UNDERSTANDING STATISTICAL TABLES BY ELEMENTARY SCHOOL STUDENTS IN CHILE

Rodolfo Jiménez-Díaz, Audy Salcedo, Danilo Díaz-Levicoy, Denisse Aviles-Henn and Yudi Caterine Diaz-Perdomo

SUMMARY

The reading levels of statistical tables achieved by Chilean elementary school students are reported. A questionnaire with items of different levels of reading statistical tables was used to collect the data. The sample was non-probabilistic and consisted of 26 Chilean 8th grade students. A content analysis of the students' responses was performed, observing that their best performance was in the questions that evaluated the level associated with literal reading of the information in the table. It was also observed that they have problems comparing data from the table or producing new information from it. Although the official curriculum establishes that 8th grade students should be able to interpret statistical tables, the results suggest that they master only its most basic aspects.

Introduction

The citizens are regularly exposed to statistical information that reaches them by various means. This information can belong to areas as different as economics, human rights, or politics, which leads the citizens, consciously or unconsciously, to make decisions or take positions regarding events that may influence their personal or professional life. Despite being aimed at a general public, not specialist in statistics, this information often requires substantial statistical knowledge (Gal, 2003). For such reasons, most countries have included topics of statistics from the first years of schooling to give citizens statistical training, thus developing statistical culture.

One of the instruments used in the media and science to transmit information is the statistical tables, which are often considered easy to interpret. However, evidence suggests otherwise (Gabucio *et al*., 2010). Without the knowledge that allows the individuals to interpret the tables, they cannot evaluate the information depicted, which sometimes presents biases or manipulations. Therefore, students who completed high school (in the U.S., graduates) are expected to interpret and critically evaluate the statistical information represented in tables. Everybody should have cognitive skills to analyse, understand, and evaluate the information presented through different statistical representations (Rodríguez-Alveal, 2017). Also, understanding statistical tables is an element of statistical culture (Gal, 2003).

In Chile, statistical tables were included in the national primary education curriculum in 2012 through the Data and Probability axis (Ministerio de Educación [MINEDUC], 2012), to be studied from the 1st grade (6 years old). During this school period, students should build, read, and interpret statistical tables in different contexts. In this way, we can assume that they can do it well when they finish primary education. That is why this research proposes to analyze Chilean 8th-graders' level of understanding of statistical tables. For that, we will work with a sample composed of the first generations that went through schooling with objectives related to statistics and probability since 1st grade.

Most of the research located on statistical tables refers to their study in textbooks (v.g. García-García *et al*., 2019; Pallauta *et al*., 2021) and few studies involve students (Díaz-Levicoy *et al*., 2020, 2023; Gabucio *et al*., 2010). Of the identified research, only Diaz-Levicoy *et al*. (2020) worked with Chilean primary education students, specifically the 3rd grade. Therefore, we consider that this research can contribute to the knowledge of students' understanding of statistical tables at this level.

Materials and Methods

The research seeks to characterize the understanding of

KEYWORDS / Primary Education / Statistical Tables / Understanding /

Received: 06/27/2023. Modified: 10/16/2023. Accepted: 10/19/2023.

Rodolfo Jiménez-Díaz. Professor of Basic Education, Universidad Austral de Chile (UACh), Chile. Postgraduate degree, mention in Mathematics 2nd Basic Cycle, UACh, Chile. Master in Didactics of Mathematics, Universidad Católica del Maule (UCM), Chile. Teacher and Head of the Pedagogical Technical Unit, Escuela Municipal Fernando Arenas Almarza, Chimbarongo, Chile. e-mail: rajd.ariel.16@gmail.com.

Audy Salcedo. Degree in Mathematics Education, Universidad Central de Venezuela (UCV), Venezuela. PhD in Education (UCV). Professor, Faculty of Education, Universidad Autónoma de Chile, Chile. Interdisciplinary Research Group in Early Childhood Education (GIIEPI) Universidad Autónoma de Chile. e-mail: audy.salcedo@gmx.com.

Danilo Díaz-Levicoy (Correspondence author). Professor of Secondary Education in Mathematics and Computer Science, Universidad de Los Lagos (ULAGOS), Chile. Master in Didactics of Mathematics, University of Granada (UGR), Spain. Ph.D. in Educational Sciences, UGR, Spain. Professor, UCM, Chile. Address: Universidad Católica del Maule. Ave. San Miguel, 3605, Talca. Región del Maule, Chile. e-mail: dddiaz01@hotmail.com.

Denisse Aviles-Henn. Degree in Education. Master in Didactics, UCM. Chile. Ph.D. Candidate in Didactics of Mathematics UCM, Chile. e-mail: denisse.aviles@alu.ucm.cl.

Yudi Caterine Diaz-Perdomo. Degree in Mathematics, Universidad Industrial de Santander (UDES), Colombia. Master in Educational Technology Management, UDES, Colombia. Ph.D. Candidate in Didactics of Mathematics. UCM, Chile. e-mail: yudi.diaz@alu.ucm.cl.

LECTURA DE TABLAS ESTADÍSTICAS POR ESTUDIANTES DE EDUCACIÓN PRIMARIA EN CHILE
Rodolfo Jiménez-Díaz, Audy Salcedo, Danilo Díaz-Levicoy, Denisse Aviles-Henn y Yudi Caterine Diaz-Perdomo

RESUMEN

Se reportan los niveles de lectura de tablas estadísticas alcanzados por estudiantes chilenos de primaria. Para recolectar los datos se utilizó un cuestionario con ítems de diferentes niveles de lectura de tablas estadísticas. La muestra fue no probabilística y estuvo compuesta por 26 estudiantes chilenos de 8º grado. Se realizó un análisis de contenido de las respuestas de los estudiantes, observando que su mejor desempeño fue en las preguntas que evaluaban el nivel asociado a la lectura literal de la información de la tabla. También se observó que tienen problemas para comparar datos de la tabla o producir nueva información a partir de ella. Aunque el currículo oficial establece que los alumnos de 8º grado deben ser capaces de interpretar tablas estadísticas, los resultados sugieren que dominan solo sus aspectos más básicos

LEITURA DE TABELAS ESTATÍSTICAS POR ESTUDANTES DO ENSINO FUNDAMENTAL NO CHILE
Rodolfo Jiménez-Díaz, Audy Salcedo, Danilo Díaz-Levicoy, Denisse Aviles-Henn e Yudi Caterine Diaz-Perdomo

RESUMO

São relatados os níveis de leitura das tabelas estatísticas obtidas pelos estudantes chilenos do Ensino Fundamental. Um questionário com itens de diferentes níveis de leitura de tabelas estatísticas foi usado para coletar os dados. A amostra não foi probabilística e consistiu de 26 estudantes chilenos da 8ª série. Foi realizada uma análise de conteúdo das respostas dos alunos, observando que seu melhor desempenho estava nas perguntas que avaliavam o nível associado à leitura literal das informações da tabela. Também foi observado que eles têm problemas para comparar dados da tabela ou produzir novas informações a partir dela. Embora o currículo oficial declare que os alunos da 8ª série devem ser capazes de interpretar as tabelas estatísticas, os resultados sugerem que eles dominaram apenas os aspectos mais básicos.

statistical tables by elementary school 8th -graders. For this purpose, the qualitative methodology was followed, since our attention was focused on examining typical features or properties of a given activity, group, situation, or materials, through the content analysis, of the answers of some Chilean 8th-grade students.

To analyse the understanding reached by students, he four levels of graph reading (Curcio, 1989; Friel *et al*., 2001; Shaughnessy *et al*., 1996) were used because they can be adapted to statistical tables. The four levels are described as follow: N1) *Read the data*: implies a literal reading of the data represented in the table; N2) *Read into the data*: it is the interpretation and integration of the information in the table that is not explicitly represented in it and involves applying simple mathematical procedures; N3) *Read beyond the data*: information that is not represented in the table and cannot be deduced with operations or comparisons is requested. It entails making predictions, estimates, or inferences from the data; N4) *Read behind the data*: at this level, one must assess critically how the data, their validity, and purpose were collected and organized and how people interpret them. It assumes knowledge of the context used.

For data collection, we used the survey technique by an ad hoc questionnaire built from questions from the Trends in International Mathematics and Science Study (MINEDUC & IAEEA, 2013) and activities from textbooks published for the MINEDUC. Subsequently, this questionnaire was validated through experts judgment. The five experts assessed each item of the questionnaire according to its pertinence, relevance, and clarity, allowing to establish whether the different items of the questionnaire adequately represent the construct that is intended to be measured. In addition, a pilot test was conducted, giving the questionnaire to 12 students with similar characteristics to the subjects under study. This test allowed us to confirm that the students understood each question and to estimate the execution time (less than 90 minutes). Further details of the questionnaire design and validation process are detailed in Jiménez-Díaz *et al*. (2022). The final questionnaire was made up of ten items, five to assess the reading of tables and five to assess their construction. This report presents the results of the items that explore different reading levels.

Item 1 (Figure 1) comprises four subitems that aim to assess level 1 of reading, which means making a literal reading of the data in the table. The questions cover two marginal totals, a table body value, and the table title.

The two questions of the second item (Figure 2) assess level 2 of table reading. To answer both questions, students must read the information in the table and do some simple mathematical operations.

Question 3 (Figure 3) addresses the four reading levels proposed by Curcio *et al*. In 3a, the student must do a simple reading of the body of the table (level 1) to extract information about the voting intentions of two (imaginary) candidates for mayor of a town in Chile. In 3b, reading level 2, data must be read in the table, and the arithmetic mean of the percentage of the voting intention for the candidate Condorito must be calculated. In 3c, students must estimate the voting intention that the candidate Condorito could obtain in the tenth month, taking as reference the information found in the statistical table level 3). The last question requires the student to critically analyse, interpret the information presented, and issue an opinion on one of the candidates' campaign actions (level 4).

The two questions of item 4 (Figure 4) assess reading level 2, where respondents must

1. The information presented in the following table shows the number of medals won by Chilean athletes in the Summer Olympics.

Chile medals in Summer Olympics				
Sports	Gold	Silver	Bronze	Total
Athletics	0	2	0	2
Boxing	0	1	2	3
Equestrianism	0	2	0	2
Soccer	0	0	1	1
Tennis	2	1	1	4
Shooting	0	1	0	1
Total	2	7	4	13

Based on the information in the table, answer the following questions:

1a. What is the title of the table?
1b. Which sport won a total of four medals?
1c. How many silver medals did Chile win in equestrianism?
1d. How many silver medals have Chilean athletes obtained in the Summer Olympics?

Figure 1. Statement item 1 of the questionnaire.

2. The following table summarizes the number of pets owned by a group of families in a sector of the commune.

Number of pets per family	
Number of pets	Number of families
0	6
1	10
2	12
3	5
4	4
5	3

Use the information in the table to answer the following questions: 2a. How many families have more than three pets? 2b. What percentage of families have only one pet?

Figure 2. Statement item 2 of the questionnaire.

3. During the campaign for mayor of Pelotillehue, there were polls to observe the voting intention of the town's inhabitants. In each poll, 100 inhabitants of the commune were consulted, with the following results.

Candidate	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9
Condorito	33%	40%	38%	37%	41%	46%	49%	51%	55%
Pepe Cortisona	67%	60%	62%	63%	59%	54%	51%	49%	45%

Based on the information above, answer the following questions:

3a. What percentage of voting intention did Pepe Cortisona obtain in month 5?
3b. What is the average percentage of Condorito's voting intention during the nine months?
3c. If the survey is carried out in the tenth month, what will be the percentage of voting intention Condorito would obtain?
3d. Based on the information in the table, do you consider the actions carried out in the campaign of candidate Pepe Cortisona to be effective? Explain your answer.

Figure 3. Statement item 3 of the questionnaire.

perform mathematical operations to produce information not presented directly in the table.

Item 5 (Figure 5) presents a situation in the school environment where the student, based on the information in the table, must make a judgment regarding the measure he intends to take in a school (level 4).

The research involved 26 students in the 8th grade of the lower secondary education (13 to 14 years old) - 12 boys and 14 girls - from a public educational establishment in the Libertador General Bernardo O'Higgins region of Chile. It is a deliberate, non-probabilistic sample, given the researchers' possibility of access. The school serves students from kindergarten to the 8th grade of elementary school (from 4 to 13 years old) who, according to MINEDUC (2019) measurements, come from the lower middle socioeconomic level.

To participate in the study, each student had to sign an assent and present an informed consent signed by a parent or legal guardian. Students' participation in the research was voluntary, they could request exclusion at any time and request that their interventions were not considered without prior justification or harm.

We performed a content analysis of the answers, classifying them into four categories: (a) correct, gathers answers that show evidence of management on the assessed reading level; (b) partially correct, responses that show evidence of handling the assessed reading level, but do so incompletely or with impressions; (c) incorrect, answers inconsistent with what was requested, or without evidence of mastery of the required associated reading level; (d) no response, when the activity is left unanswered.

Results

This section describes the results obtained, organised by the reading levels evaluated by the items (Table I).

Although most students gave a correct answer in the level 1 items, we can see the differences in percentage. In two questions, there are 96.2% of correct answers. In the first (1a), students must identify the title of the table, a structural element that contextualises the information presented. An example of this situation is the answer of student 15 who says: "the title is Chilean medals in the Summer Olympic Games". One student did not indicate the complete title of the table, so it was classified as partially correct when he/she wrote, "Chilean medals in the Olympics" (student 8).

The second question with 96.2% correct answers is 3a, which corresponds to reading a direct datum found in a double-entry table. For example, the answer given by student 10 is considered correct: "It is 46%". Only one student did not hit it. He/she indicated the percentage of intention to vote for the candidate Condorito for the sixth month instead of Pepe Cortisona's percentage for the fifth month. This answer could be attributed to confusion when reading the table.

Question 3a is supposed to be similar to 1c since both questions request reading of data found in the body of the table. However, in 1c, the correct answers drop to 77%. The most frequent error in 1c seems to be the product of the sum of the absolute frequency of several categories, for example, student 7's answer, which indicates, "The total of silver medals is 14", which could be associated with the general total of medals obtained by Chilean athletes in the Summer Olympics. If so, the student did not understand that this total can be obtained directly from the table; but also, the student seems to have made an error when adding, since there were 13 medals and not 14, as he/she indicates.

The second highest percentage of correct answers (88.5%) occurs when requesting a marginal total from the table (1b) while the lowest percentage (65.4%) is reported when asking for the general total of the table (1d). In 1b, most students place frequency 4 in the marginal total of the rows and then identify the sport. The few incorrect answers are associated with a reading of the marginal total of columns, as in the case of student 19: "bronze got four medals in total." This type of answer could

4. The table shows the ages of 25 volleyball players in the national team.

Age of the players of the volleyball team		
Age	Absolute frequency	Relative percentage frequency
18	3	12
19	5	20
20	7	28
21	5	20
22	2	8
23	2	8
24	1	4

Based on the information presented in the table, answer the following questions: 4a. How many players are 22 years old or younger? 4b What percentage of players are over 20 and under 23 years old?

Figure 4. Statement item 4 of the questionnaire.

5. A school estimated the time that 7th-grade students spent studying. The results achieved are summarized in the table below:

Number of weekly hours dedicated to study		
Hours	Absolute frequency	Cumulative absolute frequency
3	5	5
6	12	17
9	18	35
12	30	65
15	28	93
18	7	100

Considering that the recommended average weekly study hours for this level is 14 hours, the school determined that it will implement measures to increase study hours, provided that most students are below the average number of hours they should study at this level.

By analysing the data in the table, do you think the school must implement measures to increase the number of hours students should dedicate to their studies? Support your answer.

Figure 5. Statement item 5 of the questionnaire.

be associated with the understanding of the question.

In subitem 1d, students must identify the marginal total of the column reporting silver medals. Most offered the correct answer, confirming that reading data straight from the table is usually a task that presents few difficulties for this group of students. The incorrect answers in this item seem to be the product of confusion with the general total, as can be seen in student 2's answer, where it read, "they have obtained 14 silver medals in total".

An aspect that stands out in Table I is that all the students shared an answered at this level, without leaving any blanks, which suggests that they feel confident in answering. However, it seems that the location of the information in the body of the table influences the possibility of identification by this group of students.

Level 2 questions require the table reader to read and integrate the information found in it, but it requires some simple math procedures. Table II shows a student's irregular execution, according to the different situations raised. The question with the highest percentage of correct answers is 2a, where students had to identify two pieces of information in an absolute frequency distribution and then add them, as did student 3, who wrote, "seven families with more than three pets", which is the sum of 4 + 3. It is a task that is supposed to be simple, but most of them could not give the correct answer.

The answers qualified as "Partially correct" are those where the students identify the two frequencies but do not add them. They do not seem to fully understand the information being asked, which could be caused by a reading miscomprehension. An example is the case of student 12, who writes the frequencies associated with families with four and five pets but does not do the sum. The student identified the requested information in the table but did not answer the question. In question 4a, students must also add quantities read in the table. In this case, five figures must be added; however, only 23% of the students managed to produce the correct answer. An example is student 23's answer, where he/she indicates, "There are 22 players who are 22 years old or younger". One answer was placed in the "Partially correct" category because the student identified the requested data but made a mistake when doing the operation, writing that there were 21 players who were 22 years old or older. One incorrect answer to item 4a is student 20's, who indicated the percentage of players who were 22 years old (8%) or student 12's, who affirmed that two players were 22 years old.

Questions 2b, 3b, and 4b ask students to operate with percentages. In the first case, they must calculate the percentage that one of the categories in the table represents. In the second, they must add the percentages of two categories. These are the questions with the lowest percentage of correct answers. In 2b, none of the students managed to do the math correctly, and most of the answers were scored as "Partially correct". These are cases where the student identifies the absolute frequency of the requested category but does not calculate the percentage. In item 3b, students must calculate the arithmetic mean, a

TABLE I
FREQUENCY (AND PERCENTAGE) OF THE TYPES OF ANSWERS IN THE ITEMS THAT ASSESS READING LEVEL 1

Answer Type	Item				
	1a	1b	1c	1d	3a
Correct	25 (96.2)	23 (88.5)	20 (77)	17 (65.4)	25 (96.2)
Partially correct	1 (3.8)	0 (0)	2 (7.7)	0 (0)	0 (0)
Incorrect	0 (0)	3 (11.5)	4 (15.3)	9 (34.6)	1 (3.8)
No answer	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

TABLE II
FREQUENCY (AND PERCENTAGE) OF THE TYPES OF ANSWERS IN THE ITEMS THAT ASSESS READING LEVEL 2

Answer Type	Item				
	2a	2b	3b	4a	4b
Correct	8 (30.8)	0 (0)	0 (0)	6 (23)	1 (3.8)
Partially correct	6 (23)	22 (84.6)	0 (0)	1 (3.8)	1 (3.8)
Incorrect	11 (42.3)	4 (15.4)	21 (80.8)	18 (69.2)	22 (84.6)
No answer	1 (3.8)	0 (0)	5 (19.2)	1 (3.8)	2 (7.7)

content they had studied before. However, no student offered correct or partially correct answers. Most of the answers were qualified as incorrect since they indicated the percentage of the ninth month or transcribed the percentages of the nine months without doing any calculation. Some students wrote an amount that did not seem to bear any relation to what was requested, others offered a bar graph as an answer, while others wrote some of the percentages that appear in the table, such as student 6, who wrote: "its percentage was 33%, 40%". In this case, the student transcribes the percentages of the intentions to vote for Condorito for the first two months. He/she does not seem to understand what he/she is being asked to do.

In 4b, only the student 11 identified the percentages of the categories, added them up, and indicated the correct answer. Other students indicated the percentages of the categories without adding them up, which is why student 14's answer was qualified as "Partially correct", as he/she wrote 20 and 8, omitting the percentage symbol. Most of the answers in this question were classified as "incorrect", since the students indicated only the percentage of a category or added the absolute frequencies of the categories involved in the item. For example, student 4's response, which indicates "Seven players in total," possibly comes from the sum of the absolute frequencies of players who are 21 and 22 years old. The student does not seem to understand that he/she is being asked for a percentage and does not look up the information in the percentage frequency column.

These results suggest that students in this group have problems extracting information from a table that requires doing some mathematical procedure. However, some of the answers provided could indicate problems with reading comprehension or calculating percentages.

Table III collects the results of the most demanding questions and those with the lowest percentage of correct answers. In 3c, students must estimate the next value in a series from the information provided in the table. No student estimated within the appropriate range (56% to 60%). 27% of the students estimated slightly outside that range, suggesting that the student managed to understand the type of information and identify a trend, but the estimate did not fully correspond to the data. There, student 22 points out that "Condorito would get 61% because in months 7 and 8 [the voting intention] rose 6%. If those six people voted again, they would get 61% of votes". Although the student associates people with percentage points, his reasoning considers the information in the table and estimates the percentage of votes close to that considered pertinent. About 50% of the answers were qualified as "Incorrect", since the value provided does not correspond to the data, indicating a percentage lower than 55% or higher than 65%, which is considered far from the appropriate range. This is the case of student 26, who wrote, "It would be 51% because they gave him that number of votes".

In 3d, the students are expected to give an opinion about the situation based on the data and the context. However, only student 25 gives an opinion, after correctly interpreting the data series, stating that he/she does not consider the actions of the candidate's campaign to be effective "because his votes are decreasing". Of the students, 11.5% gave their opinion, but their arguments, although based on the data, were vague, making them be classified as "Partially correct". Student 22, for example, pointed out that he does not consider the candidate's actions effective, but contradicts himself when he states, "he was doing well". Fifty percent of the answers were considered incorrect since their arguments were not based on the data in the table. For example, student 19 wrote: "Yes, because I think he fairly won the votes". Although this student was asked to make a judgment about the effectiveness of the actions in the campaign of a candidate that the table shows to have decreased in the voting intentions, the student just stated that "the votes were fairly won", which suggests that he does not understand what was being asked.

Question 5 is the one with the lowest performance. 42% gave incorrect answers, and 57.7% chose not to answer. None of the answers provided was based on the information in the table, and, in most cases, they used personal arguments or particular cases. For example, student 9 resorted to the need for personal spaces and privacy to support the non-application of measures by the school.

In Table III, it is noteworthy the percentages of students who decided not to answer levels 3 and 4 questions. There is a difference with the level 1 questions (Table I), where there were no blank answers, while in the level 3 and 4 questions, the number of students who prefer not to answer increased. This suggests that the questions were so demanding that part of the students did not feel confident enough to offer an answer.

TABLE III
FREQUENCY (AND PERCENTAGE) OF THE TYPES OF ANSWERS TO THE ITEMS THAT ASSESS READING LEVELS 3 AND 4 (N3 AND N4)

Answer Type	Item		
	3c N3	3d N4	5 N4
Correct	0 (0)	1 (3.8)	0 (0)
Partially correct	7 (27)	3 (11.5)	0 (0)
Incorrect	12 (46)	13 (50)	11 (42.3)
No answer	7 (27)	9 (34.6)	15 (57.7)

Discussions

The results in Table I show that most of the students successfully completed the level 1 reading activities of statistical tables. However, reading information found in the marginal totals or the body of data showed to be more difficult than reading structural elements, such as the title. This result is similar to that obtained by Díaz-Levicoy *et al.* (2020) and Gabucio *et al.* (2010), who report that students find it easier to do comprehension activities of the tabular structure and direct reading of statistical tables. Teachers, active and in training, present problems in reaching higher levels of comprehension (Díaz-Levicoy *et al*., 2019), so it is possible that when working with statistical tables in classes they concentrate on the lowest level of Curcio's taxonomy.

In the activities of reading level 2, they suggest that the students do not reach this level. Although the correct answers are low in all lower-level questions, they are even lower in those requiring calculations with percentages. Thus, the question remains: Would students achieve better results if they worked with absolute values? The results agree with those of Gabucio *et al.* (2010) but disagree with those of Pallauta *et al.* (2021). The former researchers point out that students have difficulties interpreting and integrating the information in the table. In turn, Pallauta *et al*. (2021) report that the students in their sample did not present difficulties reading within the data.

About levels 3 and 4 of table comprehension, the results of this group of students reveal that they show significant difficulties. In these questions, the percentages of correct answers are the lowest in the entire questionnaire, and the proportion of blank answers is

high, suggesting that the activity can be considered "foreign" to the students. These results are consistent with those of Gabucio *et al*. (2010) and Pallauta *et al*. (2021).

We should highlight that in the last two school years, the groups' classes were remote, due to the Covid-19 pandemic, which means that the class activities during that time may have skipped or neglected some contents foreseen in the prioritized programme (MINEDUC, 2020) or work with higher-order reading levels. Another possible explanation for these results is that teachers tend to emphasize levels 1 and 2 during classroom work, which aligns with the emphasis found in the textbooks, potentially leading to a neglect of levels 3 and 4. (Díaz-Levicoy *et al*., 2020; Pallauta *et al*., 2021).

Conclusions

The evaluation of the reading levels of statistical tables indicates that this group of students only reached their best performance when they extracted explicit information (level 1). The evidence indicates that students find it hard to compare data from a table, produce new information, or argue based on the information shown, which is why we considered that they did not reach reading levels from 2 to 4. This difficulty means they may find it hard to interpret information from the media and social networks depicted in the tables.

At reading level 1, the most relevant errors refer to the identification of data found in the body of the table. In the level 2, the errors are related to the answers they must offer, which could be the product of reading comprehension problems or the operation with percentages. Finally, at reading levels 3 and 4, students do not consider the context or the information in the table when producing new information. In these cases, the answers seem to correspond to Aoyama's (2007) idiosyncratic level.

We found little research on high school students' reading of statistical tables. Thus, we believe that this research adds new knowledge to the subject. Considering the time, the students are supposed to work with the statistical tables, most of them should have produced answers to level 2 questions. However, these 8th-graders' reading level is similar to the 3rd-graders (Díaz-Levicoy *et al*., 2020) since both groups reached their best performance in level 1 activities. Therefore, is believed that it is necessary to focus more on teaching statistical tables in basic education in Chile so that students can develop skills to evaluate the information of this type of representation critically. This action may expand students' statistical culture, allowing them to act with excellence in a society with high levels of statistical information.

The sample characteristics and the local and global circumstances (pandemic) have limited the possibility of generalizing these results, meaning that we assume this type of study should be repeated in other contexts. Likewise, it is crucial to address the construction of tables and their connections with other data representation types in statistics, such as graphs.

REFERENCES

Aoyama K (2007) Investigating a hierarchy of students' interpretations of graphs. *International Electronic Journal of Mathematics Education 2*: 298-318.

Curcio FR (1989) *Developing graph comprehension: elementary and middle school activities*. National Council of Teachers of Mathematics (NCTM). Reston, Virginia, USA.

Díaz-Levicoy D, Jiménez-Díaz R, Salcedo A (2023) Construcción de tablas estadísticas por estudiantes chilenos de Educación Básica. *Interciencia 48*: 160-166.

Díaz-Levicoy D, Guerrero O, Sepúlveda A, Minte A (2019) Comprensión de tablas estadísticas por futuras maestras de Educación Infantil. *Revista Educação 14*: 16-24.

Díaz-Levicoy D, Morales R, Arteaga P, López-Martín MM (2020) Conocimiento sobre tablas estadísticas por estudiantes chilenos de tercer año de Educación Primaria. *Educación Matemática 32*: 247-277. https://doi.org/10.24844/em3202.10

Friel SN, Curcio FR, Bright GW (2001) Making sense of graphs: critical factors influencing comprehension and instructional implications. *Journal for Research in Mathematics Education 32*: 124-158. https://doi.org/10.2307/749671

Gabucio F, Martí E, Enfedaque J, Gilabert S, Konstantinidou A (2010) Niveles de comprensión de las tablas en alumnos de primaria y secundaria. *Cultura y Educación 22*: 183-197. https://doi.org/10.1174/113564010791304528

Gal I (2003) Expanding conceptions of statistical literacy: An analysis of products from statistics agencies. *Statistics Education Research Journal 2*: 3-22.

García-García JI, Díaz-Levicoy D, Vidal S, Arredondo EH (2019) Las tablas estadísticas en libros de texto de educación primaria en México. *Paradigma 40*: 153-175.

Jiménez-Díaz R, Díaz-Levicoy D, Salcedo A (2020) Diseño y validación de un cuestionario para evaluar la comprensión de tablas estadísticas para estudiantes de octavo año de Enseñanza Básica. *Tangram 5*: 110-135.

MINEDUC (2012) *Bases curriculares 2012: Educación Básica*. UCE. Santiago, Chile. 256 pp.

MINEDUC (2019) *Informe resultados educativos para docentes Educación Básica 2019*. Agencia de Calidad de la Educación. Santiago, Chile. 116 pp.

MINEDUC (2020) *Priorización curricular*. UCE. Santiago, Chile. 43 pp.

MINEDUC, IAEEA (2013) *TIMSS. Marco de evaluación, preguntas y ejemplos de respuestas de la prueba*. Agencia de Calidad de la Educación. Santiago, Chile. 270 pp.

Pallauta, JD, Gea MM, Batanero C, Arteaga P (2021) Significado de la tabla estadística en libros de texto españoles de educación secundaria. *Bolema 35*: 1803-1824.

Rodríguez-Alveal F (2017) Alfabetización estadística en profesores de distintos niveles formativos. *Educação & Realidade 42*: 1459-1477.

Shaughnessy JM, Garfield J, Greer B (1996) Data handling. In AJ Bishop, K Clements, C Keitel, J Kilpatrick, C Laborde (Eds.), *International handbook of mathematics education*. Kluwer Academic Publishers. pp. 205-237.