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Teacher Self-efficacy in Northern Chile: Challenges in Instructional Strategies

Katherine Acosta García
Universidad de Tarapacá
Arica, Chile

Martín Navarro-Ibáñez
Pontificia Universidad Católica de Chile
Santiago, Chile

Abstract. This study explored the teaching self-efficacy beliefs of 430 teachers from public and subsidized private schools in the northernmost region of Chile (Arica and Parinacota/Tarapacá). A quantitative cross-sectional correlational design was employed using the Ohio State Teacher Efficacy Scale adapted to the Chilean context. This scale was considered appropriate since self-efficacy manifests across different dimensions of educational practice, including classroom management, instructional strategies, and student engagement. The results indicated the highest levels of self-efficacy in classroom management, followed by student engagement and lastly, instructional strategies with the lowest levels. Significant differences were found between the three dimensions. Secondary education teachers and those teaching at multiple levels reported greater instructional self-efficacy. Conversely, no significant relationships were found between self-efficacy and teaching experience. However, a slight but significant negative relationship was identified between age and instructional strategies. These findings underscore the importance of strengthening instructional strategies through teacher training programs tailored to the specific challenges faced by educational contexts. Additionally, they highlight the unique conditions of northern Chile such as high cultural diversity, student vulnerability, and a shortage of teachers in STEM areas. These factors emphasize the need to enhance teacher self-efficacy not only to improve instructional effectiveness but also to foster student engagement and learning outcomes in complex educational environments.

Keywords: teaching self-efficacy; instructional strategies; student engagement; classroom management; practicing teachers

1. Introduction

In contemporary educational systems, the quality of teaching and the professional development of teachers are priority areas of interest, particularly in contexts facing significant challenges in improving learning outcomes and promoting the well-being of both students and teachers. Teaching self-efficacy, defined as a teacher's belief in their ability to achieve specific teaching goals, has emerged as a critical factor for the success of pedagogical practice and the establishment of a positive learning environment (Bandura, 1977; Tschannen-Moran & Hoy, 2001). This belief influences teachers' motivation, effort, and persistence in the face of everyday challenges in education and affects the types of strategies they choose to implement in the classroom. Recent studies highlight that teachers who perceive themselves as more effective tend to adopt innovative teaching approaches, foster participatory environments, and manage conflict or discipline issues in a balanced manner (Salles et al., 2020).

The Self-Efficacy Theory, initially proposed by Bandura (1977), posits that beliefs about one's capabilities to perform specific tasks have an impact on performance and perseverance in the face of challenges within the educational field. This theory has been widely adopted to understand the relationship between teachers' perceptions of competence and their impact on student learning. From this perspective, teachers with high self-efficacy are more likely to dedicate greater time and effort to their work, which not only enhances their performance but also fosters an environment of trust and autonomy among students (Zee & Koomen, 2020).

Recent studies have explored how teaching self-efficacy manifests across different dimensions of educational practice, including classroom management, instructional strategies, and student engagement (Calkins et al., 2024; Lauermann & König, 2016; Lazarides et al., 2020). These three dimensions have prove to be critical for effective teaching, reflecting the teacher's ability to organize and implement strategies that facilitate learning in diverse contexts and educational levels (Tschannen-Moran & Hoy, 2001).

Classroom management has been identified as one of the most highly valued competencies in terms of self-efficacy, as it enables teachers to establish a safe and orderly learning environment (Guo et al., 2011). Moreover, self-efficacy in promoting student engagement is recognized as crucial for effectively involving students in the learning process (Tschannen-Moran & Hoy, 2001). Finally, the dimension of self-efficacy in instructional strategies is considered critical for achieving positive student-learning outcomes (Künsting et al., 2016). However, self-efficacy also represents significant challenges, particularly in contexts in which adaptability to new curricular approaches is a priority requirement (De Souza et al., 2023; Salles et al., 2020).

This dimension has garnered the interest of numerous researchers over the past decade (Alanoglu, 2022; Burić & Kim, 2020; Powell-Moman & Brown-Schild, 2011). Referring to confidence in teaching effectively, studies have shown that interacting didactically according to students' needs and explaining content to

enhance their learning (Künsting et al., 2016) is positively associated with teaching commitment. In other words, teachers who trust in their repertoire of effective instructional strategies and their ability to implement them tend to exhibit greater commitment to their profession and a lower likelihood of considering leaving the career (Klassen & Chiu, 2011).

The northern border of Chile that encompasses the regions of Arica and Parinacota/Tarapacá represents a tri-border area of high complexity that requires special attention in research on teacher self-efficacy for three key reasons: 1) The area is characterized by schools with high levels of diversity, multiethnicity, immigration, and vulnerability (Gómez Chaparro & Sepúlveda, 2022; Mondaca, 2018; Sánchez Espinoza & Norambuena Carrasco, 2019). These conditions create numerous opportunities and challenges for fostering educational inclusion (Mondaca, 2018). Additionally, the latest evaluations conducted by the Sistema Nacional de Evaluación de Resultados de Aprendizaje (SIMCE) [National System for Assessing Learning Outcomes] in natural sciences for 6th and 8th grades prior to the COVID-19 pandemic revealed that regions at the country's geographic extremes showed lower performance than the central regions. In both assessments, results from the northern zone were notably lower than those from the southern and central zones, as reported by the Agencia de la Calidad de la Educación [Agency for Educational Quality of Chile] (2020); 2) It is one of the areas with the poorest performance in SIMCE assessments nationwide; and 3) There is a concerning shortage of teachers, particularly in science and mathematics (Consejo Nacional de Educación [CNED], 2022).

The third aspect is particularly relevant given the significant number of teachers dropping out of classrooms worldwide (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2020). Supporting this notion, various studies have highlighted that teacher self-efficacy can act as a protective factor against attrition (Klassen & Chiu, 2011; Zee & Koomen, 2016). Simultaneously, the decline in enrollment in teacher education programs has become a significant challenge in many countries, reflecting a concerning trend observed over the past decades (Schleicher, 2019).

In Chile, this situation is particularly evident, with a 35.1% reduction in enrollment in education-related degree programs in recent years. The most affected areas correspond to disciplines associated with science, technology, engineering, and mathematics (STEM), with notable declines in biology and chemistry (-10.2%), physics (-13.8%), and mathematics (-3.2%) (CNED, 2022). This trend is compounded by the projected teacher shortage in the country (Elige Educar, 2020), further intensifying concerns regarding teacher attrition and its implications for the stability and continuity of the educational system.

Indeed, self-efficacy is associated not only with teaching performance but also with teacher well-being, particularly in relation to emotions since it enhances enjoyment and reduces anger and anxiety, according to studies conducted among science educators (Membiela, Acosta & González, 2023). Research by De Souza et al. (2023) highlights that teacher self-efficacy contributes to both personal and

professional satisfaction and influences self-esteem, job commitment, and a willingness to fulfill the social role inherent in teaching. These findings are supported by Lauermann and König (2016) who demonstrate that professional competence—encompassing general pedagogical knowledge, skills, beliefs, and motivation—is a key factor in preventing burnout within educational contexts. In this regard, teachers with high levels of self-efficacy tend to experience less burnout and greater satisfaction in their professional lives (Schwarzer & Hallum, 2008; Skaalvik & Skaalvik, 2017).

In educational practice, self-efficacy is influenced by various contextual and personal factors. For example, Guo et al. (2011) found that teacher collaboration and student engagement are significantly associated with self-efficacy in preschool teaching. These interactions enhance teachers' confidence in their abilities and foster a positive learning environment. Similarly, the study by Yasin et al. (2022) highlights the importance of curricular literacy in the development of self-efficacy, indicating that teachers with a high level of curriculum understanding tend to feel more confident and competent in their practice. These findings suggest that in addition to personal competencies, external factors such as institutional support and access to resources also play a crucial role in shaping teachers' perceptions of their self-efficacy.

On this matter within the field of teacher education, self-efficacy is a key factor in the adoption of innovative pedagogical approaches. Arce-Saavedra and Blumen (2022) demonstrate that self-efficacy mediates the relationship between creative-innovative performance and such practices. These authors explain that teacher self-efficacy is essential in implementing methodologies that foster critical thinking and creativity in the classroom, and this has a direct impact on the quality of education that the students receive. Similarly, the study by Salles et al. (2020) suggests that teachers with high self-efficacy are more likely to implement pedagogical behaviors that enhance learning and to adapt to unforeseen changes, reinforcing their ability to respond to the unexpected and evolving needs of the educational context.

Regarding the relationship between years of experience and the development of teacher self-efficacy, the literature presents contradictory findings. Some studies suggest that the levels of self-efficacy are low during the initial years of professional practice (Hoy & Spero, 2005), while others indicate that it later stabilizes (Künsting et al., 2016) and even increases over time (Ma et al., 2022; Swan et al., 2011). In this sense, it is important to note that teacher self-efficacy is not always aligned with experience, as its development largely depends on individual perceptions and the specific context in which the teaching occurs.

Globally, the most widely used instrument for measuring teacher self-efficacy is the Teachers' Sense of Efficacy Scale developed by Tschannen-Moran and Hoy (2001). This tool, which assesses teacher self-efficacy across three dimensions, is the most frequently employed internationally due to the robustness it has demonstrated in factor validity (Duffin et al., 2012). In Chile, Covarrubias and Mendoza (2016) adapted and validated this instrument for use with university

students and showed high levels of reliability. This approach allows for a more precise analysis of the specific areas in which teachers perceive their strengths and limitations, thus providing valuable insights for the development of teacher training and support programs. In this regard, the need for self-efficacy evaluation tools tailored to specific contexts becomes crucial, as they enable the design of interventions that align with the cultural and structural characteristics of each educational setting.

In the Chilean context, research such as that by Venegas Traverso (2021) identifies vocation and professional commitment as crucial components in the development of teacher self-efficacy, particularly in public schools where self-efficacy levels tend to be lower than in private institutions. The same author notes that novice teachers generally exhibit lower self-efficacy often associated with reduced professional confidence, whereas more experienced teachers demonstrate higher levels of self-efficacy, although this varies depending on the type of institution and the teaching environment. Another study, conducted by Hurtado et al. (2023) with physical education teachers, indicated that those working exclusively in secondary education reported higher levels of self-efficacy than their counterparts who were teaching at other educational levels.

Despite the abundance of studies on teacher self-efficacy in international contexts, research exploring these beliefs in depth and within specific contexts in Chile—particularly in the northern region—remains scarce. This study sought to address this gap by providing a focused examination of teacher self-efficacy in northern Chile, a region characterized by distinct socioeconomic and cultural characteristics that set it apart from other areas of the country. Considering previous findings on the importance of self-efficacy in relation to job satisfaction, teaching quality, and professional commitment, this study regarded an investigation into how these beliefs manifest in the Chilean context as crucial. The socioeconomic and cultural context of northern Chile where educational conditions may differ significantly from other regions raises questions about the factors that influence teacher self-efficacy and the areas in which interventions could be implemented to strengthen this self-perception.

Consequently, this study aimed to investigate the self-efficacy beliefs of teachers in northern Chile, focusing on the three dimensions established by Tschannen-Moran and Hoy (2001): instructional strategies, classroom management, and student engagement. The research questions guiding this study are as follows:

1. How do teachers in northern Chile perceive their self-efficacy regarding their teaching practices?
2. Which of the three dimensions of teacher self-efficacy (instructional strategies, classroom management, and student engagement) is most positively perceived according to their own beliefs?
3. How do sociodemographic and professional characteristics influence teachers' self-efficacy beliefs in this region?

This study focused on measuring teacher self-efficacy among educators in northern Chile, a topic that has been scarcely explored at the regional level. Because of the lack of prior research in this area, no specific hypotheses were formulated, thus emphasizing the exploratory nature of this research. Rather than aiming for an explanatory approach, this study sought to identify the regional particularities that contribute to a more in-depth understanding of teacher self-efficacy and to inform future context-specific educational interventions.

2. Objectives

The objectives of the study were as follows:

1. To analyze teachers' self-efficacy beliefs in public and subsidized private schools in northern Chile, focusing on the dimensions of instructional strategies, classroom management, and student engagement.
2. To identify differences in perceived levels of teacher self-efficacy in relation to sociodemographic and professional characteristics such as age, educational level taught, and academic training.

3. Methodology

3.1 Design

This study employed a quantitative method with a non-experimental, correlational, and cross-sectional design (Creswell & Creswell, 2018). The non-experimental design was chosen because the study variables were not manipulated. Instead, the aim was to analyze the relationships between the variables under investigation without any intervention. Additionally, the correlational scope is appropriate for examining relationships between variables without attempting to establish causality. This design is particularly useful for studies intended to inform decision-making and guide the improvement or initiation of activities or changes in teacher training (Creswell & Creswell, 2018). Moreover, in the current study, the cross-sectional approach allowed for data collection at a specific point in time, thus providing a time-specific overview of teachers' self-efficacy beliefs across its dimensions. This was particularly relevant for identifying patterns and disparities among the subgroups.

3.2 Study Context

Specifically, the northern region of Chile encompassing the areas of Arica and Parinacota/Tarapacá was selected due to its unique geographical, cultural, and educational characteristics. This region is distinguished by its high ethnic diversity, including a significant migrant population, and its elevated levels of socioeconomic vulnerability within the school communities. Furthermore, previous studies and national assessments such as the SIMCE have reported lower educational performance than in the other regions of the country, particularly in the scientific disciplines (Agencia de la Calidad, 2020). These conditions present unique challenges for teachers, especially in terms of adaptability, pedagogical strategies, and classroom management, making this region an ideal setting for investigating teachers' self-efficacy beliefs.

3.3 Sample

The sample consisted of 430 in-service teachers working in public and subsidized private schools in northern Chile. Among the respondents, 84 (19.5%) were men and 346 (80.5%) were women. The average age of the respondents was 44.2 years (*SD* = 9.31), ranging from 25 to 60 years. In terms of work experience, the average was 16.3 years (*SD* = 8.64), with a range of 0–35 years of experience. Regarding the academic qualifications of the sample, the majority of the respondents (62.1%) were primary education teachers, followed by secondary education teachers specializing in sciences (27.9%), childhood education teachers (6.5%), special education teachers (2.1%), and secondary education teachers specializing in mathematics and physics (1.4%).

Regarding the educational level at which the respondents were teaching, 62.1% were in primary education, 25.6% were in secondary education, 6.5% were in early childhood education, 3.7% taught at both primary and secondary levels, and 2.1% were in special education. In terms of the teaching context, 354 respondents (82.3%) worked in urban schools while 76 (17.7%) taught in rural settings (Table 1).

Table 1: Sample characteristics

Category	***n***	%
Gender		
Male	84	19.5%
Female	346	80.5%
Qualifications		
Primary Education Teachers	267	62.1%
Secondary Education Teachers in Sciences	120	27.9%
Early Childhood Education Teachers	28	6.5%
Special Education Teachers	9	2.1%
Secondary Education Teachers in Mathematics and Physics	6	1.4%
Educational Level of Teaching		
Primary	267	62.1%
Secondary	110	25.6%
Early Childhood Education	28	6.5%
Primary and Secondary	16	3.7%
Special Education	9	2.1%
Teaching Context		
Urban	354	82.3%
Rural	76	17.7%
Age		
Mean (*SD*)	44.2 (9.31)	
Range	25–60	
Work Experience		

Mean (*SD*)	16.3 (8.64)	
Range	0–35	

3.4 Data Collection Techniques

The questionnaire was completed by the respondents using pencil and paper at the school to which each belonged. This method was chosen because it was considered the most effective way to ensure that the survey was completed, that it addressed respondents' questions, and that informed consent was obtained. Additionally, this approach accounted for the fact that teachers working in remote rural schools often lack reliable internet access. The respondents were recruited through a special ongoing training program implemented in northern Chile during professional development courses and with the assistance of the Regional Education Secretariats. These entities provided access to databases and facilitated contact with the teaching staff. The respondents were initially contacted via email. All respondents in the study signed an informed consent form.

3.5 Instruments

The Ohio Teacher Self-Efficacy Scale (OSTES) (Tschannen-Moran & Hoy, 2001) was selected for its theoretical robustness and empirical validation in international contexts, including successful adaptations across various languages and cultures (e.g., Salas-Rodríguez & Martínez, 2021; Bueno-Álvarez et al., 2023). For this study, the adapted and validated version in Spanish for Chile of Covarrubias and Mendoza (2016), which demonstrated strong validity indicators, was used. This instrument has been widely implemented internationally to measure teacher self-efficacy, including pre- and post-participation in professional development programs. It consists of a 24-item Likert scale questionnaire (extended version) divided into three subscales: Instructional Self-Efficacy (IS), Classroom Management Self-Efficacy (CM), and Student Engagement Self-Efficacy (SE).

The IS dimension included eight items (e.g., How well can you implement alternative strategies in your classroom?). The CM dimension also consisted of eight items (e.g., How well can you establish a classroom management system with each group of students?). Likewise, the SE dimension comprised eight items (e.g., How much can you do to motivate students who show low interest in schoolwork?). Each item was rated on a 9-point scale, anchored at 1 (No influence), 3 (Very little influence), 5 (Some influence), 7 (Quite a bit of influence), and 9 (A great deal of influence).

In addition, sociodemographic data associated with gender, academic qualifications, educational level of teaching, teaching context, age, and work experience were collected from the respondents.

3.6 Data Analysis

To address the research questions posed in this study, reliability, descriptive, and correlational analyses were conducted. The data did not exhibit a normal distribution, as indicated by the Shapiro test and, therefore, non-parametric tests

were employed, including Spearman correlations and the Kruskal-Wallis test. The latter was used to compare differences in the dimensions of teacher self-efficacy across various categorical sociodemographic variables. Data analyses were performed using the RStudio statistical software.

4. Results

4.1 Reliability Tests

Internal reliability was estimated using Cronbach's alpha coefficient for each dimension of Teacher Self-efficacy. For the IS dimension, a value of 0.70 was obtained, indicating moderate internal consistency. Regarding the CM dimension, the Cronbach's alpha coefficient was 0.94, indicating excellent internal consistency for the items related to this dimension. Finally, the SE dimension showed a Cronbach's alpha of 0.70, reflecting moderate internal consistency.

4.2 Descriptive Statistics

Descriptive statistics were calculated for the three dimensions of Teaching Self-Efficacy. In the dimension of IS, the sample obtained a mean of 6.62 (*SD* = 1.12), with a median of 6.75. Scores ranged from 4 to 9, with a range of 5, a skewness of 0.02, and a kurtosis of -0.82. Regarding the dimension of CM, the mean was 7.40 (*SD* = 1.34) with a median of 7.50. Scores varied between 2.25 and 9, with a range of 6.75, a skewness of -1.50, and a kurtosis of 3.49. Finally, for the dimension of SE, the mean was 6.98 (*SD* = 1.09) and the median was 6.75. Scores ranged from 3 to 9, with a range of 6, a skewness of 0.21, and a kurtosis of -0.22 (Table 2).

Table 2: Descriptive results

Dimension	IS	CM	SE
n	430	430	430
mean	6.62	7.39	6.98
SD	1.11	1.33	1.08
median	6.75	7.5	6.75
trimmed	6.61	7.55	6.94
mad	1.1	1.48	0.93
min	4	2.25	3
max	9	9	9
range	5	6.75	6
skew	0.02	-1.50	0.21
kurtosis	-0.82	3.49	-0.22
SE	0.05	0.06	0.05

The normality assumption analysis was conducted using the Shapiro-Wilk test for each of the Teaching Self-Efficacy dimensions: Instruction, Management, and Engagement. The results indicated that the data did not meet the normality assumption, justifying the use of the non-parametric Kruskal-Wallis test.

The results of the Kruskal-Wallis test comparing the three dimensions of Teaching Self-Efficacy (IS, CM, and SE) indicated a statistically significant difference among the dimensions, $\chi^2(2, N = 430) = 115.58$, $p < .001$.

To explore these differences further, post-hoc tests were conducted using Dunn's test with Bonferroni correction. The results revealed significant differences between the dimensions of Engagement and Instruction ($Z = 3.78$, $p < .001$), between Engagement and Management ($Z = -6.83$, $p < .001$), and between Instruction and Management ($Z = -10.61$, $p < .001$). All p-values were adjusted using the Bonferroni method (Table 3).

Table 3: Dunn's test results with Bonferroni correction

Comparison	*Z*	*p* (adjusted)
SE – IS	3.779	0.000472**
SE – CM	-6.827	<0.001**
IS – CM	-10.606	<0.001**

** $p < .01$

4.3 Teaching Self-Efficacy and Sociodemographic Variables

The non-parametric Kruskal-Wallis test was used to evaluate differences in the three dimensions of Teaching Self-Efficacy based on 'teaching modality' and 'gender'. No significant results were found for either of these variables ($p > .05$). Regarding the variable 'training', the Kruskal-Wallis test results indicated significant differences in the dimension of Self-Efficacy in Instruction but not in the dimensions of Management or Engagement (Table 4).

Table 4: Teaching Self-Efficacy by teacher training

Dimension	Kruskal-Wallis H	*df*	*p*-value
IS	9.8106	4	0.043*
CM	3.7814	4	0.44
SE	8.185	4	0.09

* p< .05

Subsequently, the post-hoc analysis using the Wilcoxon test revealed a significant difference between the training groups 'Secondary Education in Science' and 'General Elementary Education' in the Instruction dimension ($p = 0.018$). The medians for each group are presented in Table 5.

Table 5: Median scores for Self-Efficacy in Instruction by training group

Training group	Median (Self-Efficacy in Instruction)
Secondary Education in Science	6.875
General Elementary Education	6.5

The findings suggest that teachers involved in Secondary Education in Science have a higher perception of self-efficacy in instructional strategies than teachers trained in General Elementary Education.

Conversely, the analyses for the dimension 'Educational Level' indicated significant differences in the IS dimension ($p < .05$) but not in the dimensions of CM or SE (Table 6).

Table 6: Teaching Self-Efficacy by educational level

Dimension	Kruskal-Wallis H	*df*	*p*-value
IS	12.36	4	0.01486*
CM	3.6815	4	0.4508
SE	8.3782	4	0.07866

* $p < .05$

The post-hoc analysis revealed that the only significant comparison between educational levels concerning IS was observed between teachers who were teaching in Primary Education exclusively and those teaching in both Primary and Secondary Education ($p > .05$). The medians for each group are presented in Table 7.

Table 7: Medians by educational level

Educational Level	Median (Self-Efficacy in Instruction)
Elementary Education	6.5
Elementary and Secondary Education	7.0

The above findings indicate that the teachers who taught at both educational levels reported higher self-efficacy in the Instructional dimension than those who taught in Primary Education exclusively.

Finally, to examine the relationship between the three dimensions of Teacher Self-Efficacy and the continuous variables 'work experience' and 'age', a series of Spearman correlations were conducted.

The results indicated no significant correlation between years of experience and the three dimensions of Teacher Self-Efficacy ($p > .05$). Regarding respondents' age, the correlational analyses suggested a weak but statistically significant negative correlation between respondents' age and Instructional Self-Efficacy ($\rho = -0.115$, $p = .018$). However, no significant correlation was found between age

and Management Self-Efficacy (ρ = 0.003, p = .954) or between age and Comprehension Self-Efficacy (ρ = -0.089, p = .064) (Table 8 and Figure 1).

Table 8: Correlations between teacher self-efficacy and age

	IS	CM	SE
Age	-0,115*	0.003	-0.089

*p < .05

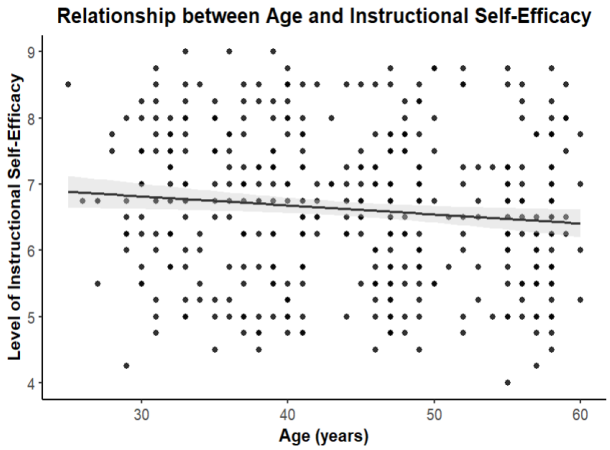

Figure 1: Relationship between age and Instructional Self-Efficacy

5. Discussion

The descriptive results reveal a tendency toward higher levels of self-efficacy in the Classroom Management dimension, with a mean of 7.40 compared to the dimensions of Instructional Strategies (6.62) and Student Engagement (6.98). This disparity suggests that while teachers feel confident in effectively managing the learning environment, they face greater challenges in implementing pedagogical strategies and fostering student motivation. These findings align with those of Ahn and Bowers (2024), Sogutlu (2022), and Shoulders and Krei (2015) who, despite identifying high levels of teacher self-efficacy in their samples, highlight that the lowest scores were observed in the Instructional Strategies dimension.

The fact that Classroom Management exhibits negative skewness (-1.50) and high kurtosis (3.49) indicates that the scores tend to cluster around the higher values, reinforcing the perception that this is a well-established strength within the sample. In contrast, the dimensions of Instructional Strategies and Student Engagement display a more balanced distribution, which could be related to the specific challenges that these competencies entail, particularly in a context of constant updates to methodologies and teaching practices.

However, the inferential analysis revealed statistically significant differences across the three dimensions of self-efficacy, reinforcing the notion that these competencies are perceived differently by teachers. The results of the Dunn's test

with Bonferroni correction indicated significant differences in all pairwise comparisons between dimensions, highlighting that teachers perceive greater self-efficacy in Classroom Management than in Instructional Strategies and Student Engagement. This finding aligns with previous studies that have identified classroom management as a fundamental competency that is less influenced by external factors than instruction and student engagement (Duan et al., 2024; González-Mayorga & Esteban, 2023).

Furthermore, the differences observed based on training type and educational level suggest that science teachers who teach at the secondary level and those teaching across multiple levels of primary and secondary education perceive greater self-efficacy in the Instructional dimension. This is consistent with another study conducted in Chile, which reported that teachers working exclusively in secondary education perceive themselves as more self-efficacious than their counterparts at other educational levels (Hurtado et al., 2023). This finding may be explained by the level of specialization that science teachers tend to acquire in addition to the diverse experience and adaptability required for teaching across different educational levels. These results align with studies such as that of Ávalos and Sotomayor (2012) who emphasize the relationship between mastery of disciplinary content and increased self-confidence in teaching. At the same time, it resents a challenge in terms of capturing and maintaining student interest in disciplines often perceived as complex and abstract such as science. Achieving that requires a high level of self-efficacy in instructional strategies, enabling teachers to innovate and adapt to their students' needs (Membiela, Acosta, Yebra et al., 2023; Salles et al., 2020). Teaching practices are significantly influenced by self-efficacy, which closely interacts with other factors such as attitudes and beliefs, thus playing a key role for STEM teachers (Shahali & Halim, 2024). It is, therefore, essential to understand self-efficacy as perceived by science teachers and their needs during their training when designing interventions to enhance their classroom performance and optimize learning outcomes (Van Aalderen-Smeets & Walma van der Molten, 2015).

The negative relationship between age and instructional strategies may reflect certain underlying factors. Older teachers may face challenges in adapting to new pedagogical approaches due to limited exposure to recent training or technological advancements (Martos et al., 2016). The findings suggest that as teachers grow older, they may perceive certain limitations in their ability to implement new pedagogical strategies, possibly due to a lack of professional development, occupational fatigue, or resistance to change, and this could affect their confidence. However, the absence of a correlation with professional experience contrasts with other studies that have identified a positive relationship between teacher self-efficacy—particularly in instruction and classroom management—and years of experience (Allouh et al., 2021; Wolters & Daugherty, 2007). The present findings indicate that in this sample, the perception of efficacy does not necessarily increase with years of practice but may instead, be influenced by other contextual and formative factors (Jornet et al., 2014).

Regarding its implications, the findings of this study highlight the importance of strengthening instructional strategies in the initial and the ongoing teacher training for science educators in Chile. In fact, educational institutions and teacher training programs could focus their efforts on developing specific pedagogical competencies that foster teachers' confidence in their instructional abilities. In agreement with Chichekian and Shore (2016), it is acknowledged that teachers' self-efficacy beliefs can influence their classroom management, student engagement, and attention to the diverse needs of students; therefore, it is essential for teachers to develop strong self-efficacy beliefs regarding instruction. In supporting this notion, it is crucial to promote teacher training that focuses on the development of instructional strategies, as educators with high confidence in their teaching abilities tend to implement a wider variety of pedagogical strategies and more frequently adjust their methods to meet students' needs (Zee & Koomen, 2016). This skill is vital in the context of the increasing student heterogeneity that characterizes education systems globally (UNESCO, 2020).

Finally, following Klassen and Chiu (2011), the importance of strengthening the instructional capabilities of science teachers lies not only in enhancing student performance but also in addressing the teacher attrition crisis. This is particularly relevant given that teachers with high confidence in their ability to implement effective instructional strategies are more likely to remain in the profession. In this context, the findings, particularly the differences among dimensions of self-efficacy and the demographic characteristics of teachers, highlight key areas for targeted interventions. For instance, the lower instructional self-efficacy observed in primary school teachers underscores the need for training programs that focus on improving pedagogical strategies during both pre-service and in-service teacher education. Additionally, addressing disparities related to age and educational level can inform policies aimed at enhancing teacher support.

To address gaps in instructional strategies and teacher self-efficacy, it is recommended to include specific modules in pre-service teacher education curricula, focusing on innovative methodologies and diversity inclusion. Furthermore, ongoing professional development programs could be implemented, incorporating in-classroom pedagogical support and the establishment of professional learning communities (Widodo & Allamnakhrah, 2020). Additionally, the increasing use of virtual spaces for professional development could provide opportunities to address identified gaps in instructional strategies (Corry & Stella, 2018). Future research could explore how the findings of this study could be considered in virtual learning environments, particularly within the context of teacher training programs.

However, certain limitations should be considered when interpreting the findings of this study. First, a cross-sectional design was used, which prevents the analysis of changes in self-efficacy perceptions over time and how teaching experiences could modify these beliefs at different career stages. Another limitation that is inherent in self-report instruments is the potential for overestimation or underestimation of abilities, as highlighted by Kruger and Dunning (1999). This

bias may influence the accuracy of the respondents' responses and consequently, the interpretation of the results.

Future studies could benefit from adopting a longitudinal approach to observe the development of self-efficacy across various career stages, thus providing a more dynamic understanding of this construct (George et al., 2018; Guzmán et al., 2024). Additionally, qualitative research could complement these findings by exploring teachers' perceptions and experiences regarding instructional strategies in greater depth, offering a more enriched and detailed context.

6. Conclusion

This study identified that teachers in northern Chile have higher levels of perceived self-efficacy in classroom management than in the dimensions of instructional strategies and student engagement, both of which showed more moderate scores. This finding suggests that while teachers feel confident in their ability to manage the learning environment, they face significant challenges in planning and implementing pedagogical strategies that address the specific needs of their students. Furthermore, the perception of self-efficacy in student engagement highlights the need to strengthen competencies related to motivating and actively involving students in the learning process.

The results also show that sociodemographic and professional characteristics have a limited influence on perceived self-efficacy, with training and educational level being the factors that exhibit the most significant differences between groups. In particular, teachers who combine teaching at both primary and secondary levels report higher self-efficacy in instructional strategies, possibly due to the diversity of experiences and the required specialization.

Finally, it is worth emphasizing that while self-efficacy in classroom management emerges as a strength in the studied sample, instructional strategies represent a priority area for attention. This underscores the urgent need to implement strategic actions that are aimed at improving the teachers' ability to plan and deliver instruction effectively. These efforts should thoughtfully address the specific challenges of the northern Chilean educational context, including the inequitable access to resources and the diverse needs of students. This finding highlights the need to implement strategic actions that are aimed at strengthening both the initial and ongoing training of teachers in northern Chile. This need becomes critical when considering the conditions and challenges faced by educational communities at the regional level. Furthermore, future studies are encouraged to examine the relationship between students' academic outcomes in this region and their teachers' lower self-efficacy beliefs in instruction.

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon a reasonable request.

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