially—the case created controversy because not everyone agreed with the position. On the one hand, in the first turn, most of the group (students A1, A2, and A4) defended the idea that the case student (Andrea) had the right to wear the t-shirt. The arguments that emerged were that wearing a t-shirt with a slogan is not going to have effects in the real world (turn 1), that if she wears it, it is irrelevant to the rest (turn 2), and that what matters is the comfort that the person feels when wearing it (turn 3). On the other hand, student A3 refutes this position, stating that it matters because it would be an ethically ugly attitude. Faced with this different position, students A2 and A1 maintain their initial position (in favor of wearing the t-shirt), alluding to the fact that it is irrelevant to them (whether she wears it or not) and that the student will have a reason to do so. Then, student A3 raises another counter-argument that anticipates a hypothetical situation in which men will use a slogan that says “a world without women” (turn 7). In response, student A1 insists it does not matter to her (turn 8), as does student A4, who states it is not a relevant issue for the case being discussed (turn 9). Thus, although students A1 and A4 maintain their position, in turn 10 student A2 examines—for the first time—her initial position, stating it could be considered something serious or violent (“it sounds like genocide”) and that she wants to reread the question. Likewise, student A1 proposes—for the first time—a change concerning her initial position (turn 6), and she opens up to the possibility (with doubt) of discussing what the shirt says (turn 12).

In turn 14 student A3 maintains her position against it and poses a hypothetical situation in which this situation is the other way around (as women, we would care, and we wouldn't like it). Then, student A2 poses a new argument against it (turn 15) that resonates with a possible voice of the feminist movement (you may not like men), but that makes visible a problematic aspect of that position (but it's not like you need to wear a t-shirt like that...). Later, student A4 (who had maintained her initial position of favoring wearing the t-shirt) poses a question (turn 16) that makes visible a problematic aspect of the slogan and that contradicts the very struggle for inclusion rights (“...does it include gay men too?”), given that homosexual men are considered allies of the feminist movement. Then, although student A1 asks for clarification (turn 17) and student A2 tries not to consider that question (turn 18), in the following turns the students respond to the question (turns 19–21), putting forward more solid elaborations against the use of the t-shirt (wearing the t-

shirt could be “homophobic” and even “transphobic”). They explain why it would be contradictory to use that slogan if what is sought is to respect the dignity of people (“It incites hatred, you are endorsing hatred”). In other words, the same students who at the beginning demonstrated a clear position in favor of the t-shirt (because it resonated with a voice that apparently had no problems) then open up to the possibility of examining their beliefs and transforming their arguments to arrive at new considerations.

The fascinating thing about the excerpt is how the dispute over freedom of expression related to a gender conflict is deployed in the conversation as an object of discussion with positions anchored to a feminist identity (which will not necessarily change). It is observed how, through deliberation, initial positions are disassembled (a world without men), which are then questioned and evaluated together. They face the fact that their very principles are at stake: they realize that some repeated slogans can also be problematic. The excerpt suggests that peer deliberations around gender controversies can promote perspective shifts that may be crucial for building violence-free spaces.

Final remarks

Deliberative activities are not only academic learning spaces but also developmental complex human activities (Salas & Larrain, 2024). When students talk with one another, they not only exchange academic ideas but also play with who they are, how they feel, the structure of power relationships, and their present and past relationships. The gender-creative people in this study had harmful histories of being denied, ignored, and bullied. Relationships with peers were not easy for them. Given the stories presented, it is too simplistic to assume that peer-group talk creates a horizontal dialogical space only because they share the same age and class. However, in line with Claes et al. (2017), case 1 illustrates how deliberative pedagogies, if designed properly, can offer spaces for secure development. First, regarding the structure of the interaction, students need to be able to work with peers they trust, and to be able to choose to work alone if necessary. Acknowledging their wisdom when choosing who they can engage with in an honest talk was central to the students engaging—or not—in deliberation. It is worth noting that for some students whole-class spaces might be threatening, while for others it is likely that teacher facilitation might play a relevant role (Journell, 2023). Second, activities should be designed as collaborative and not adversarial or competitive—binary (Barton & Ho, 2023). They should be explicit about the value of different answers in a context of knowledge uncertainty. Third, in terms of teachers’ dispositions, showing interest and promoting connection, caring, and empathy can help to create the right climate for deliberation and a culture of respect, which is important for all students, especially those who are excluded (Russell, 2021). Small actions like using their social names and preferred pronouns are starting points to connect with LGBTQ+ students and show that recognition matters (Knutson, 2019). Deliberative argumentation has huge potential to contribute to a classroom peer interaction oriented toward gender equity.

Moreover, gender experiences such as the ones lived by Erik, Cami, and Carolina, which result in social exclusion, should be objects of reflection. Gender conflicts can be deliberate, resulting in less polarization, more willingness to understand others’ position, and less violence. One could say that deliberation makes people more reasonable. However, reasonableness is a co-constructive process in which emotions play a key role: it is about not just logic (otherwise the group’s reactions to gay exclusion would not make sense) but also how positions matter and make people realize the limits of their thinking (Ambrosio, 2019). Case 2 shows how deliberative teaching, if properly

designed, can be a formative space promoting elaboration on gender controversies and violence, leading to less polarized spaces.

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Annex 2. Overview of curricular material, lesson guides

Guide	Learning goal	Activities
7. Albedo effect	Understand the albedo effect and the transmission of thermal energy from a star on a planet like earth	They read a case about a hypothetical planet, without an atmosphere, inhabited by white flowers that affect its temperature. They choose an alternative that better explains the effect of the flowers on that planet.
8. The role of atmosphere	Understand that the sun's impact on the earth is variable and that the atmosphere helps to regulate the planet's temperature	They read information and charts about the paradox of the rising sun. They elaborate explanations on how it is possible that, having progressively increased the luminosity of the sun, the earth's temperature has remained relatively stable.
9. Greenhouse effect	Relate the behavior of greenhouse gases to climate change and the maintenance of thermal conditions of habitability on the planet	They read about ice cores and interpret data related to the gases that make up the atmosphere for 400,000 years. They explain how it is possible for small variations in CO ₂ and CH ₄ to be related to global temperature variation.
10. History of global warming	Understand the nature of knowledge of climate change	They read about pioneering authors on climate change and their studies. They discuss why they did not have support from the scientific community at that moment in history.

11. Mitigation	Evaluate alternative and individual greenhouse-gas-emission mitigation measures	They order a series of decisions or mitigation initiatives at individual and/or collective level that can be adopted to contribute to reducing greenhouse-gas emissions, justifying their responses.
12. Effects of climate change on biodiversity	Understand that global change can produce drastic changes in the biodiversity of Chile's ecosystems and that these effects are already being recorded and predicted based on field studies and theoretical models	They read a study on the effect of climate change on the Valdivian Forest. They analyze the conclusions and validity of the project.

Annex 3. Interviews guideline

Interview Guideline 1.

Objectives

1. To characterize the development of the science identities narrated by female students before the start of the climate change unit.
2. To associate the narrative and positional identities of female students from an intersectional gender perspective that considers the figured worlds mentioned by them.

1. Well, the first thing are some questions to know your history with science.

(The following questions are only a general guideline. The idea is that it develops as a fluid conversation and inspired by these questions).

- What are sciences for you?
- What does someone who works in science? Do you find it attractive?
- Do you like science? Why yes or why not?
- Are you good at science? What does it take for someone to do well in science?
- Do you think science is important in defining who you are?
- What do you think of women in science?
- When you were younger did you like science?
- What could be done to make you like more science?
- What's your favorite subject?
- Do you occupy science outside of school?
- Do sciences relate to other things that interest you?
- What would you like to study or do in the future? Why would you want to do that?
- Do you think science is important in your future? Why?

2. Now, from what we have talked about and also including other ideas, I want to invite you to make a collage that represents the sciences in your life. You can include images that represent your past, present, and future with science.

The question that will guide your collage is:

Do these images, objects, textures, or words meaningfully represent the story of the sciences in my life?

Use at least 12 cutouts, textures, objects, drawings, or words. You can cut, paste, scratch, write, and transform any of the materials in a way that allows you to better express your feelings, thoughts, and emotions with science throughout your life. Paste everything on this blank sheet. As the collage is part of an investigation, I will take the collage at the end, but if you want we can take a picture and I will send it to your email.

There is no right or wrong way to make a collage, the idea is that you make sense of the pieces you chose and how you organized them on the sheet. I'll let you work now and we'll talk when you've finished it. You'll let me know when you're ready.

3. Now I'm going to ask you to tell me a story for each image you've put in the collage. I'm going to put a number with pencil to remember which one you were talking about.

Which one do you want to start with?

Describe the image first and then tell me what that image is to you and what it has to do with your story with science.

4. Now I want to ask you to show me what image do you think you are at this moment in your history with science.

Is there an image that you would have liked to put but did not find?

5. Now I wanted to ask you to choose 2 images from the collage that have similar meanings, sensations or feelings and 1 image that is opposite to the other 2. What are the similarities and differences between these images? Why do you think they are similar or different?

6. Finally, I would like to invite you to talk about the process of making the collage and tell me your story. What did you feel or think while making the collage? How did you feel or what did you think when you were doing the stories? Is there anything else you'd like to add to your story with the sciences that we haven't included before?

Instrument adapted from:

Langer Osuna, J. M. (2009). The Algebra of identity: Toward a new framework for understanding the co-construction of identity and engagement in mathematics classrooms [Ph.D.]. <https://www.proquest.com/pqdtglobal/docview/504828957/abstract/610FE73476AE4B2APQ/1>

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Annex 4. Codes for peer interactions (broad case study)

Annex 5. Main codes by level, with examples (core case study)

Level	Code	Example
<u>1: Characters</u>	<u>Character from another figured world</u> : when a student fakes their voice, uses dramatic gestures, quotes ways of speaking, or uses typical phrases of characters outside the social world of the classroom. Literally, these characters do not make sense in the thread of the discussion; they are metaphors acted out by the students to position themselves or others with the characteristics of the character. For example, characters from television, stories, popular culture, the neighborhood, the family. This code refers to the character and the figured world in which the character is originally performed.	- Daniela: what were you saying, Lilian?... Sorry I didn't hear you. - Lilian (cries like the <i>El Chavo del Ocho</i> character): pi pi pi pi pi. [Interpretation: Lilian brought the character of <i>El Chavo del Ocho</i>, from the figured world of TV]
	<u>Characters in the figured world of the science classroom</u> : interpreting the way the student presents themselves speaking and responding in the group as a certain kind of science student, for example as intelligent, insecure, lazy, rebellious, passive. This code refers to the character and how that character reflects the rules and characteristics of the figured world of the science classroom.	- Daniela: So (voice of dictation) without the ozone layer, we would all be dead, and there would be no life, and then, it is like a layer that reflects solar radiation. [Interpretation: Daniela performs a secure, smart and active science student. It seems that in the figured world of the science classroom, students that are active and secure are seen as proficient science learners. They act like it is necessary to have an epistemic leader that dictates the correct answer to others.]
<u>2: Positionings</u>	<u>Leadership positioning</u> : when a student organizes how the task is solved, for example gives instructions, organizes speaking turns, plans, or proposes a way to approach the problem without giving a concrete answer.	- Daniela: Ok. Let's see which numbers are closer to each other, and from there, let's compare...
	<u>Accepted/rejected leadership positioning</u> : reactions from other students to the leadership positioning reflecting that the position has been accepted or rejected, such as acting (or not) the proposed instructions or turns, following (or not) the proposed plan, or responding (or ignoring)	- Daniela: Carolina? - Erick (to Carolina): What did you write on? - Carolina (in a very low voice): I wrote that, because of the increase in temperature...it

to the way the student proposed to approach the problem.	has been due to the ozone layer being damaged by technology.
<u>Alliance</u> : when a student organizes with other(s) to position another student in a certain way.	- Erick (to Luna): You didn't want a pony for Christmas, did you? - Daniela: A pony? - Luna: Nooo... - Daniela: For a moment, I imagined Erick like that...with a pony as a gift, and he says (Daniela puts her hands on her waist, chest inflated, and talks in a fake masculine deep voice): "Hello my love, here is your gift!" Yes, I imagined it.
<u>Epistemic power</u> : when a student's contribution is considered by one or more students in the next interactions, even if that answer evolves into another.	- Daniela: Is this repairing, recycling, and reusing things like...mitigate? (silence) (Luna nods)... We would like to rank these repair, recycle, and reuse things first because that's... - Lilian: The 3R! [referring to recycle, reuse, reduce] - Daniela: Exactly!
<u>Lack of epistemic power</u> : when a student's contribution to the task is ignored, despised, or discarded in a baseless judgment by one or more students, or when a student declares they don't have an opinion or knowledge on the subject when consulted.	- Erick: Luna!! Oh my God, you ranked following a vegetarian diet almost last! - Luna (mumbling): I didn't know that you... - Erick (interrupting Luna): Do we have only to answer this? - (...) - Luna: It's just that it's complicated anyway, I wasn't so sure, but... (silence) - No wonder we broke up. Luna doesn't understand a thing (...)
<u>Epistemic power distributed</u> : when a student who has previously been positioned with epistemic power positions another student with epistemic power by acknowledging their contributions, rephrasing, or accepting their ideas, and asking and valuing the other student's opinions.	- Daniela (to Carolina): What did you understand about Carolina? (laughs) of the A? - Carolina: I mean...I also did it by discarding because I didn't understand the others and I related to it because it says the word radiation, and that's why it

		seems to me that it could have more to do with it. - (Carolina looks at the camera, opens her eyes, and looks back at her guide). - Daniela: Can't we write both?... Because the A alternative, Carolina is right, it answers an important part of the question...and the B too, because it speaks of this effect as a blanket... Then we should select both...
<u>3:</u> <u>Intersectionality</u>	<u>Feminine</u>: regardless of the assigned sex at birth of the student, the feminine is interpreted in the interactions and characters that account for passive, welcoming, empathetic, or other ways of acting typically associated with the maternal.	- Erick: Luna!! Oh my God, you ranked following a vegetarian diet almost last! - Luna (mumbling): I didn't know that you... - Erick (interrupting Luna): Do we have only to answer this? - (...) - Luna: It's just that it's complicated anyway, I wasn't so sure, but... (silence) - [Interpretation: Luna enacts feminine ways to respond to Eric—soft voice, insecure, trying to understand Erick's point of view]
	<u>Masculine</u>: Regardless of the assigned sex at birth of the student, masculine is interpreted in interactions or characters that reflect active, aggressive, self-centered, or other ways of acting typically associated with masculinity.	- Daniela (raising her voice and arms to Luna): Luna! - Daniela: She is gone! (toward Luna) - [Interpretation: Daniela enacts masculine ways to respond—active, aggressive, self-centered]
	<u>Heteronormativity</u>: when the characters or positions binarily divide the characters into romantic couple relationships in which one member is understood as male/active/aggressive and another is feminine/passive/welcoming, regardless of the sexes assigned at birth of the participants.	- Daniela: For a moment, I imagined Erick like that...with a pony as a gift, and he says (Daniela puts her hands on her waist, chest inflated, and talks in a fake masculine deep voice): "Hello my love, here is your gift!" Yes, I imagined it.

	[Interpretation: The characters brought by Daniela position Erick and Luna in a typically heteronormative romantic relationship.]
<u>Class</u> : interpretation of characters and positions as reflecting situations or conflicts typical of a given social class	Daniela began the interaction by leading the group. She puts her hands together and points around the group. All the groupmates follow her gesture, and she smiles, stops, and shakes her hands twice, pointing to Erick, who reacts to her gesture. [Interpretation: Daniela's teacher character could be linked to working-class ways of living learning in an authoritative way]
<u>Race</u> : interpretation of characters or positions as responding to social discourses traditionally attributed to a particular race or ethnic group.	Erick: They said to Luna, "No, and why do you date the Black?!" and I like eh... Like saying...to my friend, I would say back, "Hey, and you like them darker than me, dude!" things like that, like...but it's not racist, but she really likes people like between dark and dark brown like me (...) So, they tell me that just because she [Luna] is whiter and I am more, like, more...tan. They say, "No... you are Black," and so on... [Interpretation: racist standards of beauty]

Annex 6. Letter of approval from the UAH Ethics Committee



ACTA DE APROBACIÓN

SOLICITUD DE ENMIENDA

En Santiago de Chile, con fecha 31 de enero de 2023, el Comité de Ética de la Universidad Alberto Hurtado, declara conocer la solicitud de enmienda al proyecto de investigación Fondecyt n° 1210264 de 2021 denominado *“Deliberación y enseñanza de ciencias para la ciudadanía: evaluación de efecto y comprensión de condiciones de la enseñanza del cambio climático a través de la argumentación deliberativa para una ciudadanía sostenible”*, cuya investigadora responsable es Antonia Larraín Sutil, de esta Universidad. Este Comité de Ética dio su aprobación a ese proyecto con fecha 23 de marzo de 2021. La solicitud de enmienda se justifica en la incorporación de una nueva investigadora en el equipo de investigación, y en una modificación de los formularios de autorización, consentimiento informado y asentimiento informado. Dicha modificación no altera en nada los aspectos referentes a la información que se proporciona en los formularios dirigidos a los directores de establecimiento ni a los participantes (profesores, estudiantes, padres, madres y apoderados) respecto de los contenidos del proyecto, la descripción de las actividades a cuya participación se les invita, la libertad en la que pueden otorgar o negar el consentimiento ni la protección de sus derechos y de su bienestar. La nueva investigadora que se incorpora en el equipo es Helena Salas Cossio, estudiante del programa de Doctorado en Educación que se imparte conjuntamente por la Universidad Diego Portales y la Universidad Alberto Hurtado. Helena Salas se ha integrado a la investigación que dirige la Dra. Antonia Larraín, habiendo firmado la documentación correspondiente (Carta de Compromiso de la Investigadora; Declaración de Conflicto de Intereses, y Acuerdo de Confidencialidad en el uso de información en investigaciones con seres humanos).

En consecuencia, la documentación proporcionada cumple con las normas éticas vigentes en esta institución y considera aspectos específicos del protocolo que deben seguir los sujetos que participarán en el mismo; resguarda su libertad, integridad y confidencialidad en el uso de información; no vulnera la dignidad de los sujetos; no constituye una amenaza en ninguna circunstancia ni causa daño emocional o moral a las personas que participen de la investigación. Proporciona información clara y transparente respecto de la investigación, asegurando el derecho a privacidad de los investigados. Asimismo, no se establece pago ni incentivo económico a la participación de las personas que redunde en pérdida de libertad. En este estudio, se pretende reclutar



sujetos, por ello, se asegura particularmente la independencia de elección, dejando claramente establecido que pueden desistir o rechazar su participación, sin sufrir ningún menoscabo ni pérdida de derechos.

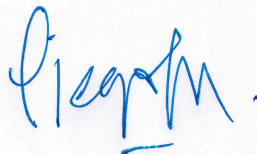
Este proyecto de investigación respeta los derechos de las personas a realizar consultas y cuida especialmente de invitar a los diferentes sujetos involucrados en el ámbito que se espera estudiar, estableciendo que de este estudio no se derivan beneficios individuales, sino para el desarrollo científico.

Esta aprobación consta para que la investigadora pueda continuar su trabajo desde la ciudad de Santiago de Chile, específicamente, en la Facultad de Psicología de la Universidad Alberto Hurtado.

El Comité de Ética de la Universidad Alberto Hurtado, es la entidad institucional responsable de velar por los derechos de los sujetos involucrados en este proyecto. Asimismo, en la eventualidad de querer incorporar nuevas modificaciones, por ejemplo, diseño o rediseño de instrumentos de recolección de datos, equipo de trabajo, procedimientos especificados en el protocolo aprobado u otros, la investigadora deberá comunicarlo al comité para la evaluación y emisión de una nueva acta de aprobación ética, así como el visado de los formularios que se continuarán utilizando, antes que la investigadora ejecute esos cambios.

El Comité está compuesto por: Juan R. Barria, Gabriel Fortes C., José Gaete P., Diego García M., Natalia Hernández M., Alejandra Morales G., Víctor Muñoz C, Marcela C. Perticará (miembro externo). Gabriel Fortes y Alejandra Morales se han inhabilitado de evaluar esta solicitud de enmienda por formar parte de las unidades académicas a las que pertenecen tanto la investigadora responsable como la nueva integrante del proyecto de investigación.

Por último, a través de este medio, el Comité de Ética de la Universidad Alberto Hurtado se pronuncia favorablemente respecto de este proyecto y suscribe esta declaración.



Diego García M.

Presidente Comité de Ética

Universidad Alberto Hurtado



Annex 7. Consent letters

Authorization letter for school principals.

Carta de Autorización

Estimado/a Director/a:

La Facultad de Psicología de la Universidad Alberto Hurtado está realizando una investigación acerca de la enseñanza de Ciencias para la Ciudadanía (proyecto Fondecyt N° 1210264). El objetivo del estudio es conocer el impacto que tiene la deliberación entre pares en competencias científicas para la ciudadanía y en el desarrollo de identidades científicas. Los resultados del estudio pueden contribuir a orientar la práctica pedagógica en este subsector de manera de hacerla más efectiva.

El estudio tiene una duración de un año y se realizará con estudiantes que hoy cursan segundo y tercero medio. Mediante la presente carta solicitamos su autorización para realizar el estudio en el establecimiento que dirige. De contar con su autorización, invitaremos a participar a los y las estudiantes de ese grupo curso.

El o la docente será invitado/a a participar de un programa de desarrollo profesional para la enseñanza deliberativa del cambio climático. Luego, se le invitará a enseñar esta temática con apoyo de materiales curriculares que promueven deliberación entre estudiantes, lo que se calcula puede durar entre 6 y 8 sesiones. Las interacciones entre estudiantes serán grabadas en video. Se entrevistará al profesor para conocer su experiencia en esta situación pedagógica y además se entrevistará a alguno/as estudiantes de los grupos para ahondar en cómo desarrollan sus identidades científicas antes, durante y después de la unidad de cambio climático. Asimismo, una investigadora del equipo acudirá a observar las clases e interacciones entre los estudiantes de los grupos.

Para evaluar los efectos de la deliberación en la enseñanza de ciencias en el aprendizaje de los y las estudiantes, el estudio contempla evaluar las competencias de ciencia para la ciudadanía en estudiantes. Estudiantes deberán completar una prueba de conocimiento, una tarea de escritura y dos cuestionarios escritos, dos veces en el año. Estas tareas tomarán dos horas pedagógicas y serán tomadas durante el horario de clases.

Como retribución a la participación del colegio, se ofrecerá un taller para todo el equipo docente. Todos los materiales tanto para las pruebas como para la implementación de las sesiones serán provistos por el equipo de investigación.

En la investigación participarán aproximadamente 10 establecimientos y 10 cursos (00 estudiantes aprox.).

Tanto los resultados asociados a las pruebas, entrevistas y las observaciones de clases serán confidenciales y difundidos sin dar a conocer la identidad ni del establecimiento ni de estudiantes o profesores/as. De este modo, no se conocerá el resultado individual de cada estudiante. Todos los datos serán guardados por la Investigadora responsable por 2 años.

Si tiene cualquier duda sobre el estudio, por favor no dude en contactar a:

Antonia Larrain,
Investigadora Responsable
Facultad de Psicología UAH
F.: +56228897431

En caso de que sienta que los derechos de algún participante han sido vulnerados, no dude en contactar a: Comité de Ética Universidad Alberto Hurtado, F.:8897452

POR FAVOR MARQUE SU OPCIÓN CON UNA CRUZ Y COMPLETE SUS DATOS:

SI, entiendo los procedimientos del estudio y **AUTORIZO** la realización del estudio en el establecimiento.

NO AUTORIZO la realización del estudio en el establecimiento.

Nombre Establecimiento

Nombre Director(a)

Fecha

Firma Director(a)

Consent letter for teachers.

Carta de Autorización

Estimado/a Profesor/a:

La Facultad de Psicología de la Universidad Alberto Hurtado está realizando una investigación acerca de la enseñanza de Ciencias para la Ciudadanía (proyecto Fondecyt N° 1210264). El objetivo del estudio es conocer el impacto que tiene la deliberación entre pares en competencias científicas para la ciudadanía y en el desarrollo de identidades científicas. Los resultados del estudio pueden contribuir a orientar la práctica pedagógica en este subsector de manera de hacerla más efectiva.

Esta carta tiene por objetivo invitarlo a participar en el estudio detallando lo que ya se ha conversado verbalmente. Al final de la carta usted debe expresar su decisión. A continuación, se detalla en qué consistiría su participación en caso de aceptar y cuáles son sus derechos como participante.

El estudio tiene una duración de un año y se realizará en el curso de Ciencias para la Ciudadanía en tercero medio. El estudio contempla la enseñanza del tema de cambio climático a través de deliberación entre pares. Si acepta participar, usted será El o la docente será invitado/a a participar de un programa de desarrollo profesional para la enseñanza deliberativa del cambio climático. Los costos asociados a su asistencia (pasajes y alimentación) serán cubiertos por el proyecto. Luego, se le invitará a enseñar esta temática con apoyo de materiales curriculares que promueven deliberación entre estudiantes, lo que se calcula puede durar entre 6 y 8 sesiones. Las interacciones entre estudiantes serán grabadas en video.

Se realizará además una entrevista con usted para conocer su experiencia en esta situación pedagógica y además se entrevistará a alguno/as estudiantes de los grupos para ahondar en cómo desarrollan sus identidades científicas antes, durante y después de la unidad de cambio climático. Asimismo, una investigadora del equipo acudirá a observar las clases e interacciones entre los estudiantes de los grupos.

Para evaluar los efectos de la deliberación en la enseñanza de ciencias en el aprendizaje de los y las estudiantes, el estudio contempla evaluar las competencias de ciencia para la ciudadanía en estudiantes antes y después de las clases. Estudiantes deberán completar una prueba de conocimiento, una tarea de escritura y dos cuestionarios escritos. Estas tareas tomarán dos horas pedagógicas y le solicitaremos a usted que sea quien las tome durante el horario de clases en dos momentos durante el año: a comienzos de año y al terminar las sesiones (un mes después y dos meses después).

Estamos invitando a participar a otros profesores(as) que, como usted, enseñan la asignatura Ciencias para la ciudadanía. Se estima que participarán un total de 10 profesores y 10 grupos cursos (300 estudiantes aproximadamente).

Su participación en este estudio es voluntaria. Si no quiere participar en el estudio puede decirlo en cualquier momento, sin dar ningún tipo de explicación. Esto no traerá NINGUNA consecuencia negativa para usted. Si acepta participar puede cambiar de idea en CUALQUIER momento del año. Sólo necesita informarle al encargado del equipo de investigación.

Los resultados del estudio le serán entregados a usted y el establecimiento por escrito y por correo electrónico al finalizar los análisis de este, sin individualizarle en la entrega de resultados. Esta información individualizada no será entregada a nadie más dentro del colegio. Los resultados de las pruebas y entrevistas de estudiantes no estarán asociados a la identidad de éstos, por lo que no se sabrá el resultado individual de cada estudiante. Los resultados de éstos tampoco se darán a conocer individualizando el establecimiento ni el (la) profesor. Sólo el equipo investigador conocerá esa información la que no será difundida por ningún medio. Toda la información (filmaciones, pruebas) no será ocupada en objetivos ajenos a este estudio, sin autorización expresa de los participantes. El material será tratado de manera confidencial, de acuerdo a la ley 19.628 de 1999, sobre protección de la vida privada o protección de datos de carácter personal, y guardado por la investigadora responsable (Antonia Larrain) por un tiempo de 2 años. No se dará a conocer

su fuente emisora de los datos, salvo que sea exigido por la justicia. Sólo tendrá acceso a ella el equipo de investigación. Al momento de la entrega del reporte escrito, se le ofrecerá una reunión personal con usted de retroalimentación de su participación.

Como retribución a la participación del colegio, se ofrecerá un taller para todo el equipo docente. Todos los materiales tanto para las pruebas como para la implementación de las sesiones serán provistos por el equipo de investigación.

Si tiene cualquier duda sobre el estudio, por favor no dude en contactar a:

Antonia Larraín

Investigadora Responsable

Facultad de Psicología UAH

F.: +56228897431

En caso de que sienta que los derechos de algún participante han sido vulnerados, no dude en contactar a:

Comité de Ética Universidad Alberto Hurtado

F.:8897452

POR FAVOR MARQUE SU OPCIÓN CON UNA CRUZ Y COMPLETE SUS DATOS:

_____ **SI**, entiendo los procedimientos del estudio y **AUTORIZO** la realización del estudio en el establecimiento.

_____ **SI**, autorizo al equipo investigador a usar las imágenes en las que apareceré con fines de formación profesional y/o difusión académica.

_____ **NO AUTORIZO** la realización del estudio en el establecimiento.

**Nombre del(la)
Profesor(a)**

RUT:

Fecha

Firma del(la) Profesor(a)

Investigadora responsable :Antonia Larrain Sutil

RUT:13.056.201-9

Firma de la Investigadora responsable.

Consent letter for parents or caregivers.

Carta de Consentimiento Informado

Estimado Padre, Madre o Apoderado:

La Facultad de Psicología de la Universidad Alberto Hurtado está trabajando en un estudio en el área de Comprensión de la naturaleza con estudiantes de la edad de su hijo(a). El objetivo del estudio es conocer si la colaboración entre compañeros sirve para entender mejor el mundo natural, participar en su protección y desarrollar sus identidades científicas. La información producto de este estudio podría servir para que los(as) profesores(as) sean más efectivos en la enseñanza de ciencias para la ciudadanía y que estudiantes logren más y mejores aprendizajes y competencias.

Esta carta tiene por objetivo solicitar por escrito su consentimiento para que su hijo(a) participe en el estudio. Se solicitará también el asentimiento por escrito de su hijo(a). Esta carta detalla en qué consistirá la participación de su hijo(a), dejando por escrito lo que ya se le ha expresado verbalmente. Al final de la carta usted debe expresar su decisión acerca de la participación de su hijo(a) en el estudio. **Si usted no envía esta carta con su respuesta, esto se interpretará como que está de acuerdo con la participación de su hijo/a, si este/a así lo decide.** A continuación, se detalla en qué consiste la participación en caso de aceptar y cuáles son los derechos de su hijo(a) como participante.

El estudio busca medir el efecto que tienen ciertas formas de conversación entre estudiantes en el desarrollo de sus competencias científicas para la ciudadanía y el desarrollo de sus identidades científicas. Los y las estudiantes que participen rendirán una prueba escrita, una tarea de escritura y dos cuestionarios. Las pruebas se tomarán en dos clases, en el mismo colegio y serán recolectadas por un mismo profesor(a) de su hijo(a), y parte del equipo de investigación. Todas las pruebas son relativamente breves y no duran más que treinta minutos cada una. Estas pruebas no tienen nota.

Luego, en el contexto de las clases del curso Ciencias para la ciudadanía, su hijo/a participaría de entre 6 y 8 sesiones en que deberá discutir con compañero acerca del cambio climático. Las sesiones de discusión entre pares serán filmadas en video y las clases serán observadas por una investigadora del estudio. Asimismo, alguno/as de los estudiantes de los grupos serán invitado/as a participar de entrevistas para conocer su experiencia durante el trabajo de grupo y sus identidades científicas. Por último, luego de aproximadamente seis sesiones, se volverán a tomar las mismas pruebas a los estudiantes que se realizaron al inicio del estudio.

Los resultados de las pruebas no estarán asociados a la identidad personal de los estudiantes, por lo que no se conocerá el resultado individual de ninguno de ellos. Las pruebas serán analizadas por el equipo de investigación y los resultados serán asociados a un número anónimo. Su nombre o el de su hijo(a) no aparecerán en ningún tipo de informe o publicación de divulgación. Tampoco éste será conocido por el colegio ni ninguna autoridad educativa. Los resultados serán sólo conocidos por el equipo de investigación, pero las personas que integran este equipo tampoco sabrán qué estudiante obtiene qué resultado. Estos sólo se usarán de manera grupal para describir tendencias y medir el efecto de la conversación en el aprendizaje. La información grabada en video sólo se utilizará para conocer los tipos de conversación de las sesiones y serán analizada por el equipo de investigación sin ser mostrados a nadie más en ninguna otra instancia no autorizada por usted y su hijo(a). Las entrevistas serán confidenciales y parte de su contenido se publicará en forma anónima y luego de la aprobación del contenido por parte del estudiante entrevistado. El material será tratado de manera confidencial, de acuerdo con la ley 19.628 de 1999, sobre protección de la vida privada o protección de datos de carácter personal, y guardado por la investigadora responsable (Antonia Larrain) por un tiempo de 2 años. No se dará a conocer su fuente emisora de los datos, salvo que sea exigido por la justicia. Sólo tendrá acceso a ella el equipo de investigación.

Se está invitando a participar en el estudio a todos los estudiantes del curso de su hijo(a) que durará un año. En el estudio participarán otros cursos similares al de su hijo(a), que pueden ser en el mismo establecimiento educacional u otros, estimando un total de 200 estudiantes y niñas aproximadamente.

La participación en el estudio no tiene ningún riesgo para su hijo(a). Por el contrario, su hijo(a) podría beneficiarse del trabajo que desarrollarán los investigadores con los profesores antes y/o después del estudio. Se sortearán giftcards de una casa comercial de libre disposición entre los y las estudiantes que participen.

Si usted no desea que su hijo/a participe en el estudio puede indicarlo en cualquier momento, sin dar ningún tipo de explicación. Esto no traerá NINGUNA consecuencia negativa para su hijo o hija. Este no pierde ningún derecho o privilegio, ni tendrá ningún tipo de consecuencia para él o ella.

Los resultados de este estudio serán presentados a los profesores de Comprensión de la naturaleza del colegio al que asiste su hijo(a) de manera que sirva para enriquecer la enseñanza de ciencias y la experiencia con el aprendizaje de ciencias de los y las estudiantes.

Si tiene cualquier duda sobre el estudio, por favor no dude en contactar a: Antonia Larrain, Investigadora Responsable, Facultad de Psicología UAH, F.:+56228897431

En caso de que sienta que sus derechos han sido vulnerados, no dude en contactar a: Diego García, Comité de Ética Universidad Alberto Hurtado, Cienfuegos 46 A, oficina 107, Santiago; correo comiteetica@uahurtado.cl ; fono 228897452

Antonia Larrain
(Investigadora responsable)
13056201-9

Nombre del estudiante

RUT:

Nombre del apoderado

RUT

FECHA: _____

DECLARACION DE CONSENTIMIENTO

Después de haber recibido y comprendido la información de este documento, de haber hecho todas las preguntas que consideré necesarias y haber podido aclarar todas mis dudas al respecto:

Consentimiento que se solicita (Marcar con una cruz en el recuadro correspondiente)	SI	NO
Entiendo los procedimientos del estudio y DOY MI PERMISO VOLUNTARIAMENTE para que mi hijo/a participe en la investigación de la Facultad de Psicología.		
Autorizo al equipo investigador a usar las imágenes en las que aparecerá mi hijo(a) con fines de formación profesional y/o difusión académica.		

Firma del Apoderado

Este documento se extiende en duplicado, quedando una copia en poder de cada firmante.

Informed Assent Letter for Students

Carta de Asentimiento Informado

Estimado/a estudiante:

La Facultad de Psicología de la Universidad Alberto Hurtado está trabajando en un estudio en el área de Comprensión de la naturaleza con estudiantes de su edad. El objetivo del estudio es conocer si la colaboración entre compañeros sirve para entender mejor el mundo natural, participar en su protección y desarrollar las identidades científicas en estudiantes. La información producto de este estudio podría servir para que los(as) profesores(as) sean más efectivos en la enseñanza de ciencias para la ciudadanía y que estudiantes logren más y mejores aprendizajes y competencias.

Estamos invitando a participar en este estudio a todos tus compañeros y compañeras de curso. Como tu curso, estamos invitando a participar a 9 cursos más. Serán como 300 estudiantes en total los que participarán en el estudio. El estudio durará un año y consistirá en contestar pruebas y participar de sesiones de trabajo con otro/as compañero/as. También podremos invitarte a una o más entrevistas individuales o grupales para conocer sus experiencias en el curso y cómo se identifican con las ciencias.

Para saber si la colaboración entre compañero/as es buena para desarrollar competencias científicas y ciudadanas, necesitamos que contestes unas pruebas y tareas. Participarías en una prueba corta sobre cosas que tu sabes, más una tarea de escritura y dos cuestionarios escritos. Esto no tiene nota y nadie mas verá lo que escribiste. Luego, participarás de conversaciones (aproximadamente 6) con tus compañeros en el contexto del curso de Ciencias para la Ciudadanía. Estas conversaciones serán grabadas en video y una persona del equipo acudirá a la sala a observar estas clases.

Luego, entrevistaremos a un grupo de estudiantes y, finalmente, te pediremos que respondas las mismas pruebas y tareas que realizaste al inicio del año. Tanto las pruebas, videos y entrevistas son confidenciales, no se compartirán con otras personas de la escuela y los resultados derivados de estas solo se difundirán sin identificar o asociar la identidad de los y las participantes.

Estamos preguntando a tu apoderado/a si te autoriza a participar. Aun cuando ellos autoricen, tú puedes libremente decidir no participar, lo que no tiene ningún tipo de consecuencias o sanciones para ti. Si no quieres participar en el estudio puedes decirlo en cualquier momento, sin dar ningún tipo de explicación. Esto no traerá NINGUNA consecuencia negativa para ti. Si aceptas participar puedes cambiar de idea en CUALQUIER momento del año. Sólo necesitas decirle al encargado del equipo de investigación que veas. También puedes llamar o comunicarte con la investigadora responsable (Antonia Larrain) cuyos datos están al final de esta carta.

Si tienes cualquier duda sobre el estudio, por favor no dudes en contactar a:

Antonia Larraín
Investigadora Responsable
Facultad de Psicología UAH
F.: +56228897432

En caso de que sienta que sus derechos han sido vulnerados, no dude en contactar a:

Comité de Ética Universidad Alberto Hurtado
F.:8897452

POR FAVOR MARQUE SU OPCIÓN CON UNA CRUZ Y COMPLETE SUS DATOS:

_____ **SI**, entiendo los procedimientos del estudio y **PARTICIPARÉ VOLUNTARIAMENTE** en la investigación de la Facultad de Psicología.

_____ **SI**, autorizo al equipo investigador a usar las imágenes en las que aparezco con fines de formación profesional y/o difusión académica.

_____ **NO PARTICIPARÉ** en la investigación de la Facultad de Psicología.

Nombre del/la estudiante

Firma del/la estudiante

Fecha

