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Using Eurostat data to teach statistics to prospective primary teachers: on how the context of the task may promote their social awareness

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Abstract
The concept of statistical sense provides an understanding of the goals of statistics education and helps to clarify the design of activities that promote the development of statistical literacy, reasoning and thinking. The new approaches to statistics in schools mean special attention must be paid to teacher training. This training should enable them to develop their statistical sense while awakening their social awareness. Drawing on the idea of the cycle of learning from data, we developed an activity based on data extracted from EUROSTAT, with the goal being to find out how the social issues underlying the data might play a role in the development of a socially critical stance among prospective teachers. We also wanted to find out how the complexity of the data presented might interfere with a satisfactory resolution of the cycle of learning from data. In general, we observed that when the data were socially relevant and closely related to their interests, the activity generated opportunities for the development of their social awareness. However, the development of the cycle may have been constrained by the difficulties they encountered when handling data with characteristics typical of civic statistics. We conclude that not all the contexts that accompany the cycle of learning from data promote social awareness in the same way and that the data representations associated with the cycle must be aligned with the prospective teachers' prior statistical knowledge.

Keywords Prospective teachers' education · Statistics education · Statistical sense · Civic statistics · Social awareness

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Introduction

Given the challenges facing statistics education in the modern world, the American Statistical Association (ASA) published the Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report—GAISE I—in which Franklin et al. (2007) present guidelines for the teaching of statistics in schools. By way of an offshoot to that publication, the ASA issued the Statistical Education of Teachers document (Franklin et al., 2015), which contains guidelines for teacher education. Then, in an update to the document (GAISE II), Bargagliotti et al. (2020) incorporated the need to develop skills that enable students to ask themselves questions, work with non-traditional data and different types of variables, develop multivariate and probabilistic thinking, make use of technology, and clearly communicate statistical information. We would expect the education of prospective teachers who will go on to teach statistics to also include the updates presented in GAISE II.

For our part, we consider that the education of primary school teachers should evolve by following, and even anticipating, the primary education syllabus and should place special emphasis on the role of context in statistics. Nowadays, all too often, as Zapata-Cardona (2018) points out, statistics teaching is usually fragmented and focused on the teaching of procedures, thereby being disconnected from the context in which knowledge is generated. However, statistical tasks are often characterized by the fact that they require simultaneous reasoning about the data and the context in order to draw qualified conclusions that allow for both the data and the context (delMas, 2004). Lesser (2007) argues that teaching statistics with social justice should provide opportunities for students to reflect on a particular context while learning about statistical concepts and procedures. Therefore, we think that an appropriate selection of the contexts of prospective teachers' statistical training tasks could foster their ability to recognize injustice and inequality, while providing them with examples to work on with their future students in favour of justice and social equity.

Taking into account the reflections of various authors (Sousa et al., 2020; Ubilla & Gorgorió, 2022; Weiland, 2019; Zapata-Cardona, 2018), we also think it necessary that prospective teachers should not only "learn" to consume data, i.e. read and interpret statistical information in context, but also be data producers (Weiland, 2019), i.e. they should formulate their own questions and then answer them through statistical research. Furthermore, the data they handle should be of different types and be presented in various ways, in order for them to make progress in learning statistics. In some of our previous studies (Ubilla et al., 2021; Ubilla & Gorgorió, 2021a), prospective teachers were asked to develop a statistical investigative cycle (Wild & Pfannkuch, 1999). In those studies, we observed that the prospective teachers, being data producers, had opportunities to ask research questions and design their data collection instruments (Ubilla& Gorgorió, 2021b). However, the topics they suggested and addressed did not provide evidence of the use of statistics from a social perspective within the prospective teachers' context. Nor did the prospective teachers have the opportunity to deal with data representations different to the conventional ones they had already encountered during their schooling.

Ridway (2022) presents a conceptual framework and proposals for teaching and learning statistics by addressing socially relevant topics. However, given what we found in our review of the literature, there is clearly still not much research focused on the analysis of how prospective teachers carry out activities with data possessing characteristics typical of civic statistics. This prompted us to design a new activity based on the statistical research cycle (Wild & Pfannkuch, 1999) and the cycle of learning from data (IDSSP, 2019), in which we gave prospective teachers data packages from EUROSTAT that dealt with

different social issues and presented different levels of complexity. The idea was that prospective primary teachers should be initiated into the role of consumers of data delivered through different representations, as well as being asked to formulate their own questions and answer them. We were interested in seeing how the various social issues underlying the data packages fostered the development of their social awareness, understood as well-informed concern and interest in a particular issue or situation shown by people because they belong to a community. We also wanted to find out how the complexity of the data representations might condition their approach to the cycle of learning from data.

Theoretical position

Goals of statistics education

From the outset, the goal of statistics education is to educate people to be statistically literate and capable of reasoning and thinking statistically, i.e. to develop their statistical sense. To this end, different referential frameworks have been proposed that encompass the constituent elements of statistical literacy, reasoning and thinking.

Gal (2002) establishes that a statistically literate citizen is capable of interpreting and critically evaluating the statistical information present in the media, and of communicating his or her opinion about this information. Garfield and Ben-Zvi (2008, p. 34) state that "Statistical literacy involves understanding and using the basic language and tools of statistics: knowing what basic statistical terms mean, understanding the use of simple statistical symbols, and recognizing and being able to interpret different representations of data". A statistically literate person will be able to understand the significance of the arithmetic mean and know how to calculate it and interpret its value in a given context.

On the other hand, statistical reasoning is the way of reasoning that people use to make sense of statistical information (Garfield & Ben-Zvi, 2008). Making sense of statistical concepts and information involves, for example, relating the arithmetic mean of a data set to the standard deviation, or understanding why the value of the arithmetic mean is less or greater than the median if the dataset presents extreme values (Garfield, 2002). Finally, Wild & Pfannkuch (1999) define statistical thinking as the way statisticians think. Statistical thinking involves knowing how and why to use a certain statistical procedure, as well as being able to recognise the limitations of statistics (Garfield & Ben-Zvi, 2008). One of the dimensions that describes statistical thinking is the statistical investigative cycle (Wild & Pfannkuch, 1999), with its five phases: establishing a research question, generating a plan to answer this question, collecting and organizing data, analysing the data collected, and obtaining conclusions that provide an answer to the problem, as well as generating new questions.

In line with Garfield et al. (2010), we consider that these three skills—literacy, reasoning and thinking—interact and that there exists a gradation (see Fig. 1). Thus, statistical literacy would be on a first level, statistical reasoning on a second level, and statistical thinking on a higher level. We consider that to develop statistical thinking, for example, it is necessary to understand basic statistical concepts and procedures (literacy) and having the ability to link up and relate the different concepts and procedures (reasoning). In Fig. 1, we also present the referential frameworks of statistical literacy, reasoning and thinking, focusing on constituent elements of each skill, with context being a relevant aspect in all three cases.

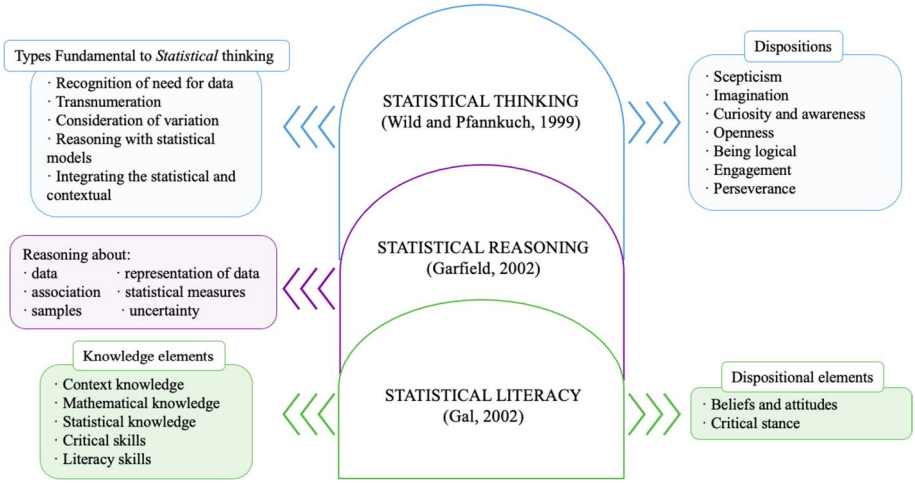


Fig. 1 Components of statistical literacy, reasoning and thinking. Figure created by the authors

Given these frameworks, one might expect the goal of statistics education to be the development of students' statistical sense, considered as an amalgam of statistical literacy, reasoning, and thinking (Ubilla, 2019). However, this is not the only goal of statistics education. Ograjenšek and Gal (2016) state that there are three challenges facing statistics education: (a) *purpose*—getting students to understand why data are important, who uses it and how, and how data can help to understand the world; (b) *motivation*—getting them interested in statistical concepts and procedures; and (c) *skill transfer*—getting them to use the skills they develop in statistics classes outside them.

Therefore, a second goal of statistics teaching, as important as the first, is to train up critical citizens, interested in and capable of using statistical concepts and procedures to understand and act critically in the world around them.

The role of context in statistics education

The idea of statistical sense makes it possible to understand the goals of statistics education since it clarifies which components we should consider when designing activities. However, from a critical perspective, we understand statistics teaching as a process that should lead students not only to develop their statistical sense, but also to use that statistical sense to become more aware of social inequalities, question and criticize social injustice. Cobb and Moore (1997, p. 801) state that "data are not just numbers; they are numbers with a context". Context therefore plays a crucial role in the design of statistical activities aimed at developing critical citizenship.

Watson and Callingham (2003) introduced the notion of statistical literacy as a hierarchical construct with six levels of interaction between students and the task. At the lowest level, which they denominate idiosyncratic, the students interact individually with the context of the task. At the highest level, which they denominate critical mathematics, the students have a critical relationship with the context. This hierarchy emerges out of the increasing complexity of statistical concepts and procedures. On the other hand, Weiland (2016) proposes three levels of interaction between the development of a task and its context. At a basic level, the context can be easily exchanged for another, without affecting

the development of the task, while at a higher level the task requires students to reason and think statistically in order to learn more about its context. Therefore, the context is no longer a mere addition to the problem to be solved but rather a central feature that has to be understood, and about which decisions have to be made, bringing statistical sense into play. Solving problems about real contexts can contribute to the development of statistical reasoning and thinking (Zapata-Cardona & Marrugo, 2019). On the one hand, reasoning statistically implies being able to explain a statistical process and interpret statistical results in context. On the other, statistical thinking requires an understanding of the big ideas of statistics and the development of statistical research in context.

There are several approaches to statistics teaching that place special emphasis on the role of the context providing the data, with all of them considering the preparation of critical citizens the goal of statistical education. Lesser (2007) argues that statistics should be recognized as the "grammar of social justice" because the "tools to identify statistical group differences or patterns can help people recognize, analyse or address social inequalities." (Paragraph 4). This author proposes the idea of teaching statistics with social justice as the practice of teaching statistics using non-trivial examples of social justice, offering students the opportunity to reflect on these contexts while learning or applying statistical concepts and procedures in accordance with the context.

Weiland (2019) proposes a discussion around critical statistics education and how its ideas can transform the experience of teaching and learning statistics. This author links up Paulo Freire's notion of literacy with the definition of statistical literacy set out by Gal (2002) and the statistical research process proposed by Franklin et al. (2007) and Wild and Pfannkuch (1999). Problematizing the ideas of being data consumers or data producers, Weiland (2017) presents the idea of critical statistical literacy. He affirms, on the one hand, that this perspective encompasses the need to interpret the world through statistics, not only as consumers of information but also using statistics as a lens that lets us see world in a new way. And on the other hand, he argues that critical statistical literacy also contemplates the need to record the world through statistics, not only by producing and analysing data, but also by using statistics to alter the context under study. Continuing on the same lines, Weiland and Sundrani (2022) designed the Critical Statistical Literacy Developmental Framework (CSL-DK), which is based on Weiland's framework (2017) for critical statistical literacy and the hierarchical framework for statistical literacy developed by Watson and Callingham (2003). Thus, the CSL-DK presents a reformulation of the levels of statistical literacy in terms of the characterization of the practices related to critical statistical literacy.

From a practical standpoint, Zapata-Cardona (2018) reflects on the teaching of statistics from a critical perspective. This author suggests that statistical research should serve as a central axis in statistics teaching, since it is an "investigative process that takes place when students explore and understand social dilemmas and try to react critically to them" (p. 32). Her proposal aims to educate for critical citizenship and understands students as social subjects, seeking to awaken in them a sense of responsibility for social phenomena. The author considers that, while tasks are often designed to follow a research process, they remain focused on learning statistical concepts rather than using statistical reasoning or thinking, and that rarely does this type of research aim at the development of critical citizenship.

The ProCivicStat project (2018) proposed a new discipline along these lines called civic statistics, aimed at promoting work in educational contexts on statistics dealing with social phenomena. The materials used in civic statistics (Engel et al., 2021) are characterized by the fact of addressing multivariate phenomena (correlated, nonlinear), using various formats for data representation, presenting a social context as a central axis, and working with

aggregated data characterized by the presentation of indexes or ratios instead of raw variables. Furthermore, civic statistics seeks to promote civic statistical literacy among students so that they are capable of making evidence-based decisions in political and social contexts (Weber-Stein & Engel, 2022).

Therefore, in this study, we were interested in finding out to what extent and in what way the different social themes underlying the data packages involved in an activity could help prospective teachers use their statistical sense to question the world around them in a well-informed way. We also wanted to find out how the different formats used to represent the data could influence the way the prospective teachers approached their cycle of learning from data.

Study goals

We had previously worked on primary teacher education with activities based on the statistical research cycle (Ubilla et al., 2021; Ubilla & Gorgorió, 2021a). At that time, we observed that the fact of being data producers generated, among others, the need to design the data collection instruments. However, the issues chosen by the study participants had little social relevance, being limited, for example, to aspects related to leisure or academic matters, and their conclusions were essentially descriptive listings of results (Ubilla et al., 2021).

In view of these studies, we realized that it is not enough for prospective teachers to be data producers; rather it is crucial that they are also data consumers. This prompted us to modify certain aspects of the activity we were implementing in initial teacher education, moving from an activity designed according to the research cycle (Wild & Pfannkuch, 1999) to an activity based on the cycle of learning from data (IDPSS, 2019). Initially, when the prospective teachers worked with the research cycle, they had to construct their research question and their data collection instruments, acting as data producers. In this new activity, we wanted them to start with existing data and, through the cycle of learning from data, to take on the role of data consumers.

Taking into account the actions associated with tasks that assess statistical literacy, reasoning and thinking (Garfield et al., 2010), we designed the activity using second-order data, i.e. data that comes from a source external to the prospective teachers. We began by assuming that an activity based on the cycle of learning from data would foster the development of statistical sense (Ubilla, 2019). With the emphasis on a critical social view, we were mainly interested in understanding how different social issues underlying the data might play a role in the development of a social conscience among prospective teachers.

Therefore, we decided that the data provided to prospective teachers for the development of the cycle of learning from data should place them in the position of consumers of data dealing with socially relevant issues. We aimed to identify to what extent and in what ways an activity based on the cycle of learning from data with representations of real data that addressed socially relevant issues could promote social awareness among prospective teachers.

Thus, the first question guiding our research was as follows: *How may data collections linked to social issues that are taken as a starting point in a cycle of learning from data trigger the development of prospective teachers' social awareness?* We also asked ourselves a second question because real data can be presented in different formats: *What role*

does the complexity of the representation of the activity data play in the way prospective teachers develop their cycle of learning from data?

Therefore, we set ourselves the goals of characterizing three distinct aspects of their cycle of learning from data, in terms of social awareness and how to handle the complexity of the data, namely:

1. the justification of their choice of research topic,
2. the research questions they ask once the topic has been chosen, and
3. the conclusions they reach when answering their research question.

An understanding of the rationale behind their choices, their questions and their conclusions could provide evidence of the possibilities and limitations influencing the development of social awareness during an activity in which they acted as consumers of data related to relevant social issues.

Methodology

This study draws on an interpretative paradigm with a qualitative approach, since the goal was to find out how the design of an activity can promote a certain way of understanding the world through statistics. (Cohen et al., 2007).

Selection of data packages and data collection instrument

The participants were provided with a set of real second-order data in the form of tables, graphs and infographics dealing with various social issues. The data came from a study entitled "The Lives of Women and Men in Europe" developed by the Spanish National Institute of Statistics (INE) and from the European Statistical Office (Eurostat), whose goal was to compare men and women in aspects of everyday life. The graphs and infographics were obtained from the INE online publication of the study (https://www.ine.es/prodyser/myhue17/index.html), while the data tables were downloaded and adapted for students from the Eurostat website. The data were grouped into four packages entitled *education and work* (E&W), *habits and health* (H&H), w*ork and family* (W&F) and *life satisfaction* (LS). The following scheme (Fig. 2) displays the characteristics of the representations of the data provided. When a table is referenced, the columns in the representation correspond to the columns in the tables issued to prospective teachers. All the tables have a first column that is not included in Fig. 2, which lists the EU countries that the information in the other columns referred to.

With regard to the complexity of the representation of the data provided, as shown in Fig. 2, the tables covering the E&W and H&H issues display aggregated data and so the interpretation of the relative frequency percentages requires an understanding of how the values of different variables interact. On the other hand, the tables concerned with the W&F theme display the information in a rate format, which means that, in order to interpret them correctly, it is necessary to understand the meaning of each value according to how the rate was calculated. Finally, the LS theme only features two representations, which include indices concerning concepts that are common knowledge, such as life expectancy and retirement age.

SOCIAL ISSUE	INFORMATION PRESENT IN THE REPRESENTATION			
Information for all social issues	*General table*			
	Population by gender (men / women).	GDP per capita in PPS.	Region in Europe.	
Education and work	*Table 1 - E&W*			
	Population aged 25 to 64 by highest level of studies completed and gender (%).	Active unemployed population according to age range (15-24 years and 25-75 years) and gender.		
	Table 2 - E&W			
	Population according to age range (15-24 years and 25-75 years) and gender.	Active population in thousands according to age range (15-24 years and 25-75 years) and gender.		
	Graph 1 - E&W			
	Double bar graph: Vertical axis: Age at start of first job; Horizontal axis: EU countries; Bars according to gender.			
	Graph 2 - E&W			
	Stacked bar graph: Distribution of percentage of men and women in management positions for each EU country.			
	Infographic - E&W			
	Gender pay gap: Shows the difference in average gross hourly wage between female and male employees (as a percentage of the average male wage).			
Habits and health	*Table 1 - H&H*			
	Habits (smoking / drinking alcohol) according to age range (18-44 years / 45-64 years / over 65 years) and gender.	Life expectancy by gender.		
	Table 2 - H&H			
	Cause of death per 100,000 inhabitants (cancer / heart disease / cardiovascular disease) according to age range (< 65 years / > 65 years) and gender.			
	Graphs 1, 2 and 3 - H&H			
	Double bar graphs: Percentage of people who consider their health good or very good (for ages 16-44 / 45-64 / over 65). Vertical axis: relative frequency percentage; Horizontal axis: EU countries.			
Work and family	*Table 1 - W&F*			
	Employment rate (%) by gender.	Population between 15 and 64 years old by gender.		
	Table 2 - W&F			
	Employment rate according to number of children and gender (%).	Part-time workers among total number of employed persons (%) by gender.		
	Graph 1 - W&F			
	Percentage of adults aged 25-49 who care for and/or educate their children on a daily basis, by gender (for each EU country).			
	Graph 2 - W&F			
	Percentage of adults over the age of 18 who cook and/or do housework every day, by gender (for each EU country).			
Life satisfaction	*Table 1 - LS*			
	Life expectancy in 2015 by gender.	Retirement age in 2012 by gender.	Life satisfaction on a scale of 0 to 10 by gender.	Percentage of people who consider their health good or very good according to age range (16-44 years / 45-64 years / over 65 years) and gender.
	Infographics 1, 2, 3 and 4 - LS			
	Life trajectories in the EU (1), Spain (2), Lithuania (3) and Sweden (4) by gender with ages shown for: start of compulsory education, start of first job, age at leaving the family home, age at birth of first child, age at first marriage, age at retirement and life expectancy.			

Fig. 2 Characterization of the data representations used in the activity

We chose these four data packages because we were looking for a high level of interaction between task development and its context, in line with Weiland (2016). Furthermore, according to Zapata-Cardona and Marrugo (2019), the incorporation of issues such as the wage gap and domestic work may greatly help with the development of social awareness. With these data packages, we set up an activity with the structure of the cycle of learning from data (IDSSP, 2019). Drawing on the data provided, the prospective teachers had to write a news report, the result of a research process aimed at answering a question they had formulated. Figure 3 contains the complete description of the activity. Those interested in the design, implementation and development of the activity can find the details in Ubilla and Gorgorió 2021b.

Following a preliminary analysis of the answers to the tasks, in this paper we present the study of the answers to Tasks 3, 4 and 9. We focused on how prospective teachers justify their choice of research topic (Task 3) because their interest may indicate a critical approach to the use of the data provided. We were interested in the type of questions they asked (Task 4) because the purpose of their questions could reveal an attitude in keeping with social awareness. Finally, we were interested in their conclusions (task 9) and, in particular, how they answered the questions that they themselves had posed.

Participants and data collection

A total of 137 first-year prospective teachers, with women in the majority (78%), pursuing a primary education degree at the Universitat Autònoma de Barcelona participated in this activity. The participants' prior knowledge of statistics depended on their previous education—secondary school, vocational training cycles or another university degree. However, the information presented in Table 1 shows that the common base was undoubtedly the

ACTIVITY: FROM A DATABASE TO A BRIEF NEWS REPORT

1. Approach
   Discuss the data in the table and the graphics you have been provided with. What do they refer to? What do they suggest to you?
2. Identification of variables
   What variables can you identify in the table and graphs? What are the values of the variables? What kind of variables are they? Why?
3. Topic
   Establish four topics that you can work on with the data provided. Choose one to work on during practice and justify your choice.
4. Questions
   From the chosen topic, make a list of questions that can be answered with the data. Choose one (or more than one) that goes beyond a direct reading of the data. Justify your choice.
5. Plan
   How will you approach the process to answer the question asked? Make a list of the steps you are going to follow, detailing the necessary actions in each step.
6. Data
   Indicate the variables you will use to answer your question and how they will help answer it. If you need a new variable, introduce it, define it and indicate what values it has.
7. Analysis
   Explain your calculations and why you did them. Draw the necessary graphics and explain why you chose this type of representation.
8. Results
   Write out the partial results of the various steps you took until you found the answer to the question you asked.
9. Conclusions
   Interpret the results obtained and write out the conclusions of your research, thus answering the question asked.
10. Reflection
    Reflect on the development of the process. Identify strengths and weaknesses and suggestions for improvement.
11. News
    In the seminar you have to present a news report linked to your practice work. The news report must include a headline, subtitle, basic ideas box, photographs, and accompanying graphics.

Fig. 3 Data collection instrument

statistics they had studied during compulsory education (up to 16 years old). According to the Catalan government decree 143/2007, the official statistics syllabus at the time of the participants' compulsory education comprised the following: the design of statistical studies; sampling; randomness in experiments; discrete and continuous variables; databases, absolute and relative, ordinary and cumulative frequencies; graphs: bar diagrams, line diagrams, pie charts, histograms, box plots and point clouds; classes and intervals, histograms and frequency polygons; point clouds and regression lines; measures of centralization, dispersion and position.

The data collection activity was carried out in the "Mathematics for Teachers" classes in six sessions lasting 90 min. During their training to be teachers, this subject is the first to focus on mathematics and deal with the development of their specialized mathematical knowledge, while the other subjects related to mathematics work on mathematical knowledge for teaching. "Mathematics for teachers" tackles statistics, arithmetic, proportionality, measurement, and geometry. One of the authors of this article teaches this subject, while the other author participated as an observer during the activity. Both authors had previously worked on the design and implementation of statistics activities within the context of the initial training of primary school teachers.

Table 1 Distribution of prospective teachers according to previous studies*

Previous education	Specialty	Absolute frequency
Non-compulsory secondary Total = 123	Humanities	41
	Social	57
	Scientific	33
	Technological	4
	Arts	4
Vocational training cycle Total = 20	Sports	6
	Pre-school teaching assistant	7
	Administration and finance	4
	Others	3
Others		6

*In Spain, for admission to a primary teaching degree students must have completed compulsory education (up to 16)—during which all of them will have received a minimum of 1050 h of formal preparation in mathematics. From this point on, they access the primary teaching degree by taking one of two paths that are different from the standpoint of their mathematical education: (a) either the science and technology track or the social sciences track of the Bachillerato (the two years of non-compulsory, pre-university secondary education), during which students complete a mathematics course each year—amounting to a minimum of 280 h—or (b) the humanities or arts tracks of the baccalaureate, or any vocational training cycle related to education, none of which include courses in mathematics. Therefore, only some of the students admitted to primary education degree programmes will have studied mathematics beyond compulsory education

The information corresponds to 127 of the 137 prospective teachers. Some of them stated that they had completed both secondary education and a training cycle. Furthermore, in the case of secondary education, some prospective teachers had studied two specialties

In the first session, their previous training was reviewed to identify the basic ideas needed to develop the activity, and the teacher worked together with the prospective teachers on the table that appeared in all the data packages, identifying variables, and classifying them according to their type. They discussed what information could be obtained from reading the table and worked on statistical graphs, on how to construct and read them. During Sessions 2, 3 and 4, the prospective teachers met up in groups of three to four, which they themselves organized. The activity data packages were randomly assigned, while ensuring that the distribution of the topics was balanced. During Sessions 5 and 6, group discussions were held, and each group presented the news generated by the activity. Our research data correspond to the part related to Tasks 3, 4 and 9 in the reports written by the 34 groups of prospective teachers during the activity. By way of a complementary data source, we used the notes taken by the researchers during and after the sessions.

Analysis

We developed a mixed type of analysis for the interpretation of the data. It was qualitative as regards the coding of the data and construction and application of the categories in order to characterize the data. And quantitative in the search for relationships between the topics underlying the data and the characterization developed in the qualitative part.

To characterize the groups' answers to Tasks 3, 4 and 9, we carried out a content analysis (Cohen et al., 2007) based on the texts provided by the prospective teachers. Thus, we used an inductive/deductive analysis to focus on how the prospective teachers justified their choice of research topic, the questions they posed and their conclusions. First of all, we reduced the texts to units of meaning and organized them on the basis of emerging themes (inductive analysis) and pre-existing categories (deductive analysis). As units of meaning—units of analysis—we took those sentences, sentence segments or chains of sentences that, having meaning in themselves, could be related to the set goals (Cohen et al., 2007).

The inductive analysis began with the identification of units of meaning from the standpoint of social awareness in order to create our own categories. In a data-driven coding process (Gibbs, 2007), we assigned one or more codes to each of the units of meaning. In the inductive analysis, the expansion and revision of the codes enabled us to generate categories that we continued to refine until we had established a series of categories that included all the units of meaning. In a concept-driven coding process (Gibbs, 2007), the goal of the deductive analysis was to relate our data to existing theoretical frames of reference, with the codes drawn from the theory of statistical sense.

Below we show, for each of the tasks that we analysed—justification of the chosen topics, questions formulated, and conclusions reached—, the different categories used in the analysis. For those created through an inductive process, we include the name assigned to the category and its definition. For the categories derived from theory, we indicate the theoretical framework they refer to. In both cases, we exemplify the categories on the basis of units of meaning derived from the prospective teachers' answers. For each of the tasks analysed, after presenting the categories, we describe what the corresponding quantitative analysis consisted of.

In the given examples, we mark the categories that emerged from the inductive analysis in brackets [] and the pre-existing categories in braces {}. We refer to the units of meaning with the letter G and the number of the group from which they came, followed by the acronym of the social issue they addressed. Thus, for example, G3_W&F would correspond to a unit of meaning from Group 3 that worked on the social issue of Work and Family.

How did they justify their choice of research topic?

We began with an inductive analysis of the responses to Task 3 (Fig. 3) provided by the nine groups assigned the E&W data, detecting patterns in these groups' intentions when choosing their research topic. We were interested in characterizing the groups' interest since it could indicate a more or less critical stance towards the use of the data provided. We then moved on to the groups that worked with the other data packages. We identified a total of 15 units of meaning for the data package of the E&W social issue; 20 for H&H; 15 for W&F; and 14 for LS.

Based on these units of meaning and depending on the *interest* described in the justification of the research topic, we created 5 categories:

- *Social criticism*—they wanted to give visibility to the social issue and use their results to show that the situation was socially relevant.
- *Social interest*—they considered the issue socially relevant.
- *Professional*—they considered the issue relevant as future teachers.
- *Statistical*—they were interested in the variables, graphs and data used to develop some statistical procedure.

Table 2 Examples of topics and characterization of justifications

Topic chosen	Justification
G1_E&W: *Gender discrimination in the workplace*	*This is a very important topic for today's society* [social interest] {context knowledge}. *As future teachers we think it is crucial to educate students from a gender perspective* [professional interest] *and build a fairer society* [social criticism]
G4_H&H: *Tobacco and alcohol consumption among men and women and mortality*	*This is the topic where we were able to establish more relationships between variables* [statistical interest] *and we found it interesting* [nonspecific interest] {curiosity}
G1_W&F: *Men's and women's occupations and childcare and/or domestic work*	*We were surprised by these data. We knew there were differences between the two genders in terms of care* {context knowledge} *but the difference observed as compared to the data* {literacy skills} {statistical knowledge} *from the rest of the world surprised us* {scepticism} *and we think it would be a good issue to work on* [social interest] *and, furthermore, to explain to other people because we also found it important to raise awareness* [social criticism] {beliefs revision}
G7_LS: *Life satisfaction and the factors involved*	*This is a topic that encompasses many different variables* [statistical interest] *and that can provide very interesting results* [unspecific interest] {curiosity}

- *Unspecific*—they did not explain why they thought the topic they chose was interesting.

A deductive analysis was then carried out based on the theoretical categories existing in the literature with regard to the components of statistical sense. Given the design of the activity, the elements of literacy skill and statistical knowledge appear transversally in all the reports. We therefore focused on those categories that linked up with social awareness.

With regard to the statistical literacy described by Gal (2002), we found evidence that the activity enabled prospective teachers to make progress as follows:

- *Context knowledge*—they were able to deepen their knowledge of the context.

When analysing how they justified their choice of topic from a critical standpoint, elements related to dispositions and dispositional elements were identified, corresponding to both statistical literacy and statistical thinking. Thus, in relation to statistical literacy, we considered the following category:

- *Beliefs revision*—they presented and reviewed their ideas or opinions on a given topic.

As regards statistical thinking (Wild & Pfannkuch, 1999), we observed *dispositions* such as

- *Curiosity*—they showed an interest in knowing about or finding out something.
- *Scepticism*—they identified errors of logic and factual mistakes when receiving new information.

- *Awareness*—they showed an interest in making a particular issue visible and raising awareness of it.

It is important to insist on the distinction between the concept of *social awareness* that provides the main thread of this study and the concept of *awareness* as defined by Wild and Pfannkuch (1999). For us, if something is to be considered an issue of social awareness, then the issue to be made visible must have social relevance in the community the person belongs to, while Wild and Pfannkuch (1999) do not establish this condition.

It is important to point out that, although these categories were generated from statistical sense theory, we could also interpret them from the standpoint of social awareness. Thus, we understand that context knowledge, scepticism and awareness are elements in agreement with a critical stance towards statistics and, if this is focused on a social issue, they can be incorporated as elements of social awareness. Likewise, beliefs, if reviewed, can form part of a civic stance, while curiosity, if it does not develop into real concern, does not necessarily imply a civic stance on the part of the data consumer.

Table 2 shows examples of how four groups justified their choice of topics and in which categories we incorporated them, using {} and [] to indicate deductive and inductive categories as explained above.

A group's justification of a chosen topic may be computed in more than one category at a time, since it may contain units of meaning from different categories, as shown in Table 2.

In the quantitative analysis, for each social issue, we studied the distribution of the characterization of justifications—social criticism, social, professional, statistical or unspecified interest. Likewise, we also studied the frequency of occurrence of justifications suggesting social awareness—context knowledge, beliefs revision, curiosity, awareness, and scepticism—for the different data packages.

What kind of questions did they ask?

It is essential to formulate questions based on data or its representations for the development of statistical sense. In this study we were interested in finding out, on the one hand, what kind of questions, in terms of purpose, the prospective teachers asked. Knowing what the purpose of their questions was could have revealed a stance more or less in keeping with social awareness. On the other hand, we wanted to interpret the questions posed in terms of what users required of the data.

On average, the groups asked four possible questions, with one, or more than one, chosen to guide the development of their project. To characterize these questions, we developed an inductive analysis that followed a process of category generation analogous to that described in "How did they justify their choice of research topic?" section, with three categories emerging to characterize the purpose of the question.

- *Explaining social phenomena* that affect two or more groups. For example, G6_E&W asked: *"Is the fact that more women have higher education than men but occupy lower job positions due to gender inequality?"*
- *Comparing* two or more groups, when faced with a given social phenomenon. For example, G6_W&F's question was: *"In which countries are there more women taking care of children and doing domestic work?"*

- *Describing social phenomena* using statistics. G4_LS, for example, asked: *"What is the trend in life satisfaction?"*

Ubilla and Gorgorió (2022) studied the questions that prospective teachers may ask when working with data in socially relevant contexts in terms of what the users require of the data. Drawing on the idea of the data consumer and data producer, and work carried out by other authors (Arnold, 2013; Arnold & Franklin, 2021; Puloka et al., 2021; Schield, 2007; Shaughnessy, 2007), they characterized the types of questions posed by a group of prospective teachers when coping with data and complex representations that address social issues. According to these authors, during the question-asking process involved in the research, four types of analysis questions appear: asking the data, asking between the data, asking beyond the data and asking behind the data, with the last two types able to generate new cycles of research.

Below we return to the definition of these four categories and exemplify them with units of meaning taken from this study.

- *Asking the data*: questions that seek a direct reading of the information present in the data or comparing values of the same variable in two groups. For example, *What is the most common disease among men and women?* (G1_H&H).
- *Asking between the data*: questions that seek to make calculations from the data present in the representations. For example, *Which country has a higher percentage difference in the perception of good health by men and women?* (G1_LS).
- *Asking beyond the data*: questions that seek to establish relationships between variables present in the representations. For example, *Is there a trend between the GDP of European countries and women's part-time work?* (G9_W&F).
- *Asking behind the data*: questions that seek an explanation of the relationships or trends identified in the variables present in the representations. For example, *Why do women earn less than men?* (G7_E&W).

In our quantitative analysis of the formulated questions, for each of the data packages, we studied the distribution of the characterization of the purpose of the questions asked by the groups, and the distribution of the requirements that users made of the data.

What kind of conclusions did they reach?

Our third goal required a study of the conclusions reached, looking in particular at the answers to the questions that emerged from the data provided. First, we characterized the conclusions in terms of statistical sense, emphasizing the aspects related to social awareness. Next, we looked at how each group tried to answer its research question(s) and whether it managed to do so (Table 3).

We characterized the conclusions by looking at the dispositional elements and those related to the context. To do this, we carried out a deductive analysis where the categories consisted of the dispositional elements shown in Fig. 1, typical of *statistical literacy* (Gal, 2002) and *statistical thinking* (Wild & Pfannkuch, 1999).

Table 3 Examples of conclusions and their characterization

Group	Conclusions
G6_H&H	*Men certainly consume more alcohol than women in the countries in the north of the EU. In these countries, the most common fatal disease among all genders is cancer* [reading the data]. *However, it should be pointed out that more men die from these diseases than women* {being logical}. *Therefore, we see a possible relationship, but specific studies are lacking* {recognition of the need for data}
G3_H&H	*We wanted to find a justification using external data, other than what we were given in the class, so when searching the internet* [seeking external information] *we were able to observe how women actually follow a healthier diet than men […]. On thinking about it more, we came to the conclusion that this survey was very subjective and, therefore, the population statistics often provide information that does not correspond to reality* {critical skills}
G7_LS	*The results do not give us a clear answer, since they do not follow the same order in any of the graphs. But they do make us see that the countries that are in the top 10 positions in the first graph, or even lower, are also there in the second graph. […] We can confirm then that when more people perceive their health as good, they also have a feeling of greater life satisfaction* [establishing relationships between data that cannot be related]

In the case of statistical literacy, our data provided evidence that the writing of their conclusions fomented:

- *Critical skills*—they questioned the origin of the data and the statistical procedures.
- *Context knowledge*—they made deeper use of their knowledge of the context.
- *Beliefs revision*—they presented and reviewed their ideas or opinions about a topic.

We observed different types of fundamental statistical thinking and dispositions typical of statistical thinking (Wild & Pfannkuch, 1999) that reveal some degree of social awareness. These types of thinking are as follows:

- *Recognition of the need for data*—they sought information and/or data to answer their questions.
- *Integration of the statistical and the contextual*—they linked up existing contextual knowledge and the results of their statistical analysis.

And *dispositions*:

- *Awareness*—they expressed an interest in making issues visible or raising awareness of them.
- *Being logical*—the ability to detect whether or not one idea leads on from another.

Furthermore, we studied whether they answered the questions that had been asked and we carried out an inductive analysis to characterize what resources they used to answer their questions, which gave rise to four categories:

- *Reading the data* present in the different representations.
- *Seeking external information* to complement the data provided in order to answer their questions.

- *Reinterpreting the questions* because they could not answer them with the data provided.
- *Establishing relationships between data that cannot be related,* thus resulting in a statistically incorrect answer to the question.

In the quantitative analysis corresponding to this part, for each of the data packages we examined how the conclusions were characterized in terms of statistical literacy, statistical thinking and social awareness. We also studied what resources they used to answer their questions depending on the social issue they worked on.

Results

Justification of their choice of research topics depending on the underlying social issues in the data packages

Figure 4 shows the distribution of the frequency of appearance of the different categories when characterizing the interests that justified the topics chosen.

In Fig. 4, in the case of the E&W and W&F packages, we observed that the justifications based on a social interest exceeded 30% and those related to social criticism also amounted to around 30%. On the other hand, the justifications given by the groups that worked with the H&H and LS packages were characterized by a statistical interest or a non-specific interest. Thus, globally, we see that, from the perspective of social awareness, the E&W and W&F data packages generated more evidence of social awareness than the H&H and LS packages. On the other hand, H&H and LS data tended to generate evidence of statistical interest without an explicit social intention.

On the other hand, we can affirm that the groups proposed relevant topics after reading the tables and graphs and incorporating the knowledge of the context. Focusing exclusively on those elements that might reflect a social stance, we constructed Fig. 4, which shows the frequency of occurrence of data in the categories of context knowledge, beliefs revision, curiosity, awareness, and scepticism for the different data packages.

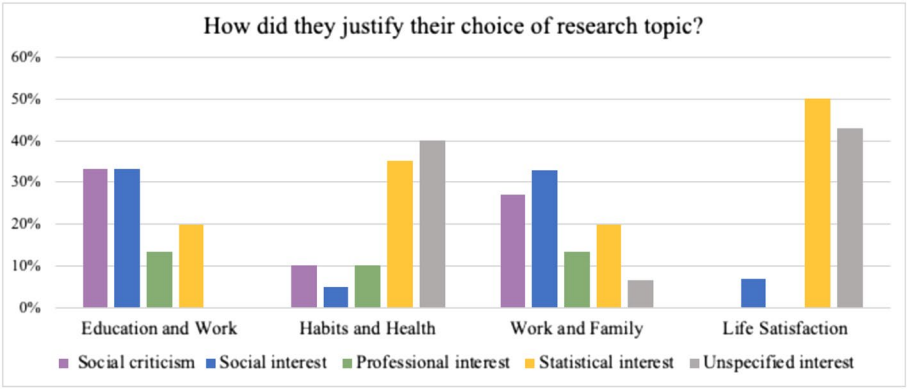


Fig. 4 Distribution of the characterization of justifications. Percentage of the total number of justifications for each issue

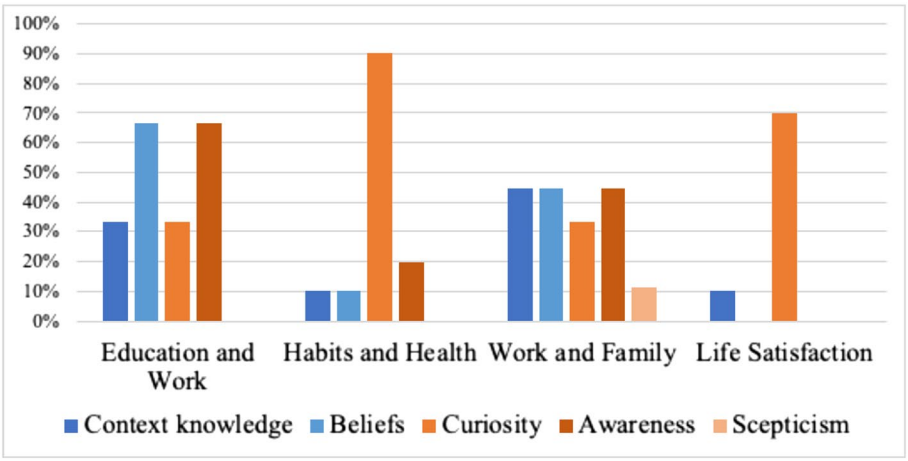


Fig. 5 Frequency of occurrence of justifications suggesting social awareness. Percentage of the total number of justifications in each category out the total number of justifications for each social issue

In Fig. 5, in relation to statistical literacy, we observed that in the justifications concerning the E&W and W&F data packages, there was more evidence in terms of context knowledge and belief management than for the other two data packages. Likewise, in relation to statistical thinking, we observed that in the justifications of the groups that addressed social issues H&H and LS, there was more evidence of curiosity, while in the case of the E&W and W&F data, aspects related to social awareness appeared more often. Overall, we can affirm that we found more evidence of social awareness in the data pertaining to the social issues related to E&W and W&F.

Characterization of the questions they asked and their purpose depending on the social issues underlying the data packages

The quantitative analysis provided evidence that the task promoted the development of statistical sense—reading data, relating variables, identifying trends, and making statistical calculations. In addition, we observed that encouraging the prospective teachers to ask questions to guide their cycle of learning from data prompted them to want to explain, compare and describe social problems.

For each of the data packages, Fig. 6 shows the distribution of the characterization of the purpose of the questions asked by the groups.

In Fig. 6, we see that the characterization of the questions asked is similar for all the topics and that most of them seek to explain phenomena and compare social groups in the case of a certain phenomenon.

Figure 7 shows, for each of the data packages, the distribution of the questions posed in terms of the requirements that users made of the data.

Thus, we see that, out of the 70 questions that guided the working groups' development of the cycle of learning from data, 21 of them belong in the asking the data category, 12 in asking between the data, 25 in asking beyond the data, and 12 in asking

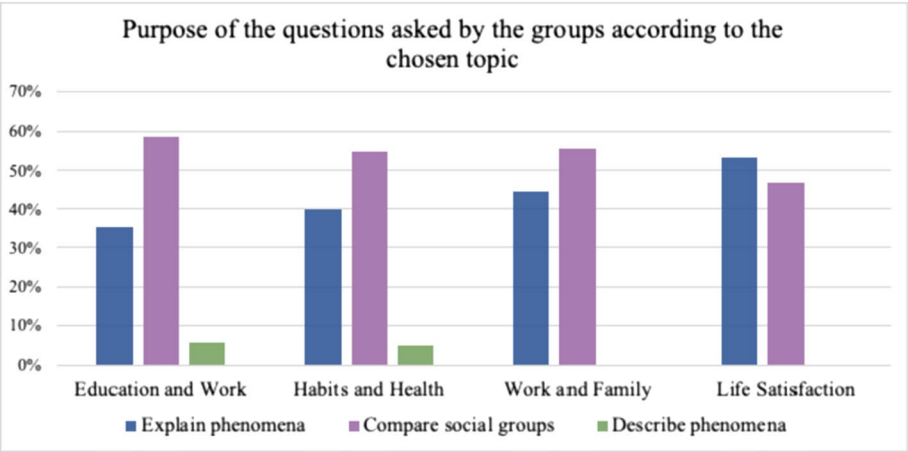


Fig. 6 Results of the characterization of the questions posed by the groups. For each social issue, percentage of the total number of questions in each category out of the total number of questions that the groups set out to resolve

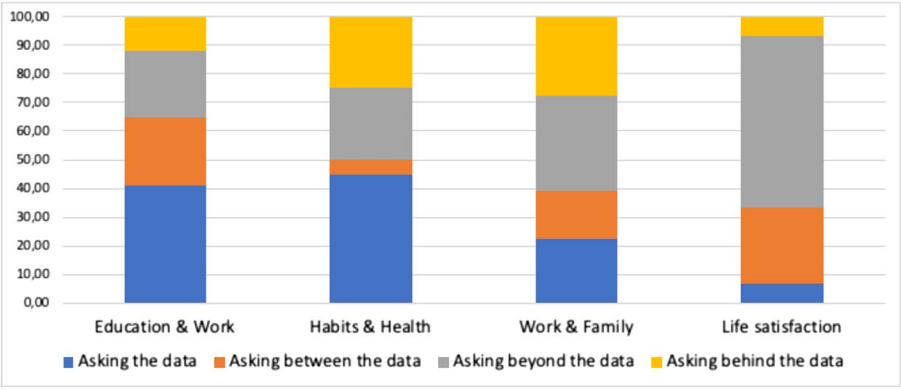


Fig. 7 Characterization of the questions posed according to the associated action. Percentage of the total questions that the groups set out to resolve for each social issue

behind the data. In other words, the most represented categories correspond to questions that required the groups to read the representations directly and those questions where relationships had to be established between variables. These two categories are observed more frequently in the H&H topics (asking the data—reading representations) and in the LS topic (asking beyond the data—relating variables), as shown in Fig. 7.

Characterization of the conclusions reached depending on the social issues underlying the data packages

As a result of the quantitative analysis, Fig. 8 shows the characterization of the conclusions of the different groups. Each component is preceded by an acronym: SL for statistical literacy and ST for statistical thinking. In general terms, regardless of the social issue addressed, we were able to identify elements of statistical literacy and thinking in less than half of the groups' conclusions. On the other hand, we observed that when the data referred to E&W or W&F, there were more groups that reached conclusions that suggested a critical stance, while the opposite occurred with the LS topics.

Figure 9 shows how the groups answered the questions depending on the social issue they worked on. Those who worked on the H&H and W&F social issues mostly answered their questions by reading the data. On the other hand, most of the groups that worked on the LS issues gave an answer but established incorrect relationships between data. It is important to note that the actions in the first three categories—reading data, searching for external information, and reinterpreting the question—enabled them to

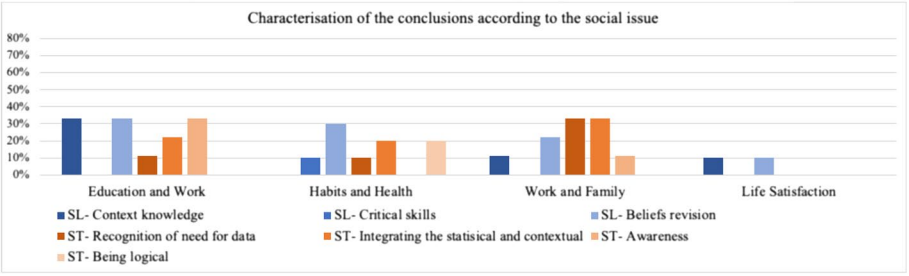


Fig. 8 Characterization of the conclusions drawn by the groups. Percentages as a function of the total number of groups per issue

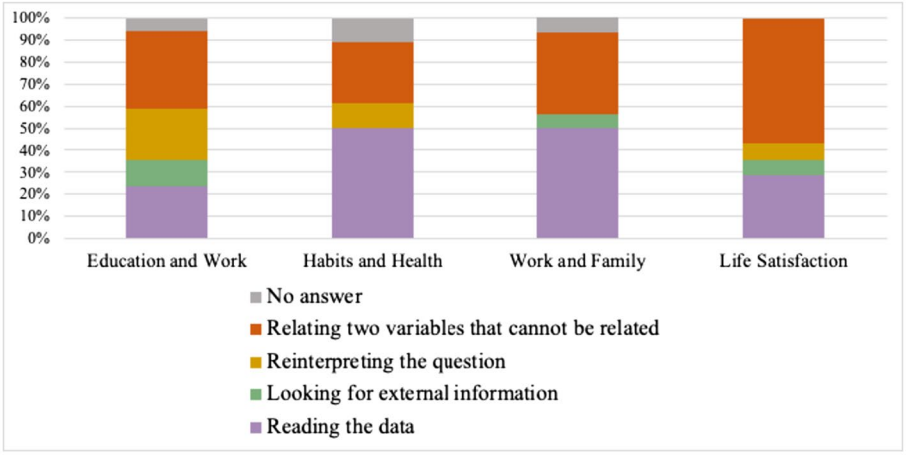


Fig. 9 How did they answer the questions? Percentage of the total number of questions asked for each issue

arrive at the correct answer from a statistical point of view, although reinterpreting the question was not valid from the standpoint of the activity.

It should be noted that an important number of questions engaged the relationship between variables, expressed as "directly linked", "one depends on another" or "is related". While these questions offered the opportunity to take an interest in or be critical of social phenomena, they were not statistically answerable using the data provided.

Discussion

We took into consideration the notes we made during and after the class sessions when interpreting the results. On reviewing these notes, we verified that the prospective teachers found handling the data in some of the tables very complex, especially the tables supporting the E&W and H&H social issues—containing aggregated data—and those serving the W&F topic—with information in rate format. The prospective teachers who worked with the LS topic had no particular difficulty in understanding the indices. On the other hand, a frequent comment among the prospective teachers was that they found the activity very interesting, but, as one of the groups put it, "it would be good to know more statistics to get to the bottom of the matter."

First of all, we looked for potential relationships between the social issue underlying the data and the justification of their research topic and the elements of statistical sense present in those justifications, with the emphasis on the social awareness side. The justifications of the chosen research topic ranged from social criticism to unspecified interest. Overall, we found that the E&W and W&F data packages generated more evidence of stances close to social awareness—social criticism and social interest—than the H&H and LS packages, which displayed a statistical or non-specific interest in their research topic, with almost no presence of elements that tended to generate evidence of statistical interest without an explicit social intention.

An examination of the justifications of the prospective teachers' responses, focussing on the frequency of occurrence of data in the theory-driven categories concerning statistical literacy (context knowledge and beliefs revision) and statistical thinking (from scepticism to curiosity), showed that, in the justifications of the groups working with E&W and W&F data, there was a greater presence of elements denoting a social stance—such as beliefs revision and awareness. On the other hand, from the point of view of statistical thinking, the category of curiosity was the most frequent in the responses of the groups that worked with H&H and LS, while aspects related to social awareness appeared more often in the case of those who worked with E&W and W&F. We found that the packages that included topics such as the wage gap between men and women or the division of childcare and housework clearly promoted social awareness. From our conversations with the groups and bearing in mind that most of the prospective teachers were women, we deduced that the data of the E&W and W&F topics, apart from being socially relevant, were closely related to the reality of their social group. To conclude the discussion of the results corresponding to the first goal, it is worth highlighting that the complexity of the data did not seem to affect the justification of the chosen theme.

As a second goal we proposed finding empirical evidence for a potential relationship between the social issue underlying the data and the purpose of the questions they asked according to the three categories constructed in the data-driven process—explaining or

describing a social phenomenon and comparing groups facing a social phenomenon. It is difficult, if not impossible, to decide which of these three categories indicates higher social awareness. We can only say with certainty that the questions that required describing a situation could be solved with a basic knowledge of statistics, while the others required a deeper knowledge. However, we observe that regardless of the data packages, most of the groups sought to explain a social phenomenon or compare two groups facing the same social phenomenon. This leads us to conclude that, if most of the groups decided to go beyond questions that required a basic knowledge of statistics, it was due to their interest in understanding the data, which implies that the proposed task and the data provided were potentially useful for awakening their social awareness.

Another point concerning the second objective is that on taking into account the concept-driven categories—asking the data, asking between the data, asking beyond the data, asking behind the data, we can conclude that those questions that demand a direct reading or calculations have lesser degree of social awareness than those that seek to establish relationships between variables or those that seek an explanation for the trends identified in the data. Most of the questions posed by the prospective teachers required a direct reading of the representations or the identification of relationships between variables. These two categories appeared most frequently in the E&W and H&H (asking the data) topics and in the LS (asking beyond the data) topic. The tables that accompanied the E&W and H&H topics mainly presented aggregated data (Fig. 2). Therefore, in order to interpret the numbers that appear in them, it is necessary to understand the meaning of different variables. This might explain why the groups that worked with these two topics mostly asked questions that only required a direct reading of the data. On the other hand, the LS topic table presented indices known to the groups. Considering together the results obtained for the second goal, we understand that the type of research question posed by the prospective teachers was more closely related to the characteristics of the data delivered—raw data vs. aggregated data—than the underlying social issue.

Finally, regarding the third goal, we observed that a considerable number of the groups asked questions that sought to explain social phenomena. However, they could not provide answers to the questions they had formulated because answering them required the use of statistical procedures that had not been covered during the course. Furthermore, the data format (Fig. 2) did not make it easy for them to carry out the statistical treatments they had in mind either. Nonetheless, the prospective teachers gave answers to their questions, often changing the statement of their question or even relating variables that cannot be related, expressing causality without justifying it. This second stratagem often appeared in the LS topic, which is consistent with the fact that this was the topic with more questions asked that sought relationships between variables. Thus, we see that the processes that resulted in them answering socially relevant questions often lacked a critical approach to the statistical procedures they used to answer them. On the other hand, we observe that the conclusions of the groups that worked with the E&W and W&F topics displayed more evidence of statistical thinking—recognizing the need for data, integrating statistics and context, and awareness disposition. These results concur with those of the first goal, since there is again evidence that these two topics promote a critical stance. On the other hand, the LS topic presented few elements related to statistical literacy and none related to statistical thinking.

Conclusions

This study describes how a group of prospective teachers approached and terminated an activity based on the cycle of learning from data (IDPSS, 2019) starting with second-order data that came from a study developed by the Spanish National Institute of Statistics (INE) and from the European Statistical Office (Eurostat), whose goal was to compare men and women in aspects of everyday life. Zapata-Cardona (2018) affirms that the tasks in statistics teaching tend to remain focused on learning statistical concepts rather than on the use of statistical reasoning or thinking, and that they are rarely intended to develop critical citizenship. Her proposal aims to educate for critical citizenship and understands students as social subjects, seeking to awaken in them a sense of responsibility for social phenomena. In line with this author's ideas, the concept of social awareness became the common thread of our study, understood as being well-informed concern and interest in a particular issue or situation that people have because they belong to a community.

Context plays an essential role not only in the development of statistical sense but also in promoting statistics as a tool for understanding the world (Weiland, 2016). Thus, the context becomes a basic component of the tasks since it must be understood in order to make decisions, bringing statistical sense into play. There are numerous articles on statistics education that point out the importance of the context that the data comes from (Engel et al., 2021; Ridway, 2022; Watson & Callingham, 2003; Weiland, 2016, 2017, 2019; Weber-Stein & Engel, 2022; Weiland & Sundrani, 2022; Zapata-Cardona, 2018), all of them seeking to prepare critical citizenship. The ProCivicStat project (2018) proposes teaching statistics in relation to social phenomena, working with aggregated data presented in a variety of representational formats and maintaining the social context as the guiding thread (Engel et al., 2021). Although there exists a variety of proposals for tackling civic statistics in the classroom (Ridway, 2022), little research has been done that studies how prospective teachers address social issues through statistics.

This research helps to fill a gap in this area since our goal was to study whether the social issues and the complexity of data representation played a role in the development of a cycle of learning from data, particularly in the justification of their choice of topics, the formulation of their questions and the prospective teachers' conclusions, from the standpoint of social awareness. This study shows that the inclusion of data linked to social issues in the cycle of learning from data can promote the development of social awareness among prospective teachers. However, we found that not all social contexts promote prospective teachers' social awareness in the same way. In this research, the majority of the participants were female, and it was precisely the topics that revealed discrimination against the female gender that prompted a critical approach to the data. Thus, we think that those data linked to social issues closest to the prospective teachers' reality are more likely to promote the search for explanations for social injustice. This closeness to social problems reinforces a critical attitude to information, confirming the idea that "commitment intensifies each of the dispositional elements" (Wild & Pfannkuch, 1999, p. 234). This ties in with our definition of social awareness as an interest and concern felt by people because they belong to a community.

Likewise, this study reveals that the data representation format may play a relevant role in the way prospective teachers approach and conclude the cycle of learning from data. Therefore, the fact that most of the tables did not present raw data but rather indices or percentages of distribution of different variables showed that their statistical knowledge might not be sufficient to answer questions of interest from the standpoint of social awareness, motivating them to look for alternative ways of answering their questions, some of

them statistically incorrect. Thus, we see that the processes that resulted in them answering socially relevant questions sometimes lacked a critical approach to the statistical procedures they used to answer them. This suggests the importance of incorporating raw data when designing activities to learn statistical processes and procedures specific to each educational level, while maintaining tables, graphs and infographics that present already processed data (indexes, ratios, rates, etc.) specific to civic statistics (ProCivicStat, 2018).

The results of this study can serve as a starting point to prepare activities for teaching statistics with a critical stance towards social issues. However, our results came from a local study with specific characteristics. Therefore, among other aspects, it would be interesting to explore what happens when the primary prospective teachers' population is not as clearly feminized as in XXX institutions. On the other hand, implementing this type of task in other educational contexts should consider the incorporation of local data on relevant social issues. Moreover, the teacher would have a crucial role in the development of the activity, guiding the correct articulation between the research questions posed by the pre-service teachers, the possible statistical analyses needed to answer them, and the scope of their conclusions as outlined in Ubilla and Gorgorió, (2021b). Likewise, it would be worth broadening the data collection strategies, with, for example, recordings—at least in audio—of the discussions that take place in the work groups. This type of data could provide information that is not reflected in written texts.

As teachers' educators, we designed this activity as an opportunity to provide prospective teachers with a new approach to learning statistics that also enables them to reflect on social issues. In this way, the challenge in statistics education of *motivation* and *skill transfer* could be addressed (Ograjenšek & Gal, 2016), offering an opportunity for prospective teachers to activate their statistical sense so that it is available to understand socially relevant issues. Before beginning the activity, the participants in the study possessed a shared background of statistical knowledge that we would describe, from our experience of teacher training, as based on the repetition of calculations, much the same as Zapata-Cardona (2018). Therefore, the proposed task was a challenge for them because it entailed a high level of connection with the context (Weiland, 2016) and obliged them to work with data with characteristics typical of civic statistics related to relevant social issues. The task may well have generated a change in the prospective teachers' perception of the teaching and learning of statistics, something important for their future activity as teachers. According to the *purpose* of statistics education (Ograjenšek & Gal, 2016), when students are presented with a dataset that they can use to identify social issues by reading and analysing it, they have an opportunity to understand the power and importance of data.

Lesser (2007) argues that teaching statistics with social justice should offer students opportunities to reflect on a particular context while learning statistical concepts and procedures. Following his proposal and, by way of a conclusion, we affirm that if we want to educate prospective teachers to take a critical stance towards statistical messages and procedures, so that as future teachers they can address issues relevant to citizenship education, it is not enough to propose activities that promote the development of their statistical sense. We must also work to develop their critical awareness of the social issues that are reflected through data.

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Declarations

Ethical approval The data in this research correspond to written reports from groups of university students when they carried out a classroom activity. Prior to the development of the activity, the students were asked whether they agreed that we could use their reports as data for our research, taking into consideration that we would use them anonymously. No student objected to the anonymous use of the written reports.

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