Exploring early childhood teachers' attitudes towards statistics, probability, and their teaching*[1]

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Abstract

This article presents an exploratory study on the attitudes of early childhood teachers in Chile towards statistics, probability, and their teaching. Drawing on a previously validated scale, the study analyses the affective, cognitive, behavioural, and teaching competence components in a sample of 37 practising Chilean early childhood teachers. The findings reveal a generally positive appreciation of the importance of these contents, although accompanied by a low self-perception with regards to their teaching, particularly in the affective and teaching competence dimensions. Differences were observed between attitudes towards statistics, —more favourable, —and towards probability, —more neutral or negative, suggesting specific training challenges. The study highlights the need to design professional development initiatives that integrate the strengthening of Pedagogical Content Knowledge with strategies aimed at reframing the teaching of these contents from a positive, accessible, and contextually grounded perspective in early childhood education.

Keywords

Attitudes – Probability – Statistics – Teacher education – Early childhood education.

***** English version by Claudia Parada. The authors take full responsibility for the translation of the text, including titles of books/articles and the quotations originally published in Portuguese.

1- Data availability: The entire dataset supporting the results of this study has been published within the article itself.

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Introduction

The incorporation of statistical and probabilistic education into the school curriculum dates to the early twentieth century, when the *National Committee on Mathematical Requirements of the Mathematical Association of America* first recommended the teaching of this discipline in Grades 7–12 (ages 12–18) in *The Reorganization of Mathematics in Secondary Education* (MAA, 1923). However, its inclusion in the curriculum of the earliest stages of schooling is a more recent phenomenon, and it was not until the year 2000 that the *National Council of Teachers of Mathematics* (NCTM) recommended, in its *Principles and Standards for School Mathematics*, that instructional programmes at all educational levels should enable all students to develop competence in data analysis and probability (NCTM, 2003). That document explicitly states the need for children, from the age of three, to develop knowledge and skills related to data analysis and probability, with the aim of becoming well-informed citizens and educated consumers of data (NCTM, 2003).

Since then, various countries have progressively incorporated the teaching of data analysis and probability into their early childhood education curricula (Vásquez; Cabrera, 2022). Similarly, several authors have highlighted the need for students to begin developing such knowledge from the age of three, assuming that "what they know when they enter kindergarten and first grade is an indicator of their potential mathematical achievement in the years ahead—even throughout their schooling" (Clements; Sarama, 2015, p. 9). In this regard, Alsina (2012, 2017, 2021, 2022) has provided various arguments in favour of introducing statistics and probability from the earliest years, together with a proposal for the distribution of content by age groups (3–6 years) which has been revised and updated over time, alongside a variety of resources and strategies to foster their teaching at these levels, framed within the *Teaching Mathematics Itineraries Approach* (EIEM). Likewise, Batanero (2013) and Batanero *et al.* (2021) have contributed insights into the early development of probabilistic reasoning in early childhood education or the use of play as a resource to promote teaching. More generally, Bryant and Nunes (2012) present a review of the literature on children's understanding of probability, although such work needs updating.

The contributions of these different organisations and authors emphasize that statistical education from an early age promotes the development of specific knowledge and skills such as formulating questions based on data and collecting, organising, representing, and interpreting those data. Meanwhile, introductory probabilistic education helps children distinguish between deterministic events and those depending on chance, as well as compare and express the likelihood of events on a qualitative scale ranging from impossible to certain (Vásquez; Batanero, in press). According to these authors, these key ideas enable learners to gradually develop the ability to interpret data critically and to make informed decisions in a context characterised by the constant influx of large volumes of data and by the significant presence of uncertainty.

Thus, considering the relevance of statistics and probability from the earliest years, starting at age three, their incorporation into early childhood education constitutes a significant challenge for teachers. On the one hand, teachers generally have not received initial training that has enabled them to acquire the disciplinary knowledge and Pedagogical Content Knowledge (PCK) required for the effective teaching of these contents in the classroom (e.g., Vásquez; Alsina, 2019; Vásquez; Batanero, in press; Díaz-Levicoy *et al.*,

2021). On the other hand, many perceive themselves as having limited competence to teach these contents, despite recognising their importance in everyday and professional life (Vásquez; Alsina, 2023). Consequently, they tend to avoid teaching them or relegate them to the end of the annual programme, allocating less time compared to other areas of the mathematics curriculum (Alonso-Castaño *et al.*, 2021; Vásquez; Alsina, 2023).

In the specific case of Chile, although the early childhood curriculum (Chile, 2018) does not explicitly include the study of statistical concepts at this stage, it does establish among its expected learning outcomes, that children develop skills in making comparisons and formulating predictions, which are directly related to statistical and probabilistic content (Vásquez *et al.*, 2018). Nevertheless, various studies have shown that both initial and continuing teacher education at this level has prioritised other mathematical domains, such as number and geometry, while giving less attention to statistics and probability (Díaz-Levicoy *et al.*, 2021; Samuel *et al.*, 2021). This situation has resulted in limited teacher preparation for the teaching of statistics and probability, thereby reinforcing the need to investigate teachers' attitudes, particularly among in-service teachers—a group that remains scarcely studied. In this context, the present study seeks to provide relevant empirical evidence for the design of future professional development initiatives aimed at promoting the early learning of statistics and probability.

Consequently, it is essential to provide early childhood teachers with both mathematical knowledge and Pedagogical Content Knowledge (PCK) that will allow them to offer their students meaningful learning opportunities. Within this framework, an important aspect to consider—one that is central to research in early mathematics education—is the affective domain (Vásquez *et al.*, 2019). This is particularly relevant since "if a teacher does not value a topic, feels unprepared to teach it, or dislikes it, effective learning on the part of students will not be achieved" (Estrada; Batanero, 2015, p. 239). It should be noted that, although a range of terms exists to describe these issues, from McLeod's (1992) perspective—one of the most widely used in mathematics education—the affective domain is conceived as "a broad range of beliefs, feelings, and moods that go beyond the domain of cognition" (p. 576). These mental constructs that comprise the affective domain are interconnected in complex ways, often overlapping. According to Batanero (2009), such constructs are not directly observable; rather, they must be inferred from attitude scale responses or from the observation of individuals' behaviour.

Taking these considerations into account, the aim of this article is to investigate the attitudes of 37 Early Childhood Education teachers towards statistics, probability, and their teaching. To this end, an instrument was administered consisting of two attitude scales: one towards statistics and its teaching, and another towards probability and its teaching. The purpose was to obtain evidence regarding the attitudes of in-service early childhood education teachers, thereby contributing insights for the design of professional development initiatives that promote the effective teaching of statistics and probability from the earliest years.

Theoretical framework

To theoretically ground the study, a brief overview of the affective domain in mathematics education is first presented, followed by a more detailed examination of teachers' attitudes towards statistics, probability, and their teaching.

The affective domain in mathematics education

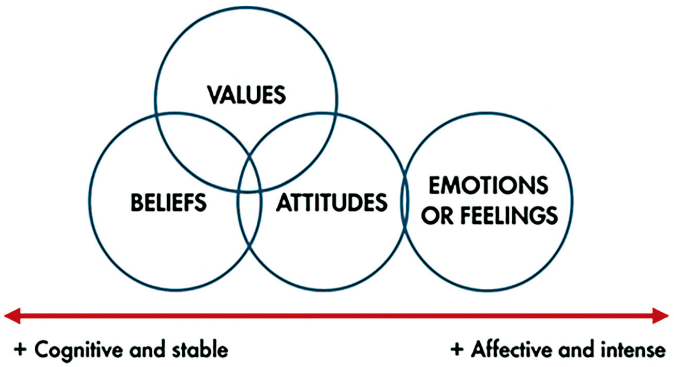
The affective domain exerts a significant influence on teachers' disciplinary knowledge and Pedagogical Content Knowledge (PCK), shaping their teaching practices (Xie; Cai, 2021). Thus, the way in which teachers conceive mathematics affects their actions in relation to it, including its teaching and learning. However, such beliefs are not homogeneous, and the literature distinguishes at least two perspectives: transmissive and constructivist (Felbrich *et al.*, 2012; Swan, 2006), which correspond to static and dynamic views of mathematics, respectively (Kaiser; Maaß, 2007; Köller *et al.*, 2000).

Within the transmissive perspective, mathematics is conceptualised as a body of pre-established knowledge and conventional procedures that the teacher must "deliver". Learning mathematics is viewed as an individual activity based on observation, listening, and imitation, with the aim of achieving procedural fluency. Teaching is structured in a linear fashion, where explanations precede the introduction of problems, understanding is assessed through exercises, and errors are corrected (Swan, 2006). From this perspective, success in learning mathematics is attributed to the intrinsic characteristics of the learner—that is, their innate capacities or abilities to learn (Köller *et al.*, 2000; Staub; Stern, 2002)—rather than to the mediations that the teacher may implement.

In contrast, the constructivist perspective interprets mathematics as an interconnected body of meanings and reasoning processes. Learning is conceived as a collaborative activity in which students are challenged through problems, reaching deeper understanding through collective discussion. Teaching is oriented towards exploring students' prior understandings, establishing conceptual connections, and treating errors as opportunities for learning (Swan, 2006).

Taking these two opposing poles into account, McLeod (1992) proposed that the affective domain is composed of beliefs, attitudes, emotions, and values, all of which are interrelated, may be stable over time, and transcend the domain of cognition (see Figure 1).

Figure 1 - Components of the affective domain and their interrelationships



Source: Pascual *et al.* (2020).

Regarding attitudes, which constitute the focus of our study, numerous investigations agree that attitudes towards mathematics are configured as a predisposition to respond positively or negatively to associated tasks, being influenced by various factors such as emotional disposition, individual characteristics, self-perception, and levels of anxiety, among others (Casis *et al*., 2017). From this perspective, several studies have focused their attention on analysing the attitudes expressed by both in-service and pre-service teachers. These studies have explored teachers' attitudes towards mathematics in general (Beilock *et al*., 2009; Tsao, 2014), as well as towards specific thematic areas within the discipline. In this regard, according to Groth and Meletiou-Mavrotheris (2018), it is important to employ instruments that make it possible to distinguish between teachers' attitudes towards the content and their attitudes towards teaching.

Attitudes towards statistics and probability and their teaching

In the field of attitudes towards statistics and its teaching, the study by Estrada (2002) is noteworthy, as it conceives o them as multidimensional, identifying both pedagogical and anthropological components (Chart 1).

Chart 1 - Components of teachers' attitudes towards statistics

Pedagogical Components	Anthropological Components
Cognitive component: conceptions and beliefs about statistics. Affective component: emotions and feelings towards statistics. Behavioural component: expressions of action or behavioural intention, thereby representing the tendency to be resolved into action in a particular way.	Social component: attitudes related to the perception and appreciation of the role of statistics in the sociocultural sphere of any citizen. Educational component: interest in statistics and its learning, in its usefulness and difficulty for students, as well as whether it should be included in the curriculum. Instrumental component: the usefulness of statistics for other subjects, as a form of reasoning, and as a cultural component.

Source: Authors' own elaboration.

Several authors have studied these attitudes. Begg and Edwards (1999) analysed the attitudes towards statistics of 34 prospective primary school teachers in New Zealand. The results revealed unfavourable attitudes and feelings of apprehension towards statistics. For his part, Estrada (2002) examined attitudes towards statistics among both pre-service and in-service teachers, concluding that although they recognised the value and usefulness of statistics, they expressed the need for more solid training, particularly in aspects related to the teaching of statistics. In a subsequent study, Estrada *et al*. (2004) expanded the investigation of attitudes towards statistics, including 66 in-service and 74 pre-service early childhood and primary education teachers. The results showed moderately positive attitudes among both groups, with pre-service teachers displaying slightly more positive attitudes, suggesting that teaching practice enhances such attitudes.

Estrada (2009) examined the attitudes towards statistics of 367 pre-service teachers and highlighted that the value component—reflecting the appreciation of the usefulness,

relevance, and importance of statistics and its teaching in everyday and professional life—received the highest score in comparison to other components. In a later study, Estrada *et al.* (2010) analysed and compared the attitudes towards statistics of 66 Spanish and 80 Peruvian primary school teachers, finding positive attitudes in both countries. Nonetheless, in the case of the Peruvian teachers, the study pointed out that although statistics is considered an important topic, it is perceived as being more appropriate for students in science-related fields.

With respect to attitudes towards probability and its teaching, Estrada and Batanero (2015) distinguished several components: probability as a discipline; the teaching of probability; and a value component towards probability and its teaching (Chart 2).

Chart 2 - Components of teachers' attitudes towards probability and its teaching

Components towards probability	Components towards the teaching of probability	Value component towards probability and its teaching
Affective component towards probability: personal feelings towards probability.	Affective component towards the teaching of probability: personal feelings about teaching probability which, although related to the affective component towards probability, may differ.	Appreciation of the usefulness, relevance, and importance of probability and its teaching in everyday and professional life.
Perceived cognitive competence component towards probability: self-perception regarding one's own competence, knowledge, and intellectual skills in probability.	Teaching competence component towards the teaching of probability: self-perception of one's ability to teach probability, support students, design effective tasks, identify appropriate resources, etc.	
Behavioural component towards probability: inclination to act in relation to probability, to make decisions in situations involving the use of probability, as well as to help others to learn and use probability.	Behavioural component towards the teaching of probability: tendency towards didactical action, disposition to teach probability, and the priority given to its teaching over other topics.	

Source: Authors' own elaboration.

Within the framework of these attitudes, a key issue lies in understanding the specific nature of probability. In this regard, Alsina and Vásquez (2024) describe some of the main purposes and applications of probability in real life, such as uncertain events that are part of students themselves (their biological world); elements of the planet (their physical world); relationships with the environment (their social world); or even decision-making through voting (their first contact with the political world). Additionally, they also exemplify purposes and applications of probability in early childhood mathematics education: for example, pupils may begin to understand the unpredictable character of each individual outcome, as well as the variability of small samples, by comparing individual results, results in pairs, and so on; or discover uncertainty in situations that, on the one hand, help them to recognise that there are non-binary possibilities of classification and, on the other hand, encourage them to express predictions about the behaviour of changes and outcomes.

Several authors have analysed teachers' attitudes towards probability. For example, Estrada *et al.* (2018) constructed and validated a scale for measuring attitudes towards

probability and its teaching, which has also been used in the present study. Tan *et al*. (2011) examined how to foster positive attitudes towards learning probability using a graphing calculator; their results indicated improvements in attitudes, particularly regarding the perceived usefulness, importance, and self-concept in probability. Veloo and Chairhany (2013) investigated the positive impact on attitudes towards probability and its learning when using cooperative games and tournaments with 64 students from an Islamic secondary school. Their findings support the view that such active instructional approaches benefit both attitudes and probability learning.

In Estrada's (2015) study with 121 pre-service and in-service primary school teachers, positive attitudes towards probability were observed across its different components, with no significant differences between the two groups, suggesting that attitudes remain stable in teaching practice. Subsequently, Estrada *et al.* (2018) developed an attitudes scale towards probability and its teaching, administering it to 232 prospective primary school teachers. The results indicated generally positive attitudes across all components, highlighting that attitudes towards probability and its teaching were more favourable than those towards statistics. In conclusion, according to Estrada *et al.* (2018), the results of these investigations underline the need for further research on attitudes towards the teaching of statistics, probability, and their components, in both in-service and pre-service teachers.

As can be observed, most studies addressing attitudes towards statistics and its teaching, as well as probability and its teaching, have mainly focused on pre-service and in-service teachers at the primary and secondary levels, with very few studies addressing Early Childhood Education. In this respect, some recent research, such as that conducted by Vásquez *et al*. (2019) with prospective early childhood teachers, indicates that although future teachers value the usefulness and importance of statistics, probability, and their teaching, their self-perception regarding disciplinary and teaching competences is low. Similarly, Samuel *et al*. (2021) measured the attitudes towards statistics of prospective early childhood teachers, reporting slightly positive attitudes towards statistics as a scientific discipline.

Unlike statistics, probability involves working with uncertain phenomena and the notion of variability, which poses an additional challenge for its teaching at early ages. The more abstract nature of this concept and its frequent association with chance or games may lead to confusion if not introduced through meaningful and contextualised experiences (Vásquez; Batanero, in press). Along these lines, Batanero (2013) emphasises that probabilistic reasoning in children must be built progressively, starting from informal experiences that allow them to explore the unpredictability of certain events, compare possibilities, and express qualitative predictions. Furthermore, from the affective perspective, several studies have pointed out that probability generates greater anxiety among teachers than statistics, due to its more limited presence in professional training and the scarcity of available teaching resources (Estrada; Batanero, 2015, 2020; Veloo; Chairhany, 2013). These characteristics reinforce the need for differentiated approaches to the two fields in teacher education processes.

Methodology

With the aim of investigating early childhood teachers' attitudes towards statistics, probability, and their teaching, a quantitative study of an exploratory and descriptive nature was conducted (Cohen *et al.*, 2018).

Participants

The participants were 37 Chilean early childhood education teachers intentionally selected based on their willingness to collaborate in the study, resulting in a non-probabilistic sample of an exploratory nature. All the teachers worked in pre-kindergarten and kindergarten levels (ages 4 to 6) in different educational centres in southern Chile. Their professional experience ranged from 3 to 22 years, and none reported having received specific training in statistics or probability, nor in their teaching, during either their initial or continuing education.

The use of a non-probabilistic sample is justified given the exploratory character of the study, whose purpose is to identify general trends within a specific group of teachers rather than to establish population inferences. In this context, data analysis was conducted by considering mean and median scores for each attitude component, in relation to the objective of identifying specific dimensions that may guide future teacher education initiatives.

For data collection, a validated scale of attitudes towards statistics, probability, and their teaching was used (Estrada; Batanero, 2015, 2020; Vásquez *et al.*, 2019).

Instrument

The instrument administered included an initial section of general information, in which the participants indicated their years of professional experience (ranging from 3 to 22 years), their previous training in mathematics, and whether they had taken courses in statistics, probability, or their teaching, either during initial or continuing education. All the teachers reported not having received specific training in these contents, which constitutes a relevant consideration for the interpretation of the results obtained.

The instrument consisted of 56 items distributed across two parallel scales: one scale of attitudes towards statistics and its teaching (Table 1), and another scale of attitudes towards probability and its teaching (Table 2).

Table 1 - Items comprising the scale of attitudes towards statistics and its teaching

	Statements
1	I enjoy lessons where statistics is taught.
2	I use statistical information when making decisions.
3	I will find it difficult to teach statistics.
4	Statistics helps to understand today's world.
5	I like statistics; it is a subject that has always interested me.
6	Statistics is easy.
7	I have never used statistics outside mathematics.
8	I master the main contents of statistics.
9	I am sure that I will enjoy teaching statistics at school.
10	I believe I can identify, and correct students' errors and difficulties related to statistics.
11	I will only teach statistics if there is time available after teaching the other topics.
12	Statistics is only useful for representing information.
13	Statistics is not as valuable as other areas of mathematics.
14	I will find it easy to design assessment tasks related to statistics.
15	I use statistics in everyday life.
16	I feel afraid when confronted with information related to statistics.
17	Statistics is understandable only to "scientific people."
18	I avoid reading information that contains statistical terms.
19	Knowledge of statistics helps students to reason critically.
20	Statistics should be taught from the earliest levels of education.
21	I worry about being able to answer my students' questions about statistics.
22	I do not feel well prepared to solve any problem in basic statistics.
23	I would not be able to prepare the appropriate teaching resources for a statistics lesson.
24	I will use statistics, when necessary, in other subjects that I teach.
25	If I could skip a topic, it would be statistics.
26	I am not interested in teaching statistics, even if it appears in the curriculum.
27	I do not enjoy solving statistical problems.
28	As a teacher, I would feel comfortable teaching statistics.

Source: Authors' own elaboration.

Table 2 - Items that make up the scale towards probability and its teaching

	Statements
29	I enjoy lessons where probability is taught.
30	I use probabilistic information when making decisions.
31	I will find it difficult to teach probability.
32	Probability helps to understand today's world.
33	I like probability; it is a subject that has always interested me.
34	Probability is easy.
35	I have never used probability outside mathematics.
36	I have a good command of the main contents of probability.
37	I am sure that I will enjoy teaching probability at school.
38	I believe I can identify, and correct students' errors and difficulties related to probability.
39	I will only teach probability if there is time available after teaching the other topics.
40	Probability is only useful for representing information.
41	Probability is not as valuable as other areas of mathematics.
42	I will find it easy to design assessment tasks related to probability.
43	I use probability in everyday life.
44	I feel afraid when confronted with information related to probability.
45	Probability is understandable only to "scientific people."
46	I avoid reading information that contains probabilistic terms.
47	Knowledge of probability helps students to reason critically.
48	Probability should be taught from the earliest levels of education.
49	I worry about being able to answer my students' questions about probability.
50	I do not feel well prepared to solve any problem in basic probability.
51	I would not be able to prepare the appropriate teaching resources for a probability lesson.
52	I will use probability when necessary, in other subjects that I teach.
53	If I could skip a topic, it would be probability.
54	I am not interested in teaching probability, even if it appears in the curriculum.
55	I do not enjoy solving probability problems.
56	As a teacher, I would feel comfortable teaching probability.

Source: Authors' own elaboration.

Each statement was answered using a five-point Likert scale (1: strongly disagree, 2: disagree, 3: neutral, 4: agree, and 5: strongly agree). Of the total items comprising the instrument, 28 were formulated in a positive sense and 28 in a negative sense. Therefore, to interpret them correctly and to ensure that all items followed the same direction, the scoring was reversed, thus providing a homogeneous scale for comparing all items, where a higher (or lower) mean always indicates a more (or less) positive attitude, regardless of whether the item was worded positively or negatively.

In relation to the objectives of the study, a descriptive analysis was carried out through the calculation of means and medians grouped by theoretical components (Table 3). Regarding the means and medians, these were calculated in relation to the total score given for each item and should therefore always be interpreted on a positive scale.

Table 3 - Components of attitudes towards statistics, probability, and their teaching

Components	Items of the scale	
Scale of attitudes towards statistics and its teaching	Affective component towards statistics (ACS)	1, 5, 16, 27
	Perceived cognitive competence component towards statistics (PCCS)	6, 8, 17, 22
	Behavioural component towards statistics (BCS)	2, 7, 15, 18
	Affective component towards the teaching of statistics (ACTS)	9, 21, 26, 28
	Teaching competence component towards the teaching of statistics (TCTS)	3, 10, 14, 23,
	Behavioural component towards the teaching of statistics (BCTS)	11, 20, 24, 25
	Value component towards statistics and its teaching (VCST)	4, 12, 13, 19
Scale of attitudes towards probability and its teaching	Affective component towards probability (ACP)	29, 33, 44, 55
	Perceived cognitive competence component towards probability (PCCP)	34, 36, 45, 50
	Behavioural component towards probability (BCP)	30, 35, 43, 46
	Affective component towards the teaching of probability (ACTP)	37, 49, 54, 56
	Teaching competence component towards the teaching of probability (TCTP)	31, 38, 42, 51
	Behavioural component towards the teaching of probability (BCTP)	39, 48, 52, 53
	Value component towards probability and its teaching (VCPT)	32, 40, 41, 47

Source: Authors' own elaboration.

Procedure

The questionnaire was administered individually, ensuring confidentiality and anonymity. Prior to its administration, a general explanation was provided regarding the objectives of the study and the voluntary nature of participation.

Data analysis

A descriptive analysis of the data was carried out through the calculation of means and medians for each theoretical component. This methodological strategy makes it possible to identify general trends which, although not statistically generalisable, provide relevant insights into aspects that could be addressed in professional development initiatives. It should be noted that the participants' lack of prior training may have influenced their responses, affecting both their self-perception of competence and their emotions related to the teaching of these contents. This limitation is acknowledged and considered in the analysis and interpretation of the results.

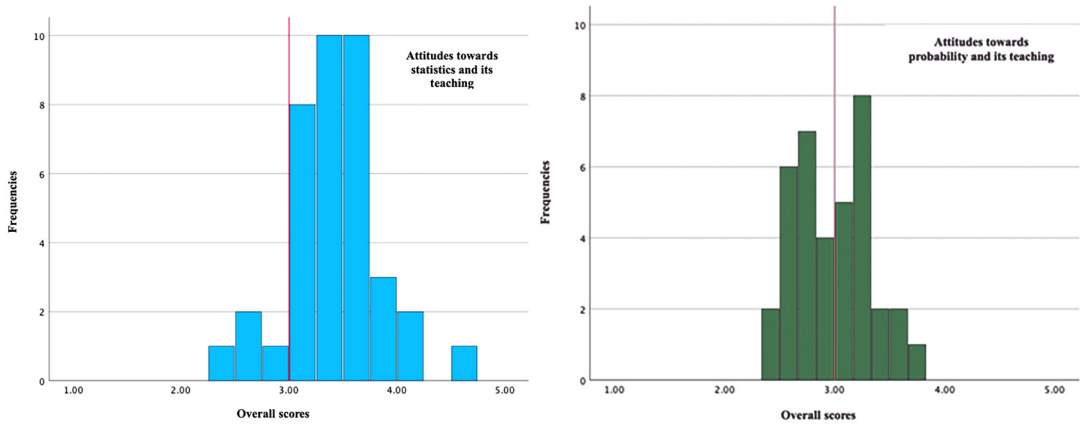
Results

The results of this study are presented below, organised into two sections: first, a global analysis of the scores for each of the scales that make up the instrument is presented. Then, the results for each of the components of the scales are detailed.

Global results

Regarding the scale of attitudes towards statistics and its teaching, the distribution of mean scores across all the items in the scale (Figure 2) ranges from 2.43 to 4.54 points, with an overall mean of 3.40 and a standard deviation of 0.41 points. Consequently, the participants in the study displayed, overall, a slightly positive attitude towards statistics and its teaching.

Figure 2 - Distribution of overall scores in both scales



Source: Authors' own elaboration.

Meanwhile, in the scale of attitudes towards probability and its teaching, the distribution of mean scores across all 28 items of the scale (Figure 2) ranges from 2.36 to 3.70 points, with an overall mean of 2.98 and a standard deviation of 0.35 points.

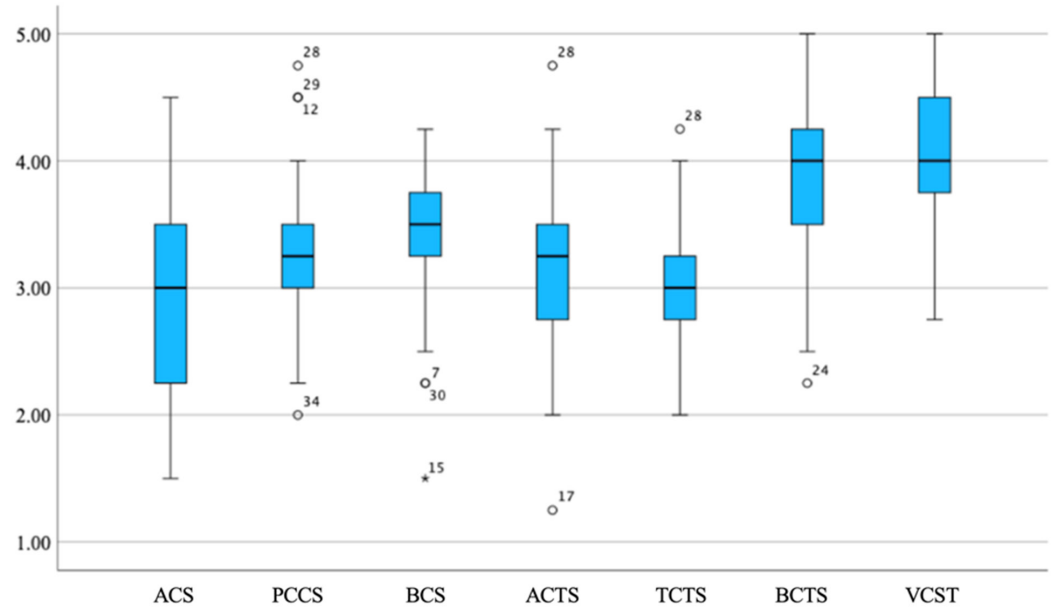
Therefore, at the global level, the participants in the study exhibited an attitude slightly below the neutral position towards probability and its teaching.

Accordingly, Figure 2 shows that the mean scores were slightly higher in the scale of attitudes towards statistics and its teaching compared with the scale of attitudes towards probability and its teaching.

Results of the scale of attitudes towards statistics and its teaching

Figure 3 presents the scores corresponding to each of the components in the scale of attitudes towards statistics and its teaching.

Figure 3 - Mean scores for the components of the scale of attitudes towards statistics and its teaching



Source: Authors' own elaboration.

From Figure 3 it can be observed that the VCST (Value component towards statistics and its teaching) reached the highest mean score (4.10 points), indicating that this group of early childhood teachers values the usefulness, relevance, and importance of statistics and its teaching both for everyday life and in the professional domain. Likewise, another component with a mean score close to 4 points is the BCTS (Behavioural component towards the teaching of statistics), with an average of 3.87 points; that is, the teachers show a tendency towards didactical action.

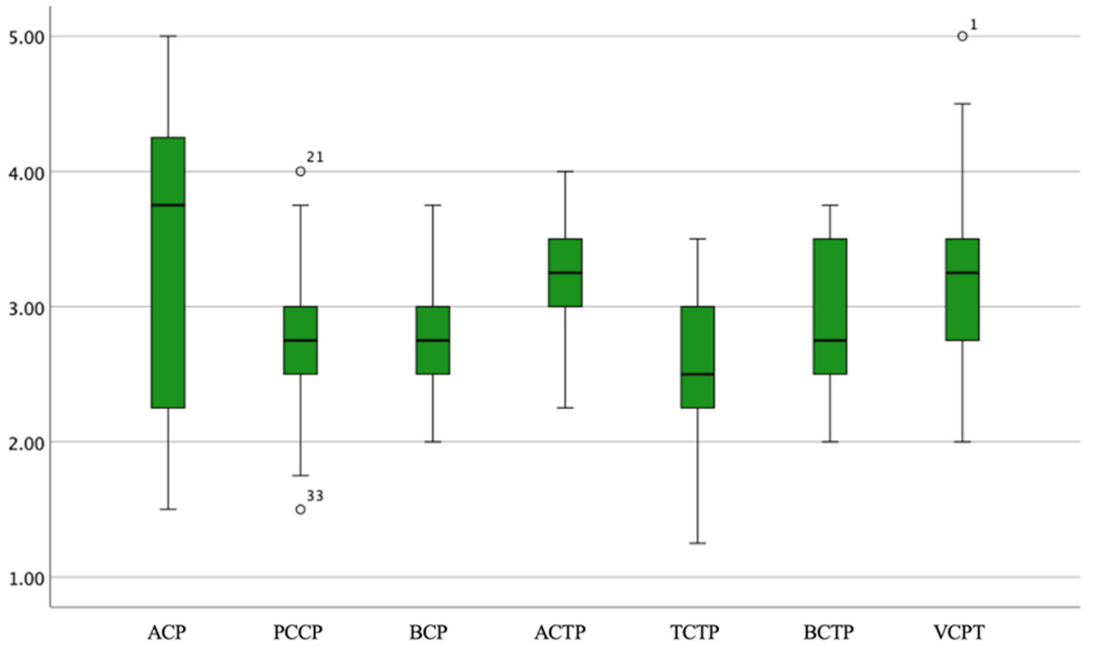
In contrast, the components with the lowest mean scores are the ACS (Affective component towards statistics), with an average of 2.98 points, and the TCTS (Teaching competence component towards the teaching of statistics), with 3.05 points. In other words, the participating teachers display a slightly negative attitude regarding emotions

and feelings towards statistics, and a neutral attitude in terms of their self-perception of the ability to teach statistics—that is, to support students in their learning of statistics, to design effective tasks, to identify appropriate resources, and so on.

Results of the scale of attitudes towards probability and its teaching

Based on the analysis of the components considered in the scale of attitudes towards probability and its teaching, Figure 4 shows the scores by component.

Figure 4 - Mean scores for the components of the scale of attitudes towards probability and its teaching



Source: Authors' own elaboration.

Based on the data represented in Figure 4, it can be observed that the ACP (Affective component towards probability) obtained the highest mean score (3.4 points), indicating that this group of early childhood teachers expressed slightly positive feelings towards probability. Likewise, another component showing a slightly positive attitude was the ACTP (Affective component towards the teaching of probability), with an average of 3.3 points. A similar situation was found for the VCPT (Value component towards probability and its teaching), with an average of 3.2 points; in other words, the participating teachers valued the usefulness, relevance, and importance of probability and its teaching for daily life and professional practice.

By contrast, the component with the lowest mean score was the TCTP (Teaching competence component towards the teaching of probability), with an average of 2.5 points. In other words, the participating teachers showed a slightly negative attitude regarding their self-perception of their ability to teach probability, support students, design effective tasks, identify appropriate resources, among other aspects.

The differences observed between attitudes towards statistics and towards probability suggest that the teachers were more familiar with data analysis in everyday contexts than with concepts related to uncertainty. Furthermore, the lower scores in the affective and teaching competence components reveal that many teachers not only feel underprepared to teach these topics but also express negative emotions or a sense of insecurity about teaching them. This combination may lead to avoiding or postponing their inclusion in the annual planning, as described in previous research (Vásquez; Cabrera, 2022; Alonso-Castaño *et al.*, 2021). From a teacher education perspective, this differentiation of components is crucial, as it allows for a clearer identification of training needs. For example, the value component (which obtained high scores) indicates that teachers recognise the importance of statistics and probability for everyday life and citizenship. However, such recognition does not necessarily translate into action if it is not accompanied by a sense of competence and a positive attitude towards teaching. Hence, the importance of designing teacher education programmes that explicitly address these components: strengthening specific didactic knowledge, offering opportunities to design and analyse tasks, and fostering experiences that improve the affective relationship with these contents.

Finally, it is important to consider that the lack of initial and continuing training in statistics and probability reported by the participants may have influenced the responses given in the scale. This absence may have led to an underestimation of their own abilities or to unawareness of available resources, thereby affecting their perceived attitudes. Therefore, the results should be interpreted in the light of this educational context, which reinforces the need for structured interventions in these areas.

Final considerations

This study analysed the attitudes of 37 Chilean early childhood education teachers towards statistics, probability, and their teaching. To measure these attitudes, a five-point Likert scale was administered (Vásquez *et al.*, 2019). The data obtained revealed, at a general level, a slightly positive attitude towards statistics and its teaching, and a more neutral or slightly negative attitude towards probability and its teaching.

In both cases, the components with the lowest scores were the affective and teaching competence components. This suggests that the teachers not only feel underprepared to teach these contents but also experience negative emotions or insecurity regarding their teaching. It is worth noting that these results differ from those obtained by Vásquez *et al.* (2019) with prospective early childhood teachers, who reported the perceived cognitive competence component towards statistics as the lowest.

As for the most highly valued components, and similarly to what was reported by Vásquez *et al.* (2019), it was observed that the behavioural component towards the teaching of statistics and the value component towards statistics and its teaching obtained the highest mean scores. In other words, the participating teachers recognised the importance of statistics as a tool to represent information, understand the world, and help students to reason critically. Through their attitudes, they acknowledged that statistics should be taught from the earliest ages, in line with the findings of Samuel *et al.* (2021), who identified a slightly positive attitude towards statistics as a scientific discipline among prospective early childhood teachers.

Nevertheless, the participants in this study expressed some fear regarding the solving of problems involving the use of statistics, as well as anxiety about teaching this discipline, particularly in relation to preparing appropriate teaching resources for early childhood education. This fear may be explained by the limited initial and ongoing training in statistics and its didactics that the teachers reported having received.

Regarding probability, the attitudes were generally lower. Although the participating teachers recognised the importance of teaching probability for dealing with every day and professional situations, they exhibited a negative self-perception of their mathematical and teaching knowledge to carry out effective instruction of this content at early ages. In short, attitudes towards statistics and its teaching were more favourable than those towards probability and its teaching.

These findings provide valuable insights for guiding future actions in the field of teacher education. Thus, the lack of confidence in teaching statistics and probability, linked to a negative self-perception of one's own knowledge, reinforces the need to design intervention programmes that foster teachers' professional development. In this respect, Alsina *et al.* (2025) highlight the diversity of effective training methods for this purpose.

In this line, we consider it particularly advisable to combine three training strategies aimed at promoting teachers' professional development for teaching statistics and probability: a) Design of contextualised tasks, since working with representations, contexts, questions, and instructions fosters the development of teaching practice in relation to the organisation of instruction (Sullivan *et al.*, 2013).

b) Analysis of classroom practices, for example through the Lesson Study model (Fernández; Yoshida, 2004), whose purpose is to improve both teaching and learning. This model includes two distinct phases: observation and implementation, which allow theorising from practice and subsequently testing such theory.

c) Critical reflection on practice, a widely established approach in teacher professional development. From this perspective (Alsina, 2019; Korthagen, 2001), teachers with low confidence in teaching statistics and probability need to become familiar with multiple ways of acting, practise them in real contexts, and have criteria to evaluate their appropriateness, reflecting systematically on their decisions.

Moreover, it is essential to promote training experiences that reframe statistics and probability as accessible, useful, and comprehensible knowledge from early ages, thus fostering the development of positive attitudes towards their teaching.

As for the limitations of this study, its restricted scope is acknowledged, given the non-probabilistic nature of the sample, composed of a small group of in-service teachers intentionally selected based on their willingness to participate. Nevertheless, despite these limitations, the results constitute a relevant starting point for future research and interventions. Such initiatives should focus on the design and implementation of teacher professional development experiences that, through diverse methodological strategies (such as reflection on practice or Lesson Study), positively influence disciplinary and pedagogical knowledge as well as the attitudes of early childhood teachers towards teaching statistics and probability.

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