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The Saresp and statistical items for the ninth year of Elementary School

O Saresp e questões de Estatística para o nono ano do Ensino Fundamental

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Abstract

The research aims to verify if questions oriented to the ninth grade of the Elementary School of the São Paulo State School Performance Assessment System - Saresp, address statistical content using problem solving according to the American document "Guidelines for Assessment and Instruction in Statistical Education - GAISE". For the selection of the questions, there was a definite time frame, as they are available online in the pedagogical reports from 2008 to 2018. For the presentation and analysis of the questions: we describe the type of reasoning used; we analyze by problem solving and variability from the GAISE document; and finally, we suggest new questions. The results indicate that despite being expressed in Saresp's annual pedagogical reports that problem solving is used in the elaboration of the questions, they were not elaborated considering the theoretical principles of the GAISE document.

Keywords: Problem Solving, Statistic, Elementary School, Saresp.

Resumo

A pesquisa tem por objetivo verificar se questões orientadas para o nono ano do Ensino Fundamental do Sistema de Avaliação de Rendimento Escolar do Estado de São Paulo – Saresp, abordam conteúdos estatísticos utilizando a resolução de problemas segundo o documento americano "Diretrizes para Avaliação e Instrução em Educação Estatística – GAISE". Para a seleção das questões, houve um recorte temporal definido, pois estão disponibilizadas online nos relatórios pedagógicos de 2008 a 2018. Para a apresentação e análise das questões: descrevemos o tipo do raciocínio utilizado; analisamos segundo a resolução de problemas e a variabilidade partindo do documento GAISE; e finalmente sugerimos novas questões. Os resultados indicam que apesar de ser expresso nos relatórios pedagógicos anuais do Saresp que há a utilização da resolução de problemas na elaboração das questões não foram elaboradas considerando os princípios teóricos do documento GAISE.

Palavras-chave: Resolução de problemas, Estatística, Ensino Fundamental, Saresp.

Introduction

The development of the information society, the rise of technology and the need for all people to interpret and analyze information about certain characteristics or behaviors of populations or phenomena of reality, coming from different media, make statistics today essential knowledge for citizen participation and decision making.

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In addition, we believe it is important the discussion of statistical elements in practice, through reading, understanding of a problem, the search for the application of statistical elements that can meet the problem resolution.

We agree with Herrera (2013) when he explains that problem solving offers students the possibility to reframe their knowledge, giving it meaning.

Thus, in this research we start from the importance of solving problems in the teaching and learning process (Díaz & Poblete, 2001; Díaz-Levicoy & Mayorga, 2014), since it is an activity that includes the nature of the contents that are the focus of the teaching process and learning (Chamorro & Vecino, 2003; Pino & Blanco, 2008), becoming the main reason for their study (Pino & Blanco, 2008).

Regarding statistical studies, Gal (2002) states that they are important tools for the formation of a citizen capable of solving problem situations that are present in their daily lives with better performance.

Garfield and Ben-Zvi (2007) summarize the points of view of educational research on statistical learning, suggesting that their teaching through problem solving is important for improving students' skills, particularly as they interact with real data.

Franklin and Newborn (2006) reported that the American Statistical Association endorsed the reports of the Guidances for Assessment and Instruction in Statistics Education - GAISE (Guidelines for Evaluation and Instruction in the Teaching of Statistics), which advocate the active learning of statistics using real data and a problem solving approach.

Rossman, Medina and Chance (2006) and Groth (2006) consider that use the problem-solving approach in teaching statistics is of great benefit to teachers and students.

In Brazil, Lopes and Carvalho (2009) defend a teaching of statistics through problematization, allowing students to confront themselves with varied problems in the real world and from the proposition of questions, carry out the process of collecting, organizing and representing data, as well as its interpretation and the initiation the ideas of probability.

Lopes (2008) considers it important to think about the ways in which the teaching of Statistics can be inscribed in contemporary pedagogical practices, mobilized by the perspective of problem solving. And the same author, Lopes (2013), considers the discussion of Statistics in practice to be important, through reading, understanding the problem, the search for the application of the Statistics tool that best meets the Problem Resolution as a guiding thread for meaningful learning.

Onuchic and Allevato (2009) consider that the application of statistical content in elementary education should be carried out critically, with a focus on reading and interpreting data, and not just on calculations and algebra and the teaching methodology chosen to achieve these goals is problem solving. The method seeks to generate debates, interaction and discovery by the students, through a posture of encouragement on the part of the teacher that they define as participant observation.

Fini (2018) states that in the process of constructing mathematical logical reasoning, including statistics, problem solving, which runs through all the themes of the National Common Curricular Base - BNCC (MEC, 2017), a Brazilian curriculum proposal published in December 2017 , constitutes the guiding axis of its construction, because when facing the challenge of solving a problem, the student must be able to comprehensively read the

statement of the problem, reflect, establish a plan, execute it, use self-correction mechanisms to prove the solution and communicate the results.

In addition, Lammoglia (2013) says that in the Pedagogical Report on Mathematics - Saresp 2010 (School Performance Assessment System of the State of São Paulo), important aspects are listed to be considered in teaching and learning practice, among them, the most outstanding it is the Problem Solving methodology, with relevance attributed to the approach of problem situations from which mathematical concepts and ideas will emerge, with greater possibilities for the student to learn Mathematics that makes sense. In this way, the stages of the "mathematization" cycle in problem solving are exposed, which involves two worlds, or domains, which are related: the real world present in the problem as it is proposed and the mathematical domain that involves the problem.

For the São Paulo State Secretariat of Education - SEE/SP (SEE, 2009), Saresp is an external evaluation of the performance of elementary and high school students in the state of São Paulo, to subsidize SEE/SP in their decision making regarding public policies aimed at improving education in São Paulo. The purpose of Saresp is to verify the students' academic performance and identify factors involved in it, providing information to the education system, to the technical-pedagogical teams of the Education Directorates and to the schools.

Problem solving and teaching statistics according to the document GAISE

According to Lopes (2011) the guiding document for this research, GAISE (Guidelines for Evaluation and Instruction in Statistical Education) was approved in August 2005 and published in 2007 by the American Statistics Association (ASA). The document indicates the need for the work with data analysis in Basic Education to prioritize the formulation of questions that can be addressed through the collection, organization and presentation of data in a relevant way to answer these questions.

The document GAISE (Franklin et al., 2007) points out five aspects considered essential for the Teaching of Statistics:

(1) Problem solving in statistics is an investigative process that involves four components: the formulation of questions (formulating one or more questions that can be answered with data), the collection of data (developing an appropriate plan for collecting data), data analysis (selecting and using appropriate graphical or numerical methods to analyze the data) and the interpretation of the results (reporting the interpretation according to the initial or provocative question of the problem);

(2) It is necessary to consider the role of variability in the problem solving process, since the formulation of a statistical question requires an understanding of the difference between the question that anticipates the deterministic answer and the question that anticipates an answer based on the variable. Anticipating variability is the basis for understanding different statistical questions which are necessary for formulating a question. Anticipating variability is the basis for understanding and a good formulation of the statistical question;

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(3) In data collection, it is necessary to recognize the variability in the data. Random sampling is designed to reduce differences between sample and population, and the sample size influences the effect of sampling;

(4) In statistical analysis, the objective is to consider the variability of the data;

(5) In interpreting the results, it is necessary to allow variability to look beyond the data. It is necessary to be clear that statistical interpretations are made in the presence of variability.

We also describe according to the document GAISE (Franklin et al., 2007) the nature of the variability, highlighting that there are different sources of variability in the data, that is:

1) Measurement Variability - Repeated measurements from the same individual may vary. Sometimes two measurements vary because the measuring device produces unreliable results, as when trying to measure a long distance with a small ruler. At other times, the results undergo changes in variability in the system being measured;

2) Natural Variability - Variability is inherent in its nature, as individuals are different. For example, when we measure the same aspect in several individuals, we obtain differences in measurements. Although in some cases the differences are due to the measuring instrument, most are simply due to the fact that the individuals differ;

3) Induced variability - When planting a packet of bean seeds in a given field and another block of the same bean seeds in another location with a different climate, a difference in the growth between the seeds in a different location can be observed. This may be due to differences inherent in the seeds (natural variability) or the difference observed may be due to the fact that the locations are not the same;

4) Sample variability - In a survey of voters, it seems reasonable to use the proportion of surveyed voters (sample statistics) as an estimate of the unknown proportion of all voters who support a particular candidate. But if a second sample of the same size is used, it is almost certain that it would not be exactly the same proportion of voters in the sample that will support the candidate. The sample proportion value will vary from sample to sample;

5) Chance variability - When random selection is used, differences between samples will be due to chance. Understanding this variation of chance leads to the predictability of results.

Methodological procedures

The objective of this work was to carry out an analysis of the issues published by Saresp regarding the 9th year of elementary school, external and large-scale evaluations used in the state of São Paulo, and to verify if the questions that address statistical content are

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elaborated using the resolution of problems and which approach is being prioritized in the issues according to the GAISE document.

For the presentation and analysis of each of the questions in the Saresp exams for the ninth year of elementary school, the following script was considered:

1) Description of the type of reasoning used in the question proposed by Saresp

Describe the type of reasoning considered in the construction of the questions of the Saresp tests under analysis and associate them with the reference matrix, which is the signaling of the basic knowledge structures to be built by the different curricular components in each level of education, in this work, statistical content focused on to the ninth year of Elementary School.

2) Analysis of the question proposed by Saresp according to problem solving and the variability proposed by the GAISE document

The justification for the analyzes is based on the document GAISE, Franklin et al. (2007) that justifies the importance of analyzing Saresp issues that present statistical content.

In this way, the document emphasizes the importance of statistical literacy to develop statistical thinking, considering this literacy as understanding the basic language of statistics and its fundamental ideas. And statistical thinking is defined as the type of thinking used when the variation present in the process is recognized, statistical methods and tools are used to quantify and understand the variation, statistical problems are solved.

The authors of the document emphasize that statistical thinking has been characterized by the need for data, the importance of production data, the ubiquity of variability and the quantification and explanation of variability.

It also warns of the importance of using real data in statistics classes, so that the task is authentic and considers the questions related to how and why the data was produced or collected; and to relate the analysis to the context of the problem.

3) Suggestion of a new question based on the question proposed by Saresp

We consider it essential to present suggestions for questions, assuming that the GAISE document considers that Problem Solving in Statistics differs from Problem Solving in Mathematics.

In Franklin et al. (2007) is the focus on data variability that defines the difference between Statistics and Mathematics. There are different sources of variability in the data and it can still be considered that repeated measurements of the same characteristic of the same individual may vary. Therefore, variability is inherent in nature, because people are different.

Analysis of Saresp issues according to the GAISE document

Below we present an analysis of seven Saresp questions from 2008 to 2018 indicated in the pedagogical reports, checking if it was elaborated using the resolution of statistical problems and the variability according to the GAISE document.

The Saresp tests from 2008 to 2018 were not made available, and the questions analyzed were obtained from the Pedagogical Reports for each of the years in which the tests were applied.

Table 1 shows the addresses where the questions in the Pedagogical Reports from 2008 to 2018 were obtained.

Table 1 - Addresses (links) where the issues of Pedagogical Reports from Saresp were obtained from 2008 to 2018.

Pedagogical Report	Address (website)
2008	http://saresp.fde.sp.gov.br/2008/pdf/Relatorios/2_Saresp%202008%20-%20Relat%C3%B3rio%20Pedag%C3%B3gico_Matem%C3%A1tica.pdf
2009	http://saresp.fde.sp.gov.br/2009/ArquivosPdf/Relatorios/2_Saresp%202009%20-%20Relat%C3%B3rio%20Pedag%C3%B3gico_Matem%C3%A1tica.pdf
2010	http://saresp.fde.sp.gov.br/2010/Pdf/Relat/Relat%C3%B3rio_Pedag%C3%B3gico_Matem%C3%A1tica_2010.pdf
2011	http://saresp.fde.sp.gov.br/2011/Pdf/Relat%C3%B3rio_Pedag%C3%B3gico_Matem%C3%A1tica_2011.pdf
2012	http://saresp.fde.sp.gov.br/2012/
2013	http://file.fde.sp.gov.br/saresp/saresp2013/Arquivos/SARESP%202013_Relat%C3%B3rio%20Pedag%C3%B3gico_Matem%C3%A1tica.pdf
2017 e 2018	http://Saresp.vunesp.com.br/resultados9mat.html

Source: SEE.

We emphasize that no issue related to statistical content was published in the years 2014, 2015 and 2016, and in the years 2015 and 2016, questions were addressed to solve problems involving counting processes and the multiplicative principle.

Analysis of the Saresp question according to the GAISE document

Below we present an analysis of seven Saresp questions, checking if they were elaborated using the resolution of statistical problems and the variability according to the document GAISE - Curricular Structure for Elementary and Secondary Education.

According to SEE (2009a), Pedagogical Report Saresp 2008, the question presented in Figure 1 intends to evaluate the following skill: Solve problems involving information presented in tables and / or graphs (H42).

Three friends went to a cafeteria that features the following menu:

They ordered two servings of fries, a hamburger and three soft drinks. The expenses were equally divided, with each one paying, in reais:
(a) R$ 8,20.
(b) R$ 7,00.
(c) R$ 6,30.
(d) R$ 5,00.

Grilled ham and cheese	R$ 1,20
Hamburger	R$ 3,50
Potato chips	R$ 3,50
Orange juice	R$ 2,00
Soda	R$ 1,50

Source: SEE (2009a, p. 98).

Figure 1 - Example of the Saresp 2008 test item for the 9th grade of elementary school.

The question asks for interpretive skills and statistical literacy, since it is necessary to associate information presented in the table. To solve it, the student must calculate the expense of his friends and divide the result by three, indicating the alternative "D".

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It is worth highlighting here what is statistical literacy, according to Wallman (1993), which is the ability to understand and critically evaluate statistical results that are part of everyday life, together with the ability to appreciate the contributions that statistical thinking can make in public decisions and private, professional and personal. Furthermore, for Snee (1990), statistical thinking is defined as mental processes that recognize variation as something that surrounds us and that is always present in everything we do.

Chart 2 presents an analysis of the issue presented in figure 1 regarding problem solving according to the GAISE document focused on the four components of the process, as well as aspects of variability.

Table 2 - Analysis of the issue related to 2008 considering the document GAISE.

Problem Solving according to the GAISE document	Problem Solving and Variability according to the GAISE document
1) In this question, there is no statistical question asked initially since it does not involve the first component "Asking questions". The issue is a mathematical problem, although tabular reading of the cafeteria menu is necessary. The context is partially related to the student's reality; however, the question does not provide meaning for the analysis. 2) The second component "Data collection" is also not involved in the investigative process. The menu was built, probably by the cafeteria manager. 3) The third component "Data analysis" is also not involved in the investigative process, as it is not related to the initial question or to the data collection. 4) The fourth component "Interpretation of results" is also not involved in the investigative process, as it is not related to the initial question, data collection and data analysis.	As this issue is not a statistical problem, the nature of the variability has not been addressed since the problem is mathematical and there is no variation in the data. Data variation could have been addressed if item values were presented for more than one cafeteria and created the possibility of comparison and verification that there are different prices in different cafeterias for the same product. In this way, the measurement variability would be addressed. Note that the focus on data diversity defines Statistics, in addition to Mathematics. Reflecting on the variability of the data, a group survey could be proposed for the students asking for the data collection of a snack and a favorite drink from each student member of the group. Subsequently, the group could collect data from three snack bars in the city about their favorite snack and drink, with the representation of these data and the interpretation of the results would be related to the question of the choice of place that the group could get together to snack, knowing that in the end the bill would be equally prorated by them. Thus, the context gives meaning to the variability of the data.

Source: Prepared by the authors.

Therefore, it is considered that this question was not elaborated using the investigative process of solving statistical problems according to the GAISE document, since to be considered as such, it is necessary that the four components of the process are involved with each other and must be considered possible sources of variability.

We suggest the question presented in Figure 2 that addresses statistical content using Problem Resolution according to GAISE.

Table 3 shows the price of some products sold in four snack bars in a city in the state of São Paulo.

Table 3 - Products sold at four snack bars in a city in the state of São Paulo.

	Mineral Water Bottle 500ml (without gas)	Mineral Water 500ml bottle (gas)	Soda can	Coffee (100ml)	Cheese bread	Simple Salty	Natural Orange Juice (300ml)	Grilled ham and cheese
Snack bar 1	R$ 2,00	R$ 2,50	R$ 3,50	R$ 0,80	R$ 2,00	R$ 2,50	R$ 3,20	R$ 3,00
Snack bar 2	R$ 2,00	R$ 2,50	R$ 3,50	R$ 0,90	R$ 1,50	R$ 2,75	R$ 3,00	R$ 2,75
Snack bar 3	R$ 2,25	R$ 2,60	R$ 3,50	R$ 1,00	R$ 1,80	R$ 3,00	R$ 3,50	R$ 2,75
Snack bar 4	R$ 2,00	R$ 2,20	R$ 3,00	R$ 1,00	R$ 1,00	R$ 2,30	R$ 2,50	R$ 2,75

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Make a research proposal requesting the data collection of a snack and a favorite drink from each student in your class. And also compare the prices of cafeterias around the school where they study, as well as the cafeteria at the school.

Source: Prepared by the authors.

Figure 2 - Suggested question considering the document GAISE (problem solving and variability).

According to SEE (2010), Pedagogical Report Saresp 2009, the Question presented in Figure 3 intends to evaluate the following ability: Associate information, presented in simple lists and / or tables, to the graphics that represent them and vice versa (H43).

A survey collected the opinion of men and women about the preferred mobile operator.
The data are summarized in the table below.

Mobile operator	Men	Women
I	120	150
II	180	50
III	80	110

The graph that best represents the data in the table is:
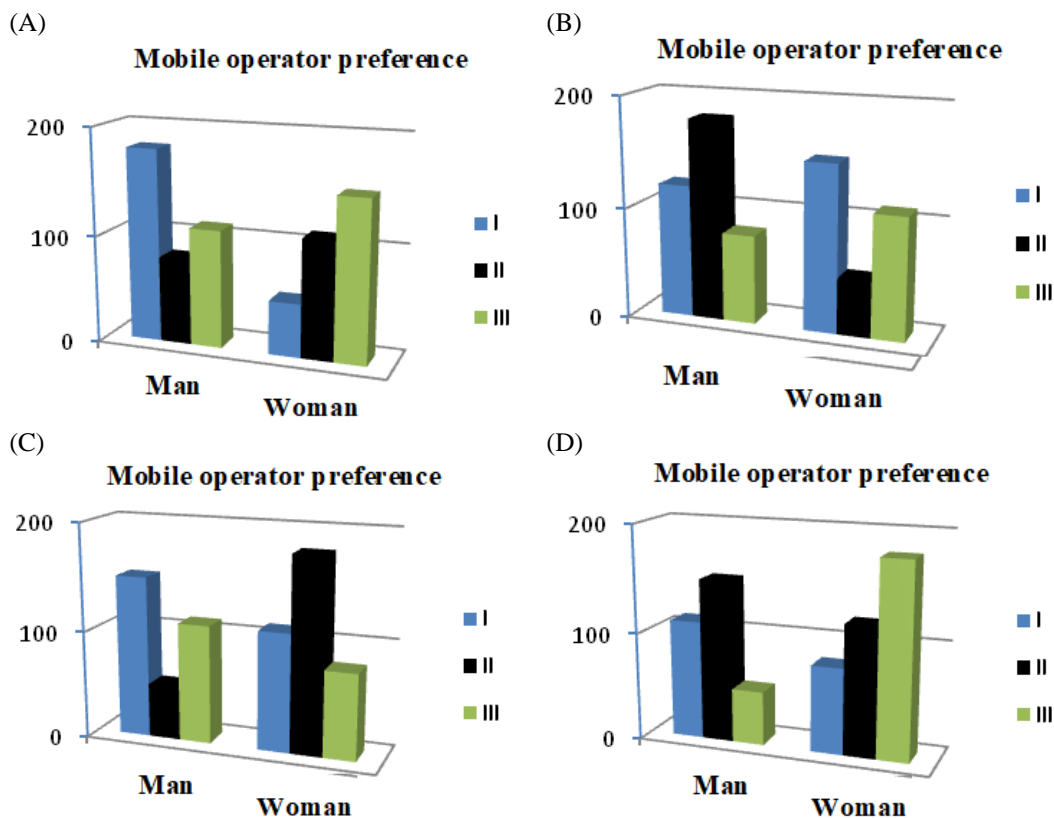
Source: SEE (2010, p. 147).

Figure 3 - Example of the Saresp 2009 test item for the 9th grade of elementary school.

This question calls for interpretative skills and statistical literacy, since it is necessary to associate information presented in the table with the graph that represents it correctly, indicating the alternative "B".

Table 4 presents an analysis of the issue presented in figure 3 regarding problem solving according to the GAISE document focused on the four components of the process, as well as aspects of variability.

Table 4 - Analysis of the issue related to 2009 considering the document GAISE.

Problem Solving according to the GAISE document	Problem Solving and Variability according to the GAISE document
1) The question initially asked for this question could be, for example, "Which cell phone operator is preferred by men and women?". This question would involve the first component "Asking questions". It is observed that the data collected were made by other people and are partially contextualized to the fact close to the students' reality. 2) The second component of the process involves the "Data collection" which is related to the initial question, however, the data collected were not part of the student's investigative process, as it is necessary to develop and execute a plan for the data collect. 3) Through the tabular representation of the data, it appears that the third component "Data analysis" is involved in the question and linked to the question initially formulated, but the collection was not carried out by the student distancing from the context of his reality. It is noted that the resolution of this question is involved in the third component, as the proposed question asks the student to point out the alternative in which the graph represents the data in the table. 4) The fourth component refers to the "Interpretation of the results" that relates the interpretation of the analysis, with the collection and interpretation of the initial question, however the fourth component was not considered in this question.	In this question, a survey research about the mobile operator preferred by men and women, but the nature of the variability was not considered according to the GAISE document. In this case, natural variability could be addressed, since the research is of an opinion, the nature of men and women being inherent, since individuals are different and there is a difference between the opinions of men and women. The question initially asked "Which cell phone operator is preferred by men and women?" it is a statistical question and the search for the answer is based on data collection that can vary, considering several factors that can interfere in the opinion being the gender, social class, economic conditions, experience with other devices, experience with other operators, among others. The presence of variability must be considered when interpreting statistical results. The question could be challenging for the student if the research was carried out by them within their context of reality, such as in the classroom, at school, at home, in the neighborhood, among others. The proposal would be the one presented in this question, that is, an opinion poll on the preferred cellular telephony considering the natural variability in the investigative process.

Source: Prepared by the authors.

We suggest the question presented in Figure 4 that addresses statistical content using Problem Resolution according to GAISE.

There are 6 groups of cell phone operators in Brazil. Table 1 below shows these data, as well as the number of cell phones purchased, and the market share controlled by each one:

Table 1 - Cell phone operator, number of handsets sold and participation in the Brazilian market in June 2012.

Operator	Cell Phones (Thousands)	Market Share
Vivo	75.720	29,57%
TIM	68.874	26,89%
Claro	62.966	24,58%
Oi	47.772	18,65%
CTBC	725	0,28%
Sercomtel	74	0,03%

Source: National Telecommunications Agency (Anatel) - June 2012.

Conduct a survey where you can determine which operator male and female students in your school use and

compare with results by gender (sex).

Source: Prepared by the authors.

Figure 4 - Suggested question considering the document GAISE (problem solving and variability).

According to SEE (2011), Pedagogical Report Saresp 2010, the Open Question presented in Figure 5 intends to evaluate the following skill: Solve problems involving information presented in tables and / or graphs (H42).

A food pyramid indicates the daily portions to be eaten for each type of food. If each portion of food at the bottom of the pyramid corresponds to 150 kcal for an adult, determine the daily calorie intake (minimum and maximum) from that type of food, recommended for an adult.
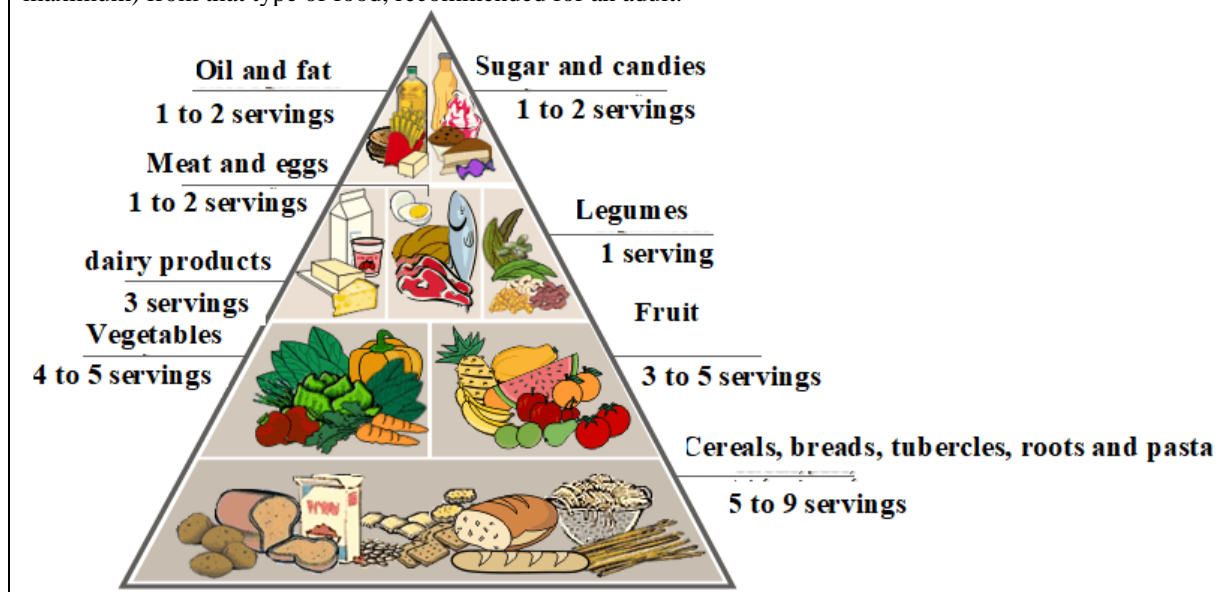
Source: SEE (2011, p. 98).

Figure 5 - Example of an open question from the Saresp 2010 exam for the 9th grade of elementary school.

This question calls for interpretive skills and statistical literacy, since it is necessary to associate information presented in the food pyramid. To resolve this issue, it is necessary to interpret the Food Pyramid, determining the daily calorie intake, which should be a minimum of 5 and a maximum of 9 of the foods at the base of the Food Pyramid, where cereals, breads, tubers, roots and pastas. In the statement, it was given that each serving corresponds to 150 kcal, therefore, the minimum daily dose from these foods is 5 x 150 kcal = 750 Kcal and the maximum daily dose is 9 x 150 kcal = 1350 kcal.

Table 5 presents an analysis of the issue presented in figure 5 regarding problem solving according to the GAISE document focused on the four components of the process, as well as aspects of variability.

Table 5 - Analysis of the issue for the year 2010 considering the document GAISE.

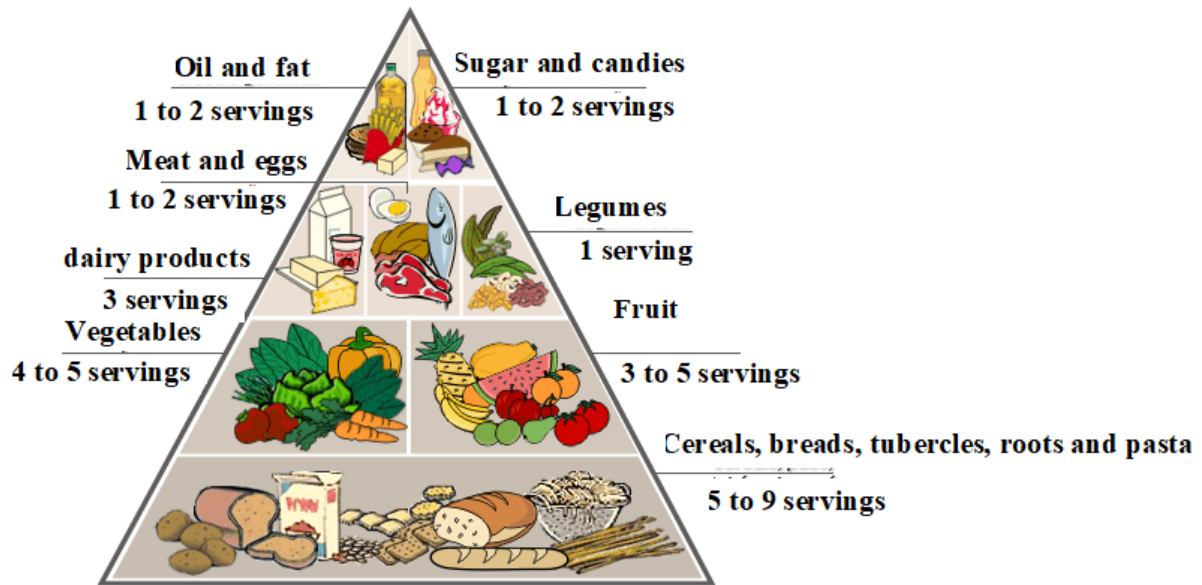| Problem Solving according to the GAISE document	Problem Solving and Variability according to the GAISE document
1) The initial question for this question could be, for example, "What are the daily portions that should be eaten for each type of food that make up the Food Pyramid?". This question asked would involve the first component of the investigative process "Asking questions". It is observed that the context is partially related to the student's reality, since the data collected refer to daily portions of foods recommended for an adult. 2) It is noticed that there was "Data collection" involving the second component of the resolution, however the collection was not carried out by the students, which indicates a limitation regarding this component. The question could be contextualized with the student's reality if daily portions of food were recommended for their age group. 3) The third component "Data analysis" is being considered in the question, as the Food Pyramid with daily portions of each type of food was presented. It is noted that this component is linked to the initial question and data collection, but the student is not involved in the context of his reality. 4) The fourth component "Interpretation of results" is related to the question asked, the data collected and the data analysis. From the interpretation of the results, it is possible to determine the daily doses (minimum and maximum) from the foods at the base of the food pyramid.	In this question, the nature of the natural variability of foods was approached, because based on information related to each food, they were grouped and organized in the food pyramid, so that the analysis and interpretation of the results take into account the variation of the portions recommended daily for an adult. The question initially asked "What are the daily portions that should be eaten for each type of food that make up the Food Pyramid?" is a statistical question and the search for the answer is based on data collection that can vary, considering several factors that can interfere in opinion, such as gender, social class, economic conditions, daily portions of food were recommended for their age group, among others. The presence of variability must be considered when interpreting statistical results. It would be interesting for the student to complement this activity adapting to their reality, that is, researching the daily doses of each type of food recommended for their age group and comparing with the data of this food pyramid.

Source: Prepared by the authors.

Therefore, the problem allows the formulation of statistical questions that can be answered with data, and with elaboration and execution for the collection, the data are represented in the Food Pyramid involving data analysis and the interpretation of results is related to all components previous ones.

We have at least two situations to consider in this matter, first that the data was not collected by the students and the other consideration is related to the student's reality context. However, to date, this issue is the one that most closely resembles a problem developed using problem solving, according to the GAISE document. This same document states that it is preferable for students to collect data, but it is not necessary in all cases.
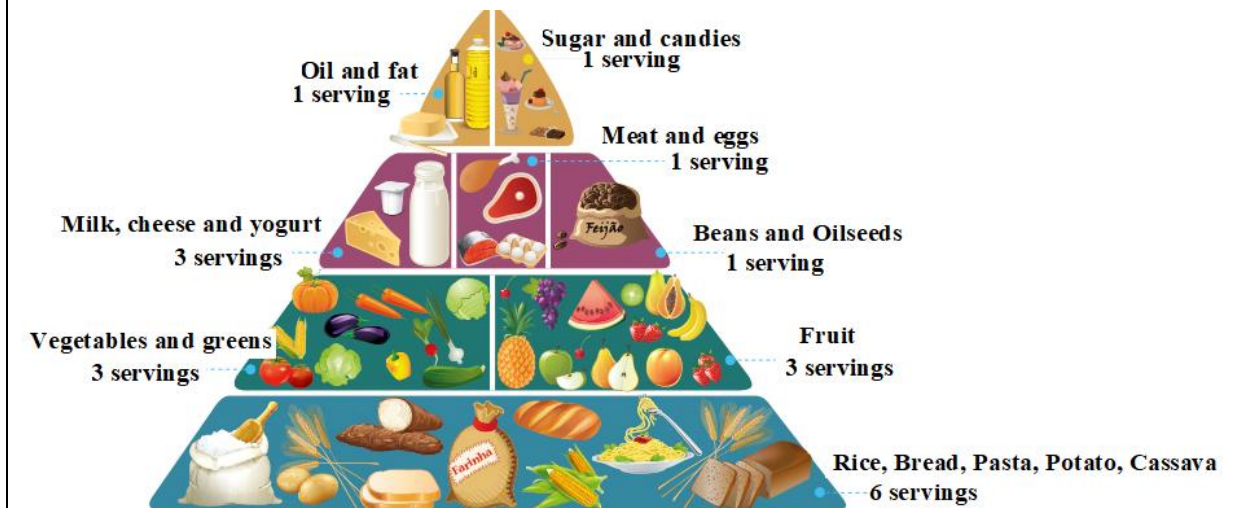
We suggest the question presented in Figure 6 that addresses statistical content using Problem Resolution according to GAISE.

Brazilian habits can be identified as responsible for the reformulation of the food pyramid. According to data from the Family Budget Survey, from the Brazilian Institute of Geography and Statistics (IBGE), they showed an "epidemic" of overweight, since between 2006 and 2010, the number of men with more than the recommended weight increased from 18 , 5% to 50.1% and among women, in the same period the proportion went from 28.7% to 48%.

Source: Ministry of Health.

Figure 41 - Ancient Food Pyramid.

Source: Prepared by the authors.

Figure 6 - Suggested question considering the GAISE document (problem solving and variability).

According to SEE (2012), Pedagogical Report Saresp 2011, the Question presented in Figure 7 intends to evaluate the following skill: Solve problems involving information presented in tables and /or graphs (H42).

Observe in the graph the result of a survey carried out by the teacher of the school "Saber é Bom" with her students.

If each child chose only one favorite activity, how many were interviewed in this survey?

(A) 30
(B) 75
(C) 80
(D) 90
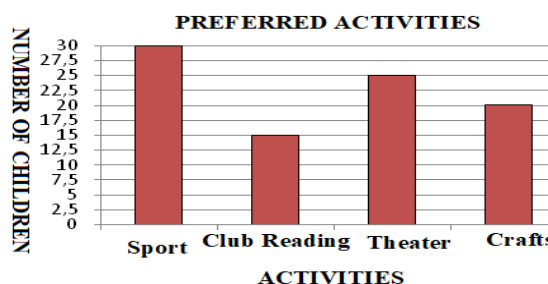
Source: SEE (2012, p. 142).

Figure 7 - Example 2 of the Saresp 2011 test item for the 9th grade of elementary school.

This question calls for interpretive skills and statistical literacy, since it is necessary to associate information presented in the graph. To solve this question, the student must be able to read, understand and interpret the statement, taking into account that each child has chosen only one preferred activity. Looking at the column graph under analysis, it can be said that the data are 30, 15, 25 and 20, height of the rectangles, and represent the number of students interviewed for each activity. Therefore, just add 30 + 15 + 25 + 20 = 90, indicating the alternative "D".

Table 6 presents an analysis of the issue presented in figure 7 regarding problem solving according to the GAISE document focused on the four components of the process, as well as aspects of variability.

Table 6 - Analysis of the item for the year 2011 considering the document GAISE.

Problem Solving according to the GAISE document	Problem Solving and Variability according to the GAISE document
1) The question initially asked could be, for example, "What is your favorite activity outside of school?". The question is related to the first component of the investigative process of problem solving "Asking questions". However, the research was carried out by the school teacher, that is, the students were interviewed for the research.	In the question, the nature of natural variability was addressed, since the students surveyed have different preferences in relation to activities that can be performed outside the classroom, such as: playing sports; join a reading club; go to the theater; or build craft materials; among others.
2) The "Data collection" referred to in the second component was carried out by the teacher and the interviewed students provided the data for the development of the research. Data collection is contextualized with the student's reality, despite the fact that he is the interviewee.	The question initially asked, "What is your favorite activity outside of school?" is a statistical question that indicates an answer based on data that may vary. There are several factors that could be considered in the question,
3) The third component "Data analysis" is linked to the initial question, data collection and refers to the representation of this data in the column chart. It is observed	among them the fact that the categories of activities were created by the teacher, chosen by the students, or were only considered the four

that the number of children entitled on the vertical axis of the graph should be represented only by whole numbers, since the variable in question is discrete quantitative and must be represented by whole numbers. 4) The fourth component "Interpretation of results" is related to the initial question, data collection and analysis, however, only in this component the student is involved in the investigative process to resolve the issue despite asking the total number of participants in the research that in our view does not take advantage of the potential of the issue.	most voted activities in the classroom, for example. It is noted that it is not possible to state how the question was presented to the interviewed student. This question could become challenging for the student if the research were carried out collectively in the classroom. Observing the factors that interfere in the investigative process of problem solving, and consequently, in the interpretations of the results.

Source: Prepared by the authors.

Therefore, it is considered that this question was not elaborated using problem solving according to GAISE, as only, and partially, in the fourth component, students were involved in the investigative process. According to GAISE, Statistical Education should be seen as a development process, leading the student to reflect on aspects of data collection, analysis, and the question in the interpretation of results.

We suggest the question presented in Figure 8 that addresses statistical content using Solving Problem according to GAISE.

Consider Table 2, which presents the results obtained in a research that aimed to identify the type of leisure activity preferred by students in a class in the ninth grade of elementary school.

Table 2 - Distribution of types of leisure activities outside the classroom.

Leisure	Number of students
Play sports	16
Watch television	7
Go to the cinema	6
Electronic games	4

Design a survey that can be conducted in the classroom to identify the sports preferred by boys and girls in your class.

Source: Prepared by the authors.

Figure 8 - Suggested question considering the document GAISE (problem solving and variability).

According to SEE (2013), Pedagogical Report Saresp 2012, the Question presented in Figure 9 intends to evaluate the following skill: Solve problems involving information presented in tables and / or graphs (H42).

The following table shows the summary of four opinion polls before the elections.

RESEARCH	RESULT
1	Of every 1,200 voters, 600 will vote for candidate A.
2	55% of voters will vote for A.
3	1 in 2 voters will vote for A.
4	2 out of 10 voters will vote for A.

The most favorable result for candidate A was the result of:
(A) research 1.
(B) research 2.
(C) research 3.
(D) all surveys show the same result.

Source: SEE (2013, p. 132).

Figure 9 - Example 3 of the Saresp 2012 test item for the 9th grade of elementary school.

This question calls for interpretive skills and statistical literacy, since it is necessary to analyze the data in the table and establish the probability of each statement. Thus, to solve the student must compare the statements made to choose the largest one. The correct alternative is the letter "B".

Table 7 presents an analysis of the issue presented in figure 9 regarding problem solving according to the GAISE document focused on the four components of the process, as well as aspects of variability.

Table 7 - Analysis of item 3 for the year 2012 considering the document GAISE.

Problem Solving according to the GAISE document	**Problem Solving and Variability according to the GAISE document**
1) The question asked could be, for example, "Which candidate will you vote for?" involving the first component of the "Asking Questions" process. It is observed that this question is statistical due to the presence of data variability. The context is not related to the student's reality and the initial question was not elaborated by him. 2) The second component "Data collection" is involved in solving the problem and linked to the initial question, however the data collection was not performed by the student, that is, the data was collected by other people. 3) The "Data analysis" that involves the third component is linked to the initial question and the collection. It is observed that the data collected are represented in the table and that the four surveys carried out show results only for candidate A. This fact is out of context with our reality, as candidates generally have at least one competitor and the surveys appear comparatively between they. 4) The fourth component "Interpretation of results" is linked to the question asked, data collection and analysis of results. However, only in the fourth component does the student become involved in the problem solving investigative process.	In this question, the nature of the variability that could be, for example, sampling, was not addressed, since the survey was conducted with voters. It is noted that some factors were not considered in these surveys, which makes us reflect on the interpretations of these results, for example, the only answer options for this survey are yes or no. Could it be that all respondents answered only yes or no in relation to the vote for candidate A. And the candidates who did not know, or did not have an opinion? Note that the statistical issues and the variation of data interfere in the search result. The research question could be: "Which candidate will you vote for?" This same question would be interesting to be worked on in the classroom with students, to reflect on how this research may have been conducted. If the fact of not presenting another candidate in the research has any meaning for the dissemination of the research to society. If we do not consider the other possibilities for answers is the research reliable?

Source: Prepared by the authors.

It is concluded that this question was not elaborated using the problem solving according to the document GAISE, as it does not meet the investigative process of the four components. It is also noted the lack of contextualization in the statement of the issue, where it could be expressed, for example, some information about the elections, how data collections were carried out, if there were other political competitors, among others.

We suggest the question presented in Figure 10 that addresses statistical content using Problem Resolution according to GAISE.

In a certain municipal election, the following results were obtained in an electoral survey of 700 voters, Table 3:

Table 3 - Electoral survey with 700 voters.

Candidate	Number of votes in the research (n = 700)	Percentage of intention to vote

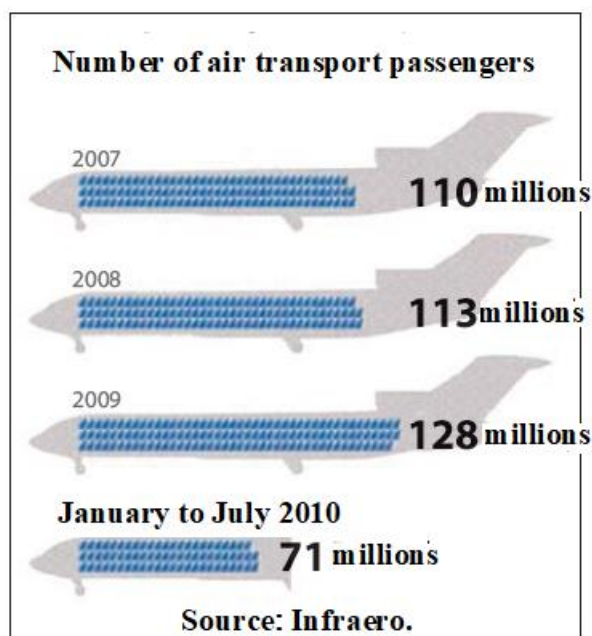| A	26%	182
B	24%	168
C	22%	154
Null or white	28%	196

Considering that in October 2016 elections will be held for mayor and councilors in your municipality and knowing that the municipality in question has three candidates, A, B and C, running for mayor, what do you suggest to determine the evolution of the intention to voters' votes and to approach the results obtained in the counting of votes in October?

Source: Prepared by the authors.

Figure 10 - Suggested question considering the document GAISE (problem solving and variability).

According to SEE (2014), Pedagogical Report Saresp 2013, the Question presented in Figure 11 intends to evaluate the following ability: Associate information, presented in simple lists and / or tables, to the graphics that represent them and vice versa (H43).

With the promotions that many airlines have made, it is becoming easier to travel by plane. Observe the increase in the number of passengers in recent years in the graph below.

Number of air transport passengers

2007 — **110** millions

2008 — **113** millions

2009 — **128** millions

January to July 2010 — **71** millions

Source: Infraero.

The table that best represents this graph is:

(A)

Year	Months	Number of Passengers (in millions)
2007	january to december	71
2008	january to december	128
2009	january to december	113
2010	january to juy	110

(B)

Year	Months	Number of Passengers (in millions)
2007	january to december	113
2008	january to december	110
2009	january to december	71
2010	january to juy	128

(C) Year	Months	Number of Passengers (in millions)	(D) Year	Months	Number of Passengers (in millions)
2007	january to december	110	2007	january to december	110
2008	january to december	113	2008	january to december	113
2009	january to december	71	2009	january to december	128
2010	january to juy	128	2010	january to juy	71

Source: SEE (2014, p. 113).

Figure 11 - Example of the Saresp 2013 test item for the 9th grade of elementary school.

This question calls for interpretive skills and statistical literacy, to translate data from the graph to the table that represents it. To resolve this issue the student must relate the number of passengers to their respective year. The correct alternative is the letter "D".

Table 8 presents an analysis of the issue presented in figure 11 regarding problem solving according to the GAISE document focused on the four components of the process, as well as aspects of variability.

Table 8 - Analysis of the item for the year 2013 considering the GAISE document.

Problem Solving according to the GAISE document	Problem Solving and Variability according to the GAISE document
1) The question initially asked could be, for example, "What is the annual number of air transport passengers from 2007 to July 2010?". This question involves the first "Asking questions" component of the problem solving investigative process. However, the question was not elaborated by the students and the context is not related to their reality. 2) The second component "Data collection" is linked to the initial question, however, the data was not collected by the students, that is, they were not involved in this investigative process. In the statement of this question, it could contain information about how this data was collected. 3) "Data analysis" involves the third component, since the collected data are represented in the pictorial graph using a bar graph as a basis. The third component is linked to the initial question and data collection. However, it is only in this component that the student participates in the investigative process in which he has to associate the data displayed in the graph with the table that represents them. 4) The fourth component "Interpretation of results" is not considered in this question, as the student solves it in the third component.	In this question, the nature of the variability addressed could be the measurement variability, but the way the question is elaborated, there is no evidence of variability. What could have been considered is that when there are promotions, an increase in the number of passengers is perceived, which may be related to the proximity of national holidays, for example. The formulation of the statistical question "What is the annual number of air transport passengers from 2007 to July 2010?" Indicates an answer based on data that varies, considering several factors that can interfere, such as economic crisis, promotional travel, affordable price, airport location, among others; whereas interpretations must be made in the light of variability. In this matter, it would be interesting to propose a collective research for students about which activities are preferred by students outside school and in the end make inferences about the research carried out.

Source: Prepared by the authors.

Therefore, it is considered that this question was not elaborated using the resolution of statistical problems according to the GAISE document, since the students were not involved in the investigative process of the components, in addition to the question being out of context with its reality.

We suggest the question presented in Figure 12 that addresses statistical content using Problem Resolution according to GAISE.

Table 4 shows the flights departing from three capitals in the Southeast region and the capital of the country, as well as the percentage of variation (ratio between extra flights and scheduled flights):

Table 4 - Number of flights departing from three capitals in the Southeast region and the capital of the country, as well as the percentage of variation.

Main city	Regular Flights	Extra Flights	Total Flights	% Change
São Paulo	20,261	6,401	26,662	31.6%
Rio de Janeiro	5,977	2,678	8,656	44.8%
Belo Horizonte	6,931	789	7,721	11.4%
Brasília	3,392	2,175	5,567	64.1%

Considering that students from a state school are going on a trip to participate in a sports competition, prepare a survey that can indicate the best way to make this trip, considering ticket prices and the possible routes.

Source: Prepared by the authors.

Figure 12 - Suggested question considering the document GAISE (problem solving and variability).

According to SEE (2018), Pedagogical Report Saresp 2018, the Question presented in Figure 13 intends to evaluate the following ability: Associate information, presented in simple lists and / or tables, to the graphics that represent them and vice versa (H43).

The graph (Revista da Folha de São Paulo - 07.2011) shows the lowest temperatures recorded each year in São Paulo, from July 2000 to June 2011, and the dates on which they were noted.
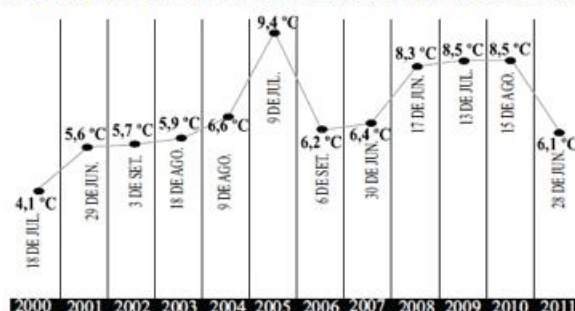
Source: Inmet - National Institute of Meteorology.

According to the information in the graph, it is correct to state that:
(A) the lowest temperatures recorded each year show continuous growth from 2000 to 2007.
(B) the lowest temperatures recorded each year show a continuous decrease from 2005 to 2008.
(C) the lowest temperatures recorded were not the same in any year of that period.
(D) the greatest variation, in °C, in relation to the temperature recorded in the previous year, occurred in 2006.

Source: http://saresp.vunesp.com.br/resultados9mat.html.

Figure 13 - Example of the Saresp 2017 and 2018 exam item for the 9th grade of elementary school.

The item is associated with skill H42, described as "Solving problems involving information presented in tables and / or graphs". The problem requires reading and analyzing the data present in a line graph to identify the correct statement, among four indicated. In this case, the graph shown depicts the evolution of the lowest temperatures recorded in São Paulo, from 2000 to 2011. The correct answer is the letter (D).

Table 9 presents an analysis of the issue presented in figure 13 regarding problem solving according to the GAISE document focused on the four components of the process, as well as aspects of variability.

Table 9 - Analysis of the item for the years 2017 and 2018 considering the document GAISE.

| Problem Solving according to the GAISE document	Problem Solving and Variability according to the GAISE document
1) The question initially asked could be, for example, "What were the minimum temperatures in São Paulo from July 2000 to July 2001?". This question involves the first "Asking questions" component of the problem solving investigative process. We consider that the question was not made clear in the statement, despite indicating that data collection was performed. 2) The second component "Data collection" is linked to an initial problem, however, the data was not collected by the students, that is, they were not involved in these investigative processes, but was based on data obtained in a major newspaper published in the state of São Paulo. In the statement of this question, it could contain information about how this data was collected. 3) "Data analysis" involves the third component, since the collected data are represented in a line graph. The third component is linked to an initial question and that generated, possibly a data collection, there is the participation of the student, because the data were taken from a newspaper, therefore, the student does not participate in the investigated process in which he has to associate the data arranged on the graph. 4) The fourth component "Interpretation of results" is considered in this question, as statements are made that should take the student and read and interpret the data indicated in the graph.	In this question, the nature of variability is addressed, as the temperature variation recorded in the period from 2000 to 2011 is studied. The temperature variation recorded in the statement period was equal to 3.2°C, and a visual analysis of the behavior suggests that the variation in this period is one of the most significant. Case analysis numerically along with the other visually attractive variations being: 2000-2001; 2000-2001; 2004-2005; 2007-2008; 2010-2011; with the detail that the 2004-2005 and 2007-2008 variations are close to 2005-2006, which may mean that the respondent does not have the need to use numerical calculations to conclude which is the biggest variation.

Source: Prepared by the authors.

Therefore, it is considered that this question was elaborated using partially the resolution of statistical problems according to the GAISE document, since the students were not involved in the investigative process of the components. However, we observed that it provokes the thought of data variability, which we saw little in the other questions analyzed in this work.

We suggest the question presented in Figure 14 that addresses statistical content using Problem Resolution according to GAISE.

In a classroom, a teacher asked students to conduct a survey on the lowest temperatures recorded in São Paulo from July 2000 to June 2011, asking the following research question: What were the minimum temperatures in São Paulo during the period July 2000 to June 2011? One of the students conducting the research found in the Revista da Folha de São Paulo for the month of July 2011 the following graph that represented the temperature trend in that period.

LOWEST TEMPERATURES REGISTERED IN SAO PAULO LAST DECADE
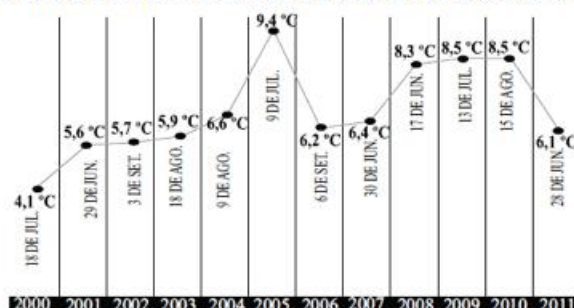
Source: Inmet - National Institute of Meteorology.

According to the information in the graph, it is correct to state that:
(A) the lowest temperatures recorded each year show continuous growth from 2000 to 2007.
(B) the lowest temperatures recorded each year show a continuous decrease from 2005 to 2008.
(C) the lowest temperatures recorded were not the same in any year of that period.
(D) the greatest variation, in °C, in relation to the temperature recorded in the previous year, occurred in 2006.

Source: Prepared by the authors.

Figure 14 - Suggested question considering the GAISE document (problem solving and variability).

Final considerations

We consider that the questions analyzed in the Saresp tests that address statistical content were elaborated using part of the problem solving according to the document GAISE (Franklin et al., 2007) when stating that Statistical Education should be seen as a development process, taking the student to reflect on aspects of data collection, analysis and

also the question in the interpretation of results.

This statement is supported by the analyzes carried out in which there is no concern with formulating a question that guides an investigation process and that compromises the collection of data or information from this question, in addition to not indicating that it is performed by students and does not address a context close to reality of this student or even worse, not presenting a context that supports later representations, graphs, tabular or statistical measures such as the mean and the median, and that finally compromises interpretations linked to the initial question.

Below we present some aspects that we consider most important and which support our statement that the Saresp issues are partially adequate to the GAISE document that presents the resolution of problems linked to an investigative process and to the aspects of variability.

It is worth mentioning that we propose the grouping of questions in order to avoid repetition of discussions or conclusions. Another factor considered for grouping the questions is the converging characteristics from the analyzes carried out on each of the Saresp questions.

Assim, por exemplo, questões que envolvem informações apresentadas em tabelas e/ou gráficos estão relacionadas às questões apresentadas nas Figuras 7 (Saresp 2011) e 9 Saresp 2012). Consideramos que não são questões elaboradas utilizando a resolução de problemas estatísticos, segundo o GAISE. Nessas questões a componente referente à "Interpretação dos Dados ou Resultados" destaca-se por ser a única componente em que o aluno se envolve no processo investigativo, mesmo que não esteja relacionado à sua realidade.

We also emphasize the lack of context in the Saresp issues. This statement is supported by the analyzes carried out in which the data collection was not performed by the students and the context of the questions is far from their reality. The questions indicate the student to get involved in some part of an investigative process, according to the questions presented in Figures 3 (Saresp 2009) and 11 (Saresp 2013). When the student is involved in the "Data Analysis" component, they are directly asked to resolve the issue, but there is no indication for data interpretation. The question simply proposes the association of information presented in lists and / or simple tables with graphs that represent them and vice versa, according to the Saresp descriptors. According to GAISE, Statistical Education should be seen as a development process, leading the student to reflect on aspects of data collection, analysis and the question in the interpretation of results.

The question presented in Figure 1 (Saresp 2008), which addresses the purchase and payment of a snack, is a mathematical problem with a deterministic question and not a statistical question that proposes participation in an investigation process, let alone make the student think that variability is present in this process. It is considered that it was not elaborated using the investigative process of solving statistical problems according to the GAISE document, since to be considered as such, it is necessary that the four components of the process are involved and still considered possible sources of variability.

ZETETIKÉ

The question addressed in Figure 5 (Saresp 2010) is a problem that allows the formulation of a statistical question, as it can be answered through the data. Therefore, it is the question that most closely matches the model presented in the GAISE document, together with the question shown in figure 13 (Saresp 2017 and 2018). However, we have two situations to consider in this matter: (1) The data were not collected by the students; (2) Regarding the context or proximity to the student's reality, the analyzed food pyramid could be targeted to his age group.

In the question (figure 5) the natural variability of the foods was approached, because based on information related to each food they were grouped and organized in the food pyramid, so that the analysis and interpretation of the results take into account the variation of the recommended portions daily for an adult.

Specifically with regard to variability, it was approached in a timid manner in the Saresp questions and was not an easily observable reality. Question 13 (Saresp 2017 and 2018) was the only one that we consider to meet the assumptions of the analysis of variability according to the GAISE document.

The elaboration of the questions was challenging, as an in-depth study of all the approaches expressed in the GAISE document is needed. First, it is important to be clear about the difference between a question that anticipates a deterministic answer and a question that anticipates an answer based on varying data. The question elaborated came from the reflection of the questions analyzed in the Saresp tests that could be improved to be in line with GAISE's problem solving proposal and its approaches to context, variability, the student involved in the investigative process.

The importance of elaborating these questions can also serve as support for teachers to work in the classroom with their students considering adaptation factors, context, proposals, among others.

In this way, the GAISE document suggests the conceptual development in Statistics from the problem solving process, taking into account the progress in the levels of development (problem formulation; data collection; data analysis; and data interpretation), through awareness of the ideas and concepts involved in an exploratory data investigation. Such development is closely related to understanding the nature of the variability present in the process (natural; measuring; sampling; and induced). With the understanding of statistical and variability principles, we believe in what is presented in the GAISE document, that is, making it possible to develop a critical posture in the face of information that involves uncertainty.

References

Chamorro, M. & Vecino, F. (2003). El tratamiento y la resolución de problemas. En Chamorro, M. (Ed.), Didáctica de las Matemáticas para Primaria (pp. 273-299). Madrid: Pearson Educación.

Díaz, V. & Poblete, A. (2001). Contextualizando tipos de problemas matemáticos en el aula. *Números:* Revista de Didáctica de las Matemáticas, 45, 33-41.

Díaz-Levicoy, D. & Mayorga, A. (2014). La resolución de problemas como herramienta para la integración de contenidos matemáticos. *Revista Investigaciones em Educación*, 14(1), 25-42.

Fini, M. E. (2018). *Leitura crítica*: matemática na proposta da BNCC. Disponível em: http://basenacionalcomum.mec.gov.br/images/relatorios-analiticos/Parecer_7_MA_Maria_Eliza_Fini.pdf

Franklin, C. A. & Newborn, D. S. (2006). The Statistical Education of Grades Pre-k-12 Teachers. A shared responsibility. *Thinking and Reasoning with Data and Chance,* 68th yearbook of the National Council of Teachers of Mathematics.

Franklin, C. A., Kader, G., Mewborn, D., Moreno, J., Peck, R., Perry, M. & Schaeffer, R. (2007). Guidelines for assessment and instruction in statistics education (GAISE) Report: A Pre-K-12 Curriculum Framework. Alexandria, VA. Disponível em: https://www.amstat.org/education/gaise/GAISEPreK-12.htm

Gal, I. (2002). Adult ́s statistical literacy: Meaning, components, responsibilities. *International Statistical Review*, 70(1), 1-25.

Garfield, J. & Ben-Zvi, D. (2007). How Students Learn Statistics Revisited: A Current Review of Research on Teaching and Learning Statistics, *International Statistical Review*, 75(3), 372-396.

Groth, R. E. (2006). Engaging Students in Authentic Data Analysis. In G. F. Burril, & P. C. Elliott (Eds.). *National Council of Teachers of Mathematics Yearbook*.

Herrera, A. (2013). Ambientes de aprendizajes para favorecer el desarrollo del pensamiento y lenguaje matemático: la aventura de pensar en clase de matemática. Revista Ibero-Americana de Estudos Em Educação, 8(4), 1019-1029.

Lammoglia, B. (2013). O Saresp: visão da matemática escolar por atores da rede estadual de ensino. *Anais do 11 Encontro Nacional de Educação Matemática*. Curitiba (PR): Pontifícia Universidade Católica do Paraná. Retirado em 15 de março, 2020, de: http://sbem.iuri0094.hospedagemdesites.ws/anais/XIENEM/pdf/1940_1382_ID.pdf

Lopes, C. A. E. (2008). O ensino da Estatística e da probabilidade na Educação Básica e a formação dos professores. *Caderno Cedes*, 28(7), 57-73.

Lopes, C. A. E. (2011). A Estocástica no Currículo de Matemática e a Resolução de Problemas. *Anais do 2 Seminário de Resolução de Problema - SERP*. Rio Claro (SP): UNESP.

Lopes, C. A. E. (2013). Educação Estatística no curso de licenciatura em Matemática. *Bolema*, 27(47), 901-915.

Lopes, C. A. E. & Carvalho, C. (2009). Literacia Estatística na Educação Básica. In A. Nacarato, & C. A. E Lopes. *Escritas e Leituras na Educação Matemática* (pp. 77-92). Belo Horizonte: Autêntica.

Ministério da Educação (MEC). (2017). *Base Nacional Comum Curricular:* Educação é a base. Ministério da Educação, Brasília, dez. 2017. Disponível em: http://basenacionalcomuma.mec.gov.br/images/BNCC_20dez_site.pdf

Onuchic, L. R. & Allevato, N. S. G. (2005). Novas reflexões sobre o ensino-aprendizagem de matemática através da resolução de problemas. In M. A. V. Bicudo, & M. C. Borba, M. C. (Orgs.), *Educação Matemática - pesquisa em movimento* (pp. 213-231). São Paulo: Cortez.

Pino, J. & Blanco, L. (2008). Análisis de los problemas de los libros de texto de Matemáticas para alumnos de 12 a 14 años de España y de Chile en relación con los contenidos de proporcionalidad. *Publicaciones*, 38, 63-88.

Rossman, A., Medina, E. & Chance, B. (2006). A Post-Calculus Introduction to Statistics for Future Secondary Teachers. *Proceedings of 7 International Conference on Teaching Statistics (ICOTS).* International Statistical Institute, Voorburg, The Netherlands. Retirado em 15 de março, 2020, de: https://iase-web.org/documents/papers/icots7/2E2_ROSS.pdf

Secretaria da Educação do Estado de São Paulo (SEE). (2009). *Matrizes de referência para a avaliação Saresp*: documento básico/Secretaria da Educação. v. 1. coordenação geral, Maria Inês Fini. – São Paulo: SEE.

Secretaria da Educação do Estado de São Paulo (SEE). (2009a). *Relatório Pedagógico:* Saresp 2008. Coordenação geral: Maria Inês Fini. São Paulo: SEE.

Secretaria da Educação do Estado de São Paulo (SEE). (2010). *Relatório Pedagógico:* Saresp 2009. Coordenação geral: Maria Inês Fini. São Paulo: SEE.

Secretaria da Educação do Estado de São Paulo (SEE). (2011). *Relatório Pedagógico:* Saresp 2010. Execução: Fundação Vunesp. São Paulo: SEE.

Secretaria da Educação do Estado de São Paulo (SEE). (2012). *Relatório Pedagógico:* Saresp 2011. Execução: Fundação Vunesp. São Paulo: SEE.

Secretaria da Educação do Estado de São Paulo (SEE). (2013). *Relatório Pedagógico:* Saresp 2012. Execução: Fundação Vunesp. São Paulo: SEE.

Secretaria da Educação do Estado de São Paulo (SEE). (2014). *Relatório Pedagógico:* Saresp 2013. Execução: Fundação Vunesp. São Paulo: SEE.

Secretaria da Educação do Estado de São Paulo (SEE). (2018). *Relatório Pedagógico:* Saresp 2018. Execução: Fundação Vunesp. São Paulo: SEE.

Snee, R. (1990). Statistical Thinking and its Contribution to Quality. *The American Statistician*, 44(2), 116-121.

Wallman, K. K. (1993). Enhancing statistical literacy: Enriching our society. *Journal of the American Statistical Association*, 88, 1-8.