FROM A SOURCE OF REAL DATA TO A BRIEF NEWS REPORT: INTRODUCING FIRST YEAR PRE-SERVICE TEACHERS TO THE BASIC CYCLE OF LEARNING FROM DATA

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Statistical data is used in the media and on online platforms, often with an interpretation that serves some commercial or political purpose. Primary pre-service teachers must be able to understand statistical data and analyze it critically. Only in this way will they be able to contribute as future teachers to the development of a critical spirit in the community. We present the process of construction on a teacher-training program of an activity for first-year students (aged 19) based on data published by Eurostat. The activity, structured around the basic cycle of learning from data, provided real data on different topics in the form of tables, graphs and infographics, and its final goal required students to generate a brief news report based on what they had learned from the data. Finally, we note that this activity can be used at various levels, from secondary education to the introductory tertiary.

Keyword: Teaching statistics, pre-service teachers, statistical sense, the basic cycle of learning from data, real data.

INTRODUCTION

The role of data-based information in the teaching and learning of statistics has changed rapidly over the years. Future teachers will have to teach statistics in a different way to how they learned it. For this reason, those responsible for initial teacher training ask themselves what skills future primary teachers need to develop in this changing world of statistical education. The American Statistical Association (ASA), through the document Statistical Education of Teachers (SET), suggests that courses for future primary teachers include activities that they will use with their students in the future [4]. In particular, they propose the development of educational experiences that involve formulating questions, collecting and analyzing data, and interpreting results.

We started from the idea that it is not enough for future teachers to be statistically literate. They must also to be able to reason and think statistically in order to develop statistical literacy in their future students. Along these lines, we venture that the development of statistical sense in future primary teachers will help them to better cope with both their role as members of the community and as the community's future educators. In this text, we present the fundamentals and design of a classroom activity based on three pillars: a) real data from Eurostat (the Statistical Office of the European Union); b) the words associated with evaluating statistical literacy, reasoning and thinking presented in [9]; and c) the basic cycle of learning from data presented in [10] within the framework of the IDSSP (International Data Science in Schools Project).

The activity drew on Eurostat data about different topics such as satisfaction with life, education, work, family, habits and health. The data was presented to the students in tables, charts and infographics. The activity was used to guide them in the development of the basic cycle of learning from data. Taking into account that an important activity in the cycle is the communication of new ideas and results, we required first year students (19 years old) enrolled in a teacher-training program to formulate questions that could be answered using the data packages they had been given and generate a brief news report based on the results obtained from their data analysis.

In this article we present the fundamentals and construction of the activity and describe the cycle of learning from data of two working groups and the news reports they wrote. The activity proved to be rich in results and possibilities; it enabled future teachers to mobilize not only their statistical

knowledge but also their own interpretation of statistics learning and their disposition towards the said discipline. We conclude that real, meaningful data can be useful for teaching and learning statistics, from the secondary to the introductory tertiary levels.

RATIONALE

We interpret statistical sense as the interaction between the skills known as statistical literacy, thinking and reasoning [13]. It seems indisputable that teachers should be statistically literate, i.e. capable of critically interpreting and evaluating statistical information, as well as discussing or communicating their reactions to this information [6]. Statistical thinking can help them to make informed decisions about which statistical procedures to use when solving problems [9]. Future teachers would also be expected to have a grasp of statistical reasoning, being able to explain why certain results emerge or why certain statistical concepts are used [3].

Although statistical sense suggests an interaction between the concepts of statistical literacy, reasoning and thinking, [9] places them in a hierarchal order, with statistical thinking on a higher level. Furthermore, they suggest a list of words that can be associated with the tasks used to evaluate these three skills. Figure 1 shows the words and the hierarchy put forward by these authors.

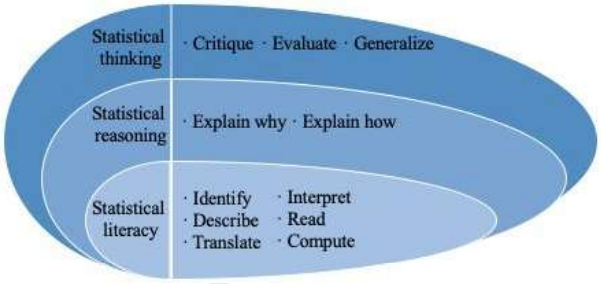

FIGURE 1 Typical words associated with different assessment items or tasks [9]. Diagram prepared by the authors

This list of words or actions not only enables the generation of evaluative instances, but also the design of classroom activities where students have to deal with problems at different levels. The ARTIST Project (Assessment Resource Tools for Improving Statistical Thinking) offers a collection of activities for the assessment of statistical literacy, reasoning and thinking in students from different disciplines [8]. The assessment activities in the ARTIST project are classified according to the underlying skill (statistical literacy, reasoning and/or thinking) and the statistical content to be assessed. The activities in the ARTIST project inspired the learning activity that we carried out with our students.

On the other hand, [12] states that statistical education presents three challenges related to a) the *purpose* - getting students to see why data is important for understanding the world, who uses it and how; b) *motivation* - getting students interested in statistical concepts and procedures; c) *skill transfer* - ensuring that students are able to apply what they have learned in their activity in the workplace or in their community activities, drawing on their knowledge to form opinions from the information that reaches them through the media. Given these goals and also the goal of the development of statistical sense in future primary teachers, there emerges a challenge for teacher educators: to generate educational instances that make this possible.

DESIGN OF THE ACTIVITY

When designing a classroom activity to promote the development of statistical sense, it should be born in mind that problem solving as a basis for statistical education has been studied for over two decades. Thus, [2] describes statistics as the process of *learning from data* and proposes three components for this process: (1) data preparation, which includes the planning, collection, organization and validation, (2) analysis of the data using models, and (3) the presentation of the data

in writing, with the aid of graphics or other resources. On similar lines, [14] presents a conceptual framework that describes statistical thinking on the basis of a study in which they interviewed statistics students. One of the elements that these authors suggest as part of statistical thinking, based on [11] is the *investigative cycle*, known as PPDAC (problem, plan, data, analysis, conclusions), which includes the five steps that reflect the participants' way of thinking and acting during the development of a statistical investigation. A decade later, [1] suggested adding two more components to the process described by [2] completing it with the formulation of a problem that can be solved by statistics and research through the interaction between observation, experimentation and theory.

Recently, the International Data Science in Schools Project generated a framework with guidelines for the organization of introductory courses on statistics, both in the last levels of compulsory education and the first courses of the various university careers where statistics is taught. Given that our research was carried out with first-year students pursuing a primary education teaching degree and in view of our interest in starting from real data, we found the idea of the *cycle of learning from data* [10], which follows the line of studies described in the previous paragraphs, particularly interesting (see Figure 2).

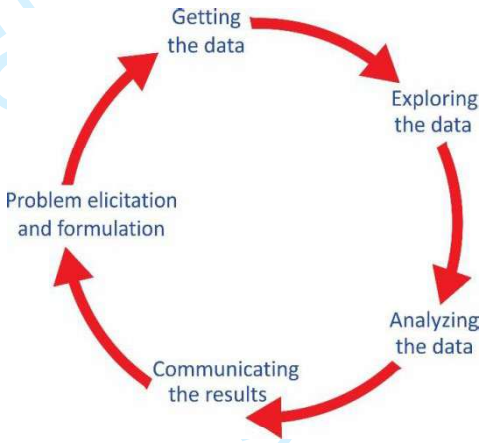

FIGURE 2 The basic cycle of learning from data [10] (p. 8)

This structure facilitates the development of classroom activities that incorporate the use of real data. In particular, and as suggested in [7], it can foster an understanding of information on demographic trends, thus fitting in with our purpose. Therefore, the construction of our activity was based on two ideas taken from statistical education research: the basic cycle of learning from data [10] and the words/actions associated with tasks used to assess statistical literacy, reasoning and thinking [9].

The design of our activity drew on the basic cycle of learning from data [10], but with the students starting with second-order data from an existing database, Eurostat. We gave each of the work groups (3/4 students per group) a dossier with eleven steps or tasks to carry out, which served to assist the students from the first reading of the data to the writing of the news report. Figure 3 illustrates the steps involved in the activity.

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.

FIGURE 3 Activity: *From a database to a brief news report*

Table 1 shows the way in which each one of the steps or tasks involved in the activity that we gave the students was related to the activities in the basic cycle of learning from data and to the words associated with the development of statistical literacy (SL), reasoning (SR) and thinking (ST).

The basic cycle of learning from data	Tasks of the activity *From a database to a brief news report*	Words/actions associated with SLRT (see Figure 1)
Problem elicitation and formulation	• Tasks 1 and 2 seek an approach to the context.	SL: describe / read
	• Tasks 3 and 4 seek to define a topic of interest, as well as the problems to be solved based on the data.	SL: identify, describe ST: evaluate a problem
Getting the data	• None: The students already have the data	
Exploring the data	• Task 5 aims for students to prepare an action plan to solve the problem posed.	SR: explain how

	• Task 6 aims for students to identify the variables to be used to answer the question.	SL: identify, describe
Analyzing the data	• Tasks 7 and 8 seek to analyze the data provided by using statistical concepts and procedures.	SL: identify, read, describe, compute, translate SR: explain why. ST: evaluate the use of concepts
Communicating the results	• Tasks 9 and 10 seek the generation of results, conclusions and hypotheses, and reflection on the process developed. • Task 11 aims to communicate their conclusions through a news report.	SL: interpret SR: explain why and how ST: criticize, evaluate, generalize.

TABLE 1 Correspondence between the tasks of the basic cycle of learning from data, the tasks involved in the activity, and the words associated with statistical sense

It should be pointed out that there is an essential difference between the tasks in the activity given to our students and those suggested by the basic cycle of learning from data. In our proposal there are none that correspond to the getting the data task in the basic cycle. There are two reasons for this decision. First, we think it is essential that our students are capable of working with data from a real context if they are to teach statistics in a meaningful way. On the other hand, in previous editions of the course we had asked the students that they pose their research question themselves and build their own data collection instrument to work with the data they obtained. However, the poor quality of this data made it impossible to address in depth the following stages of the basic cycle of learning from data.

Thus, when the activity *From a database to a brief news report* was handed to the students it was accompanied by a data package consisting of tables, graphs, and infographics. This data came from a study titled "La vida de las mujeres y los hombres en Europa" ("The Lives of Women and Men in Europe"), that compared different aspects of the everyday lives of men and women in Europe based on Eurostat data and carried out by the National Statistics Institute of Spain (INE). The graphics and infographics were obtained from the online publication of the INE study (https://www.ine.es/prodyser/myhue17/index.html), while the data tables were downloaded from the Eurostat website and adapted for the students. The different work teams chose one of the following four topics: a) life satisfaction, b) education and work, c) work and family, d) habits and health.

We provided a variety of information for each topic, even running the risk that the students might feel overwhelmed by the vast amount on receiving it. Our intention was to present the topics broadly to the students so that the data would suggest multiple problems for solution. In this way we encouraged everyone to identify thought-provoking questions. Also, when addressing their problem they were able to look for information complementary to that provided if they considered it necessary, with the only requirement being that they had to cite the data source and justify why they considered it a reliable source.

We delivered the data through tables, graphs and infographics so that the students would learn to understand and become familiar with different ways of representing and communicating information. If they were to advance in the development of statistical sense, it was necessary for them to learn to interpret these types of representations, since these are the ways in which the data appears in the media. Furthermore, as future teachers, they must be able to generate educational instances and manage activities based on different data formats. For example, infographics have a notable presence in educational materials in primary education due to their visual format. Their visual load and the

apparent ease with which they are read also made them attractive to our students. On the other hand, as future teachers they must know how to use them and understand the advantages and limitations of their use.

Since the examples presented below are related to the "education and work" topic, here we show part of the information referring to this topic that appeared in the data tables and in the graphs and infographics. In this way, the groups that developed this topic had at their disposal data tables that presented, for the EU and its different member countries: population by gender, Gross Domestic Product per capita, and region (Figure 4); percentage of population aged 25 to 64 by highest educational qualifications achieved and percentage of active population unemployed (by age bracket: 15 to 24 and 25 to 74 years old) (Figure 5); population by age bracket (15 to 24 and 25 to 64 years old) and active population in thousands by age bracket (15 to 24 and 25 to 64 years old) (Figure 6).

	Population		GDP per capita in PSS*	Region**
GEO/SEX	Men	Women		
European Union (EU)	248,232,994	260,307,109		
Belgium (BE)	5,524,068	5,713,206	118	1
Bulgaria (BG)	3,502,015	3,700,183	47	4
Czechia (CZ)	5,176,927	5,361,348	87	4
Denmark (DK)	2,811,014	2,848,701	127	2
Germany (DE)	39,835,457	41,362,080	124	1
Estonia (EE)	614,704	700,166	76	2
Ireland (IE)	2,313,342	2,364,285	178	2
Greece (EL)	5,268,390	5,589,628	69	3
Spain (ES)	22,826,546	23,623,019	91	3

* Gross domestic product (GDP) is a measure of economic activity. It is defined as the value of all goods and services produced less the value of any goods or services used in their creation. The volume of GDP per inhabitant in Purchasing Power Standards (PPS) is expressed in relation to the European Union (EU28) with the average set to equal 100. If the index of a country is higher than 100, this country's level of GDP per inhabitant is higher than the EU average and vice versa. PPS (EU28) = 100

** 1 = Western Europe; 2 = Northern Europe; 3 = Southern Europe; 4 = Eastern Europe

FIGURE 4 A part of the table that, for the different countries, presented population by gender, GDP per capita, and European region

	Highest educational qualifications in the population aged 25 to 64 years old (%)						Active population unemployed (%)			
	Compulsory[1]		Post-compulsory[2]		Tertiary education[3]		15 to 24 years old		25 to 74 years old	
GEO/SEX	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
European Union (EU)	23.1	23.0	47.9	44.5	28.9	32.5	21.1	19.5	8.1	8.5
Belgium (BE)	25.7	24.1	40.1	35.0	34.2	40.8	23.8	20.0	7.8	6.8
Bulgaria (BG)	18.3	17.2	60.0	49.0	21.7	33.8	21.2	22.3	9.0	7.7
Czechia (CZ)	5.0	8.2	73.1	67.8	21.9	24.1	11.3	14.4	3.7	5.5
Denmark (DK)	20.7	17.9	45.9	39.4	33.4	42.7	11.6	10.0	4.9	5.8
Germany (DE)	12.1	14.9	56.5	59.8	31.3	25.2	7.9	6.5	4.7	4.0
Estonia (EE)	14.4	7.5	56.3	44.4	29.3	48.1	13.8	12.2	5.5	5.6
Ireland (IE)	21.7	15.6	37.4	35.3	40.9	49.1	23.6	16.3	9.1	7.9
Greece (EL)	29.8	26.6	41.7	41.5	28.5	31.9	45.2	55.0	20.4	27.2
Spain (ES)	44.3	39.1	22.7	22.5	33.0	38.4	48.6	48.0	18.8	21.8

[1] Less than primary, primary and lower secondary. [2] Higher secondary and non-tertiary post secondary. [3] Short tertiary education program, first degree, master's degree, doctorate.

FIGURE 5 A part of the table that showed population aged 25 to 64 by gender and by highest educational qualifications achieved in the different countries and percentage of active population unemployed (by gender and by age bracket: 15 to 24 and 25 to 74 years old)

	Population				Active population* in thousands			
	15 to 24 years old		25 to 64 years old		15 to 24 years old		25 to 64 years old	
GEO/SEX	Men	Women	Men	Women	Men	Women	Men	Women
European Union (EU)	29,116,411	27,757,839	137,451,938	138,899,428	12,404	10,437	115,692	99,350
Belgium (BE)	672,737	651,219	2,996,105	2,975,523	219	176	2,421	2,105
Bulgaria (BG)	370,080	348,193	2,035,811	2,009,589	110	72	1,634	1,460
Czechia (CZ)	556,198	530,874	3,021,239	2,948,513	204	142	2,696	2,159
Denmark (DK)	373,323	356,621	1,465,571	1,450,424	228	221	1,272	1,138
Germany (DE)	4,452,557	4,200,559	22,515,527	22,253,460	2,192	1,902	19,734	17,289
Estonia (EE)	72,372	68,398	351,518	366,275	31	25	307	291
Ireland (IE)	290,959	279,537	1,230,529	1,270,335	146	125	1,060	889
Greece (EL)	566,197	546,583	2,889,773	3,008,474	148	131	2,473	1,986
Spain (ES)	2,289,512	2,183,083	13,205,411	13,130,466	831	723	11,401	9,812

* The active population is defined as the sum of the employed population and the population in search of work (unemployed)

FIGURE 6 A part of the table that presented population by gender and by age bracket (15 to 24 and 25 to 64 years old) in the different countries and active population in thousands by gender and by age bracket (15 to 24 and 25 to 64 years old)

Those who worked on the "education and work" topic were also given a double bar graph showing by gender the age of entry into working life in the various EU countries (Figure 7); an infographic showing the gender pay gap (Figure 8); and a stacked bar graph presenting the distribution of managerial positions between men and women (Figure 9).

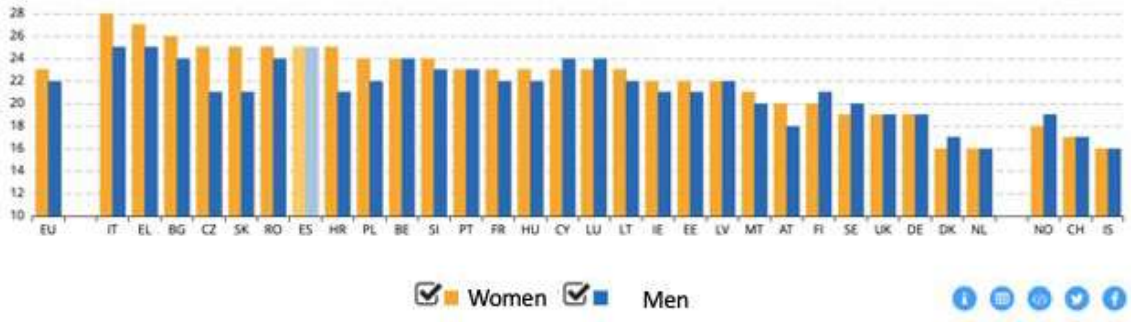

FIGURE 7 Bar graph showing the mean age of entry into working life by gender in the various EU countries

FIGURE 8 Infographic showing the gender pay gap in the various EU countries

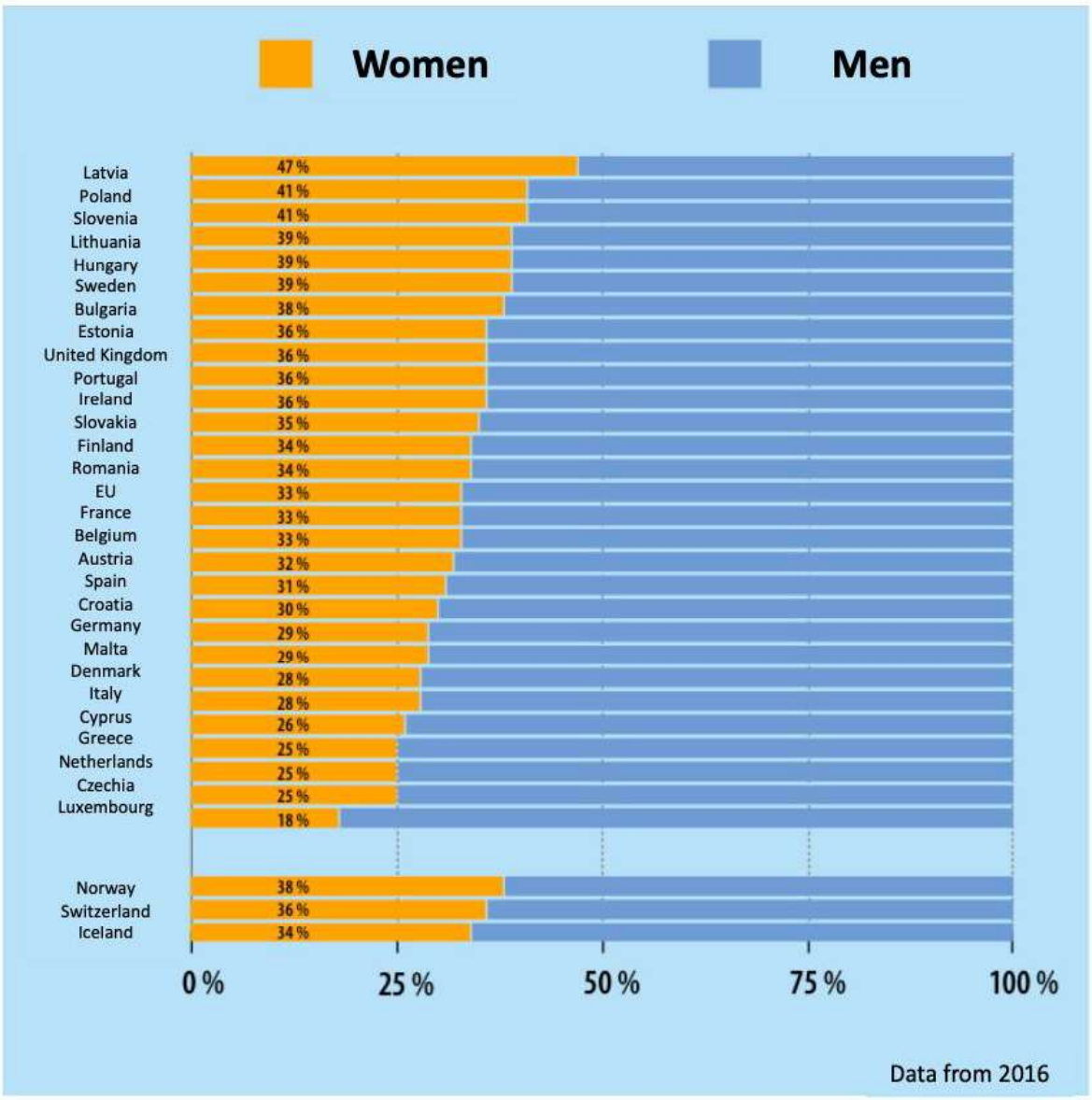

FIGURE 9 Bar graph showing the distribution of managerial positions between men and women in the various EU countries

DEVELOPMENT OF THE ACTIVITY

We carried out this activity in two class groups with a total of 134 first-year students (19 years old) pursuing a primary education teaching degree at the Autonomous University of Barcelona (UAB). The participants' initial knowledge of statistics depended on their previous education, which, after compulsory secondary education, may have consisted of either post-compulsory education aimed at preparing for university or occupational training. Therefore, we could only assume that their common knowledge of statistics was what they had studied up to the end of compulsory secondary education (16 years old). The prescribed syllabus for this educational stage consists of the following: design of statistical studies; samples; experimental randomness; discrete and continuous variables; data tables; ordinary and accumulated, absolute and relative frequencies; graphs: bar, line and sector graphs, histograms, boxplots and point clouds; classes and intervals, histograms and frequency polygons; point clouds and regression lines; measures of centralization, dispersion and position.

The activity was included in the subject of Mathematics for Teachers and implemented during the six ninety-minute sessions devoted to the study of statistics. Each class group worked with its regular teacher – in fact the second author of the article was the teacher of one of the groups while the first

author acted as a participating observer. In the first session, the teacher worked with the students on a data table where they identified variables and classified them according to their type. This was followed by a discussion about what information could be obtained from reading the table, and different types of statistical graphs were analyzed, including their construction and interpretation. During sessions 2, 3 and 4, the students formed 34 working groups of three or four members. They themselves freely defined the composition of the groups, most of the time formed simply by affinity. The majority of the groups were made up of women only, given their majority presence on the teacher training programs (82%). Each group chose one of the topics presented and developed the activity proposed in Figure 3. During sessions 5 and 6, the processes followed and the difficulties encountered were shared and each group presented a news report generated by the activity.

Given that the two groups of students each worked with their teacher, minimum objectives and assessment criteria were agreed upon for each task. In this way, a blueprint for action was drawn up (see Figure 10), which the teachers took with them to the classroom as a reminder of the agreements made.

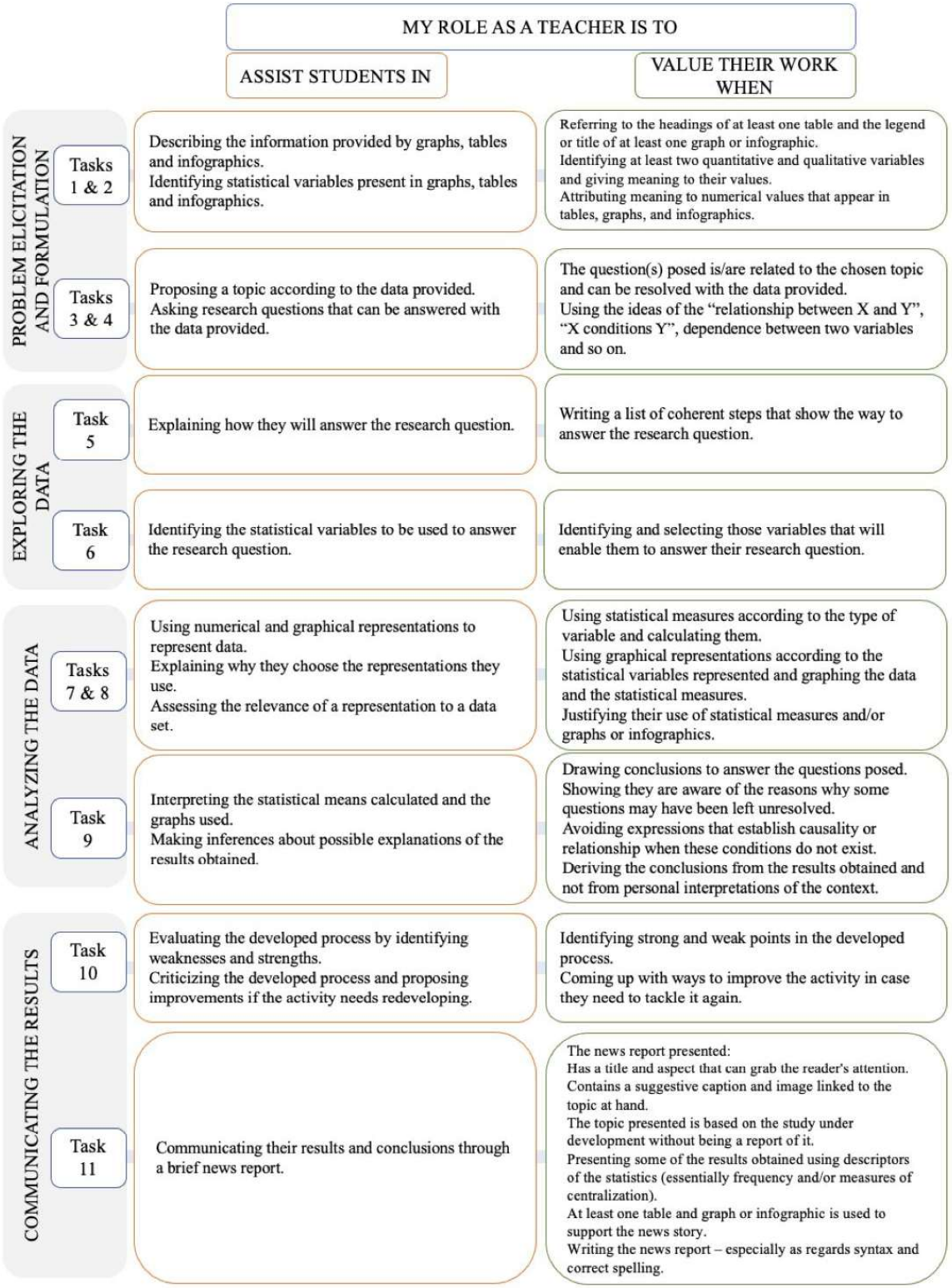

FIGURE 10 Teacher's blueprint for action in relation to the goals and assessment criteria of the tasks

The proposed activity was not intended to be an exercise in the application of ideas previously exposed by the teachers. Rather we wanted it to focus on the development of a project. To bring into line the teachers' idiosyncrasies when managing the development of the activity, and with the idea that the students' questions would lead to a dialogue that would help them resolve their doubts, three basic strategies for the management of student demands were agreed upon. First, when students raised doubts about concepts or calculations, they were advised to search the Internet. The teacher

helped them if they had difficulties understanding the information they found. Second, when an error was observed in the interpretation of a concept, they were asked questions that led them to examine their error. And the third agreed strategy was to suggest that they should simplify the problem when they had difficulties dealing with it or had made mistakes in interpreting the information. For example, given the error of calculating the mean age of the inhabitants of a country by adding the mean age of women and the mean age of men together and dividing the total by two, it was suggested that they think of a country with a population distribution similar to the class group. Those who still had trouble understanding this line of reasoning were invited to invent a country with twelve women and two men, in which the women were all very old.

EXAMPLES OF BASIC CYCLES OF LEARNING FROM DATA

Working with the dossiers handed in by the groups at the end of the activity, we studied the basic cycle of learning from data as followed by the different teams. Figures 11 and 12 present a summary of the cycle followed by two of the groups, the first consisting of three women and the second, three men. In these figures, we summarize what the students did in each of the activities in the cycle and illustrate it with a unit of meaning from the text of the dossier they handed in.

It is important to remember that in the cycles developed by our students, there was no g*etting the data* stage. Rather, they started directly on the task of *approximation to the data and problem elicitation*, in contrast to the cycle defined in [10] (p. 8). The reason for this was that in the task we gave the students, we delivered a data package at the beginning and asked them to use this package to decide what questions they could formulate to obtain an answer from the data. Furthermore, as indicated in Figure 3, we added an activity of reflection about the process to the basic cycle of learning, which also appears in Figures 11 and 12.

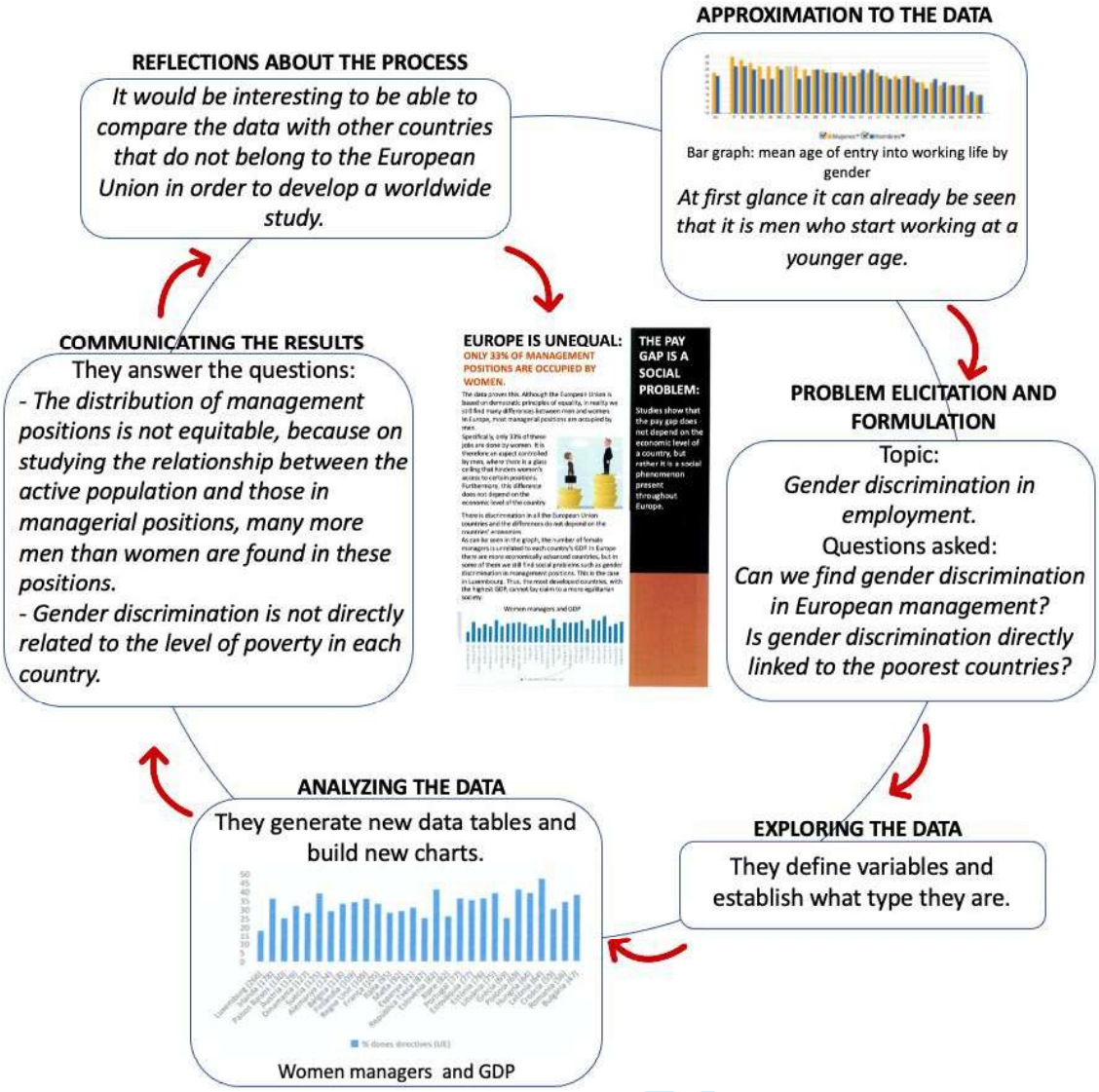

FIGURE 11 Group 1 – basic cycle of learning from data

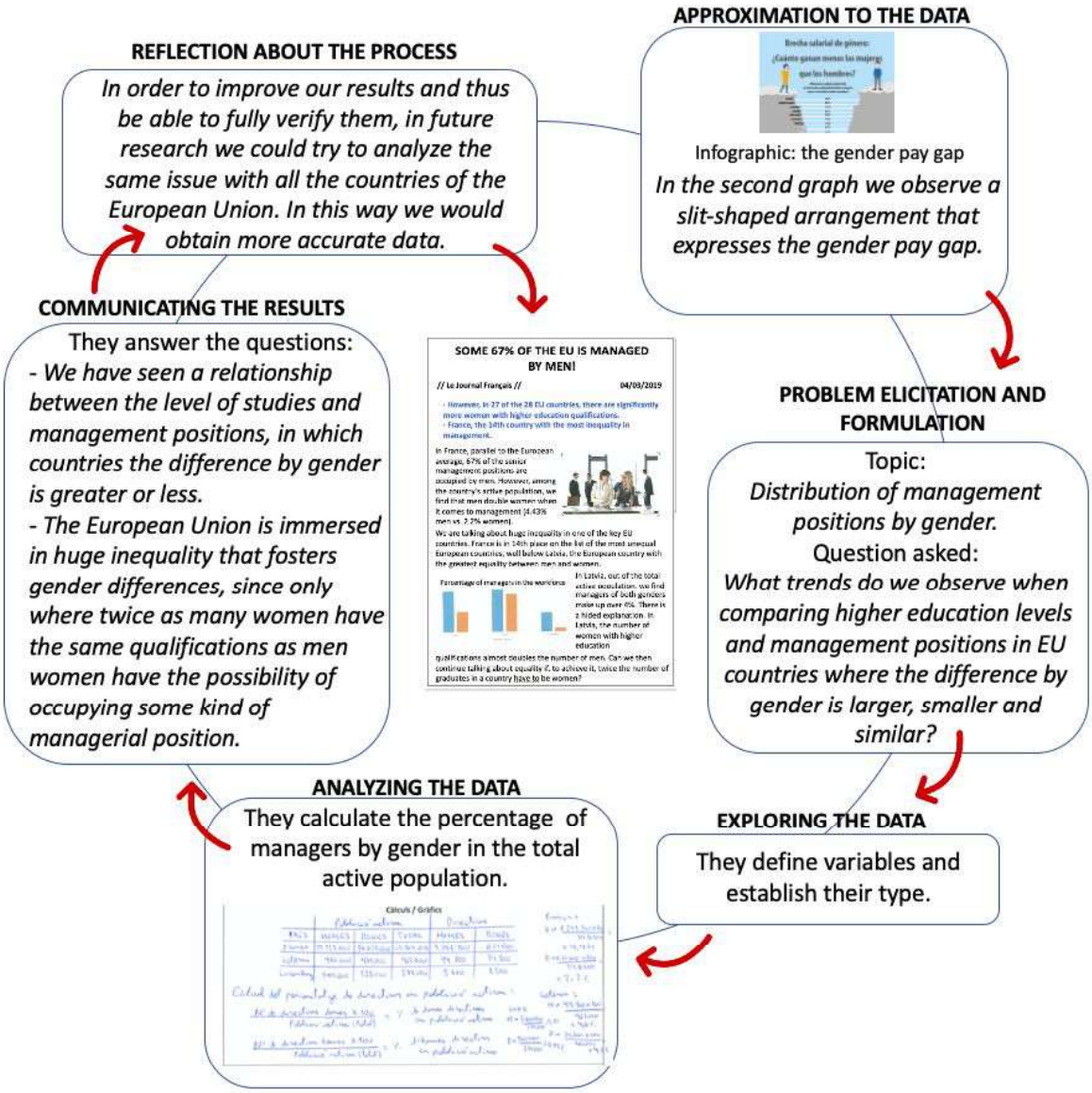

FIGURE 12 Group 2 – basic cycle of learning from data

EXAMPLES OF NEWS REPORTS

Below, we present the news generated by Group 1 (Figure 13) and Group 2 (Figure 14) with which they concluded the written part of the activity they were to deliver. Then, in the following class sessions, the working groups presented their news report to the rest of the class and their presentation and the documents handed in were discussed to strengthen the statistical concepts involved.

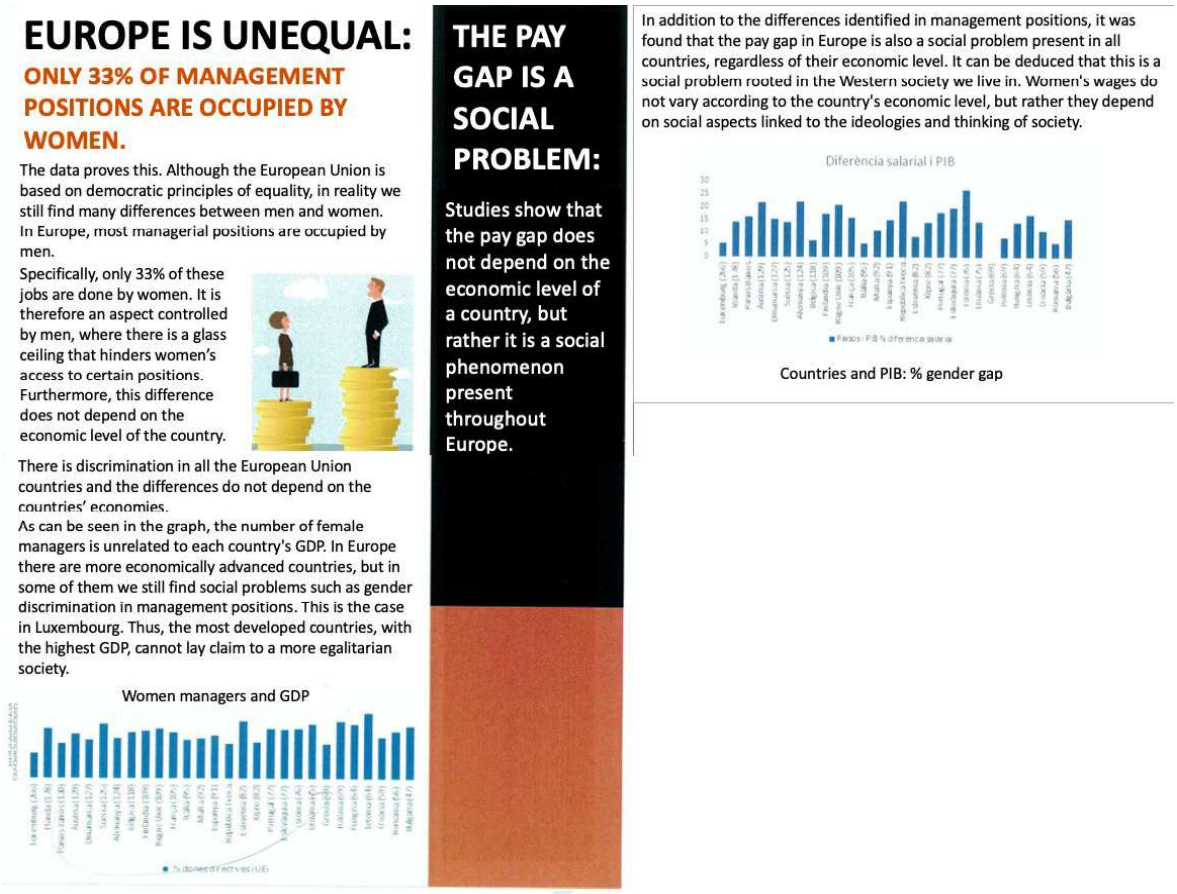

FIGURE 13 The brief news report prepared by Group 1

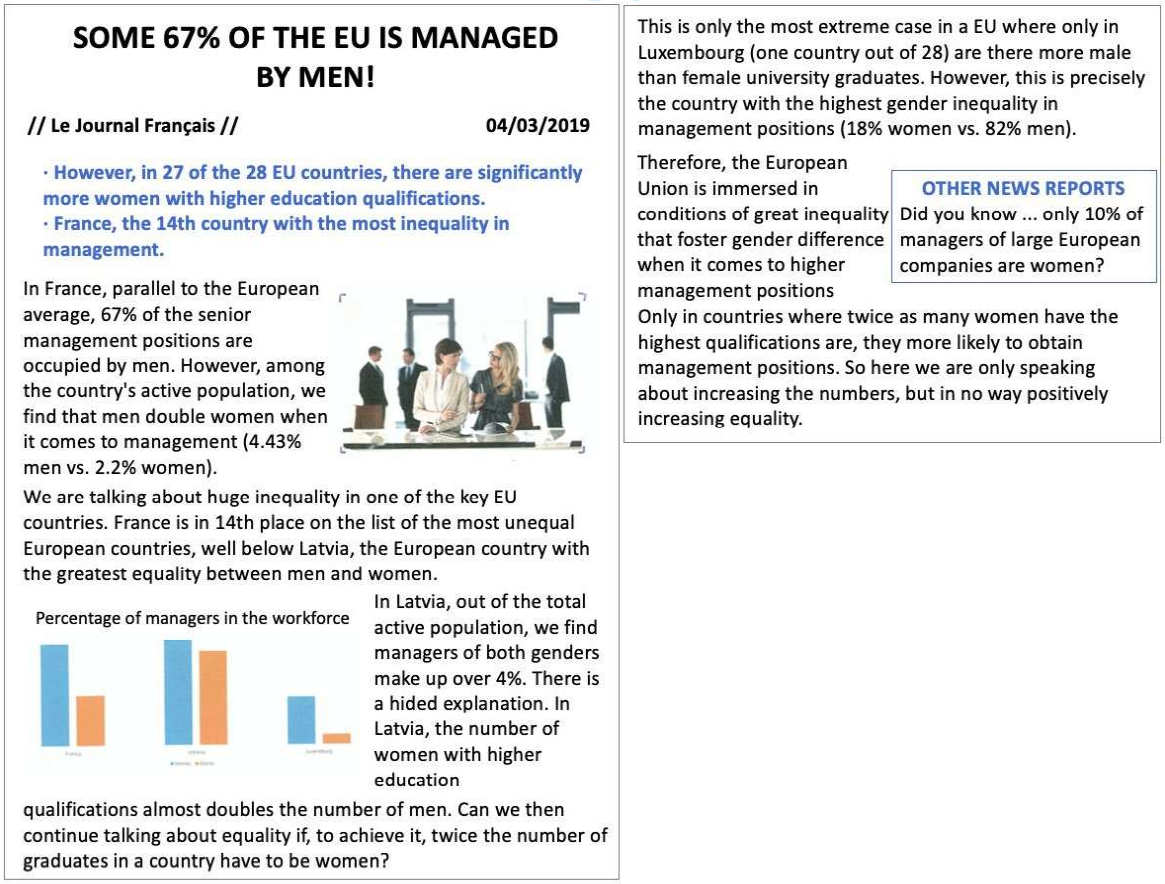

FIGURE 14 The brief news report prepared by Group 2

DISCUSSION AND CONCLUSIONS

One of the responsibilities of future primary teachers is to help develop a critical spirit in the community to contend with the current information circulating in the world and, in particular, to contribute to make their future students statistically literate. Therefore, future primary teachers must have a knowledge of statistics that goes beyond the statistics they learned as schoolchildren, which was limited to calculations and the application of formulas with little point to them. We believe that future teachers, in addition to being statistically literate, must be able to reason and think statistically. The use of real data in the activity enabled them to develop basic cycles of learning from data and give meaning to the study of statistics.

Furthermore, it made them aware of the possibility of working with real data, offering them an opportunity to discuss social issues, as suggested in [7]. In view of the challenges for statistical education posed in [12], the examples given above show us how students can find a *purpose*, by asking questions and through the need to use data to answer them. In addition, many of the students commented in the reflection section on the need for other data to expand the study, something that illustrates their *motivation* to continue researching into the issue. On the other hand, the development of a news report requires the ability to select information, as well as understanding the structure of a news report, skills that they learned in other subjects on the course, this being an example of *skill transfer*. We see, therefore, that the type of task presented can constitute a first step towards the production of classroom activities that address the three challenges of statistical education advocated in [12].

The activity that we gave our students promoted the development of their statistical sense, understood as an amalgam of statistical literacy, reasoning and thinking [13]. As regards statistical literacy [6], we observed that they were able to read and interpret graphs and tables, identify variables, calculate statistics and construct graphical representations. Furthermore, given that they had to write a report and a news report, we saw them advance in the development of language skills. We verified their statistical reasoning when identifying variables and representing them and when they had to choose which representations to use to present their results. Evidence of their statistical thinking was provided by their ability to generate research questions and answer them using the data at hand, by the basic cycle of learning from data that they completed, and by the news reports. The news reports also showed us that they were able to integrate statistical knowledge and context when interpreting the data, being critical of the conclusions obtained.

However, the activity was a struggle at some points, both for the students and the teachers. Some students were disconcerted by this new way of approaching statistics, especially as it was the first block on a course where they were asked to work with new teaching methodologies. As for the teachers, they found the lack of time available for the development of the statistics block on the course rather frustrating. In a scenario with more time available, we would suggest working on each of the parts of the activity by following the phases *thinking - peer feedback - expert feedback*, as suggested by [5] for the development of a project.

Regarding the difficulties with the content, the identification of variables in tables and graphs was a challenge for the students because they found it difficult to make sense of the already processed information that appeared in many of the tables. Therefore, in a future edition of the course we would spend more time discussing what types of data should appear in the tables and identifying variables and values in tables and graphs. Regarding the type of research questions they asked, we observed that they mainly posed questions that needed to be answered with a description or by establishing a relationship between two or more variables. In addition, we observed in their conclusions that they frequently established cause-effect relationships regardless of the need to validate them statistically, only relying on "everyday common sense", and even including their own beliefs about the topic at hand. Consequently, we now insist in our teaching on the need to distinguish between descriptive

statistics and inferential statistics and address the lack of validity of interpretations guided only by common sense.

All said and done, this type of activity promotes the development of statistical sense [13] in future primary teachers, thus enhancing their role as critical and informed members of the community, as well as their future role as educators of critical, informed citizens. This concurs with the structure set out in the SET document [4] for the teaching of future primary teachers through the incorporation of real data about topics of interests to them, data that may come from any reliable database, from agencies or institutions. For example, Procivic Statistics (https://iase-web.org/islp/pcs/) is a good resource for working with real data. And in the current context of a pandemic, both the World Health Organization and the agencies responsible for monitoring SARS-CoV-2 disease around the world databases (in Spain, https://cnecovid.isciii.es/) provide access to databases that could be interesting for statistical work in context. Finally, we would like to point out that this type of activity not only makes sense during initial teacher training but can be carried over to the last years of secondary school and the introductory tertiary in many subject areas, especially the social sciences.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ACKNOWLEDGEMENTS

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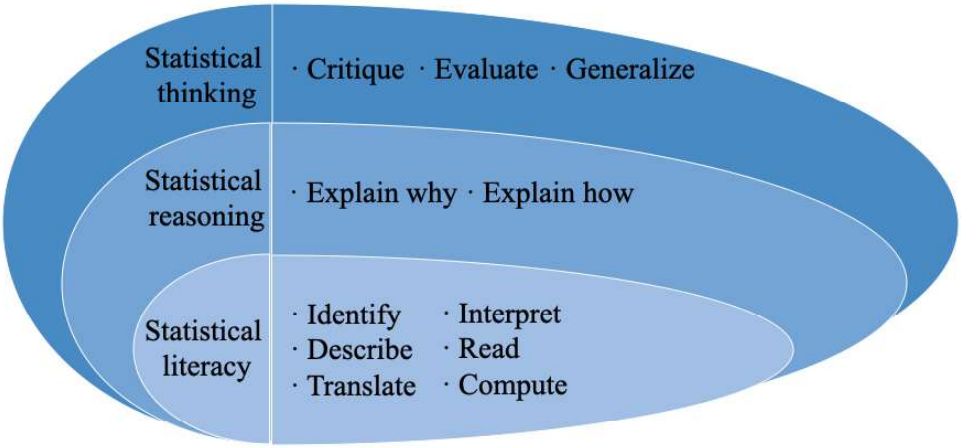
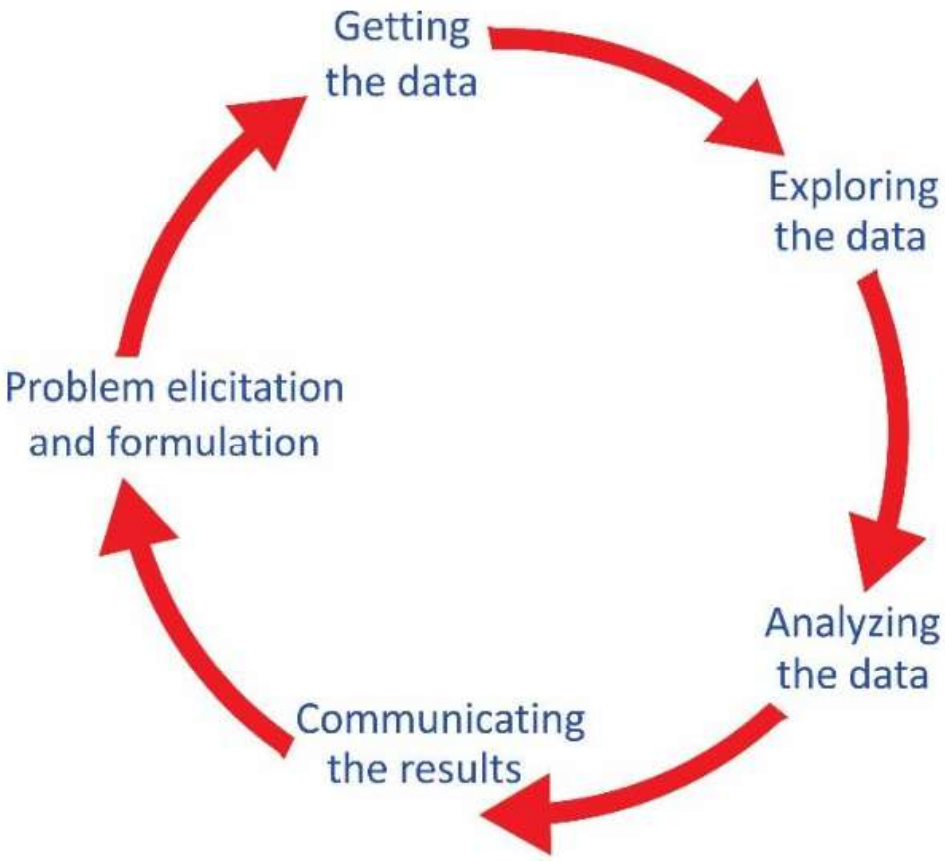


Typical words associated with different assessment items or tasks [6]. Diagram prepared by the authors.

312x146mm (72 x 72 DPI)



The basic cycle of learning from data [7] (p. 8)

215x192mm (72 x 72 DPI)

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.

Activity: From a database to a brief news report

210x215mm (72 x 72 DPI)

	Population		GDP per capita in PSS*	
GEO/SEX	Men	Women		
European Union (EU)	248,232,994	260,307,109		Region**
Belgium (BE)	5,524,068	5,713,206	118	1
Bulgaria (BG)	3,502,015	3,700,183	47	4
Czechia (CZ)	5,176,927	5,361,348	87	4
Denmark (DK)	2,811,014	2,848,701	127	2
Germany (DE)	39,835,457	41,362,080	124	1
Estonia (EE)	614,704	700,166	76	2
Ireland (IE)	2,313,342	2,364,285	178	2
Greece (EL)	5,268,390	5,589,628	69	3
Spain (ES)	22,826,546	23,623,019	91	3

* Gross domestic product (GDP) is a measure of economic activity. It is defined as the value of all goods and services produced less the value of any goods or services used in their creation. The volume of GDP per inhabitant in Purchasing Power Standards (PPS) is expressed in relation to the European Union (EU28) with the average set to equal 100. If the index of a country is higher than 100, this country's level of GDP per inhabitant is higher than the EU average and vice versa. PPS (EU28) = 100
** 1 = Western Europe; 2 = Northern Europe; 3 = Southern Europe; 4 = Eastern Europe

A part of the table that, for the different countries, presented population by gender; GDP per capita, and European region

394x229mm (72 x 72 DPI)

	Highest educational qualifications in the population aged 25 to 64 years old (%)						Active population unemployed (%)			
	Compulsory[1]		Post-compulsory[2]		Tertiary education[3]		15 to 24 years old		25 to 74 years old	
GEO/SEX	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
European Union (EU)	23.1	23.0	47.9	44.5	28.9	32.5	21.1	19.5	8.1	8.5
Belgium (BE)	25.7	24.1	40.1	35.0	34.2	40.8	23.8	20.0	7.8	6.8
Bulgaria (BG)	18.3	17.2	60.0	49.0	21.7	33.8	21.2	22.3	9.0	7.7
Czechia (CZ)	5.0	8.2	73.1	67.8	21.9	24.1	11.3	14.4	3.7	5.5
Denmark (DK)	20.7	17.9	45.9	39.4	33.4	42.7	11.6	10.0	4.9	5.8
Germany (DE)	12.1	14.9	56.5	59.8	31.3	25.2	7.9	6.5	4.7	4.0
Estonia (EE)	14.4	7.5	56.3	44.4	29.3	48.1	13.8	12.2	5.5	5.6
Ireland (IE)	21.7	15.6	37.4	35.3	40.9	49.1	23.6	16.3	9.1	7.9
Greece (EL)	29.8	26.6	41.7	41.5	28.5	31.9	45.2	55.0	20.4	27.2
Spain (ES)	44.3	39.1	22.7	22.5	33.0	38.4	48.6	48.0	18.8	21.8

[1] Less than primary, primary and lower secondary. [2] Higher secondary and non-tertiary post secondary. [3] Short tertiary education program, first degree, master's degree, doctorate.

A part of the table that showed population aged 25 to 64 by gender and by highest educational qualifications achieved in the different countries; and percentage of active population unemployed (by gender and by age bracket: 15 to 24 and 25 to 74 years old)

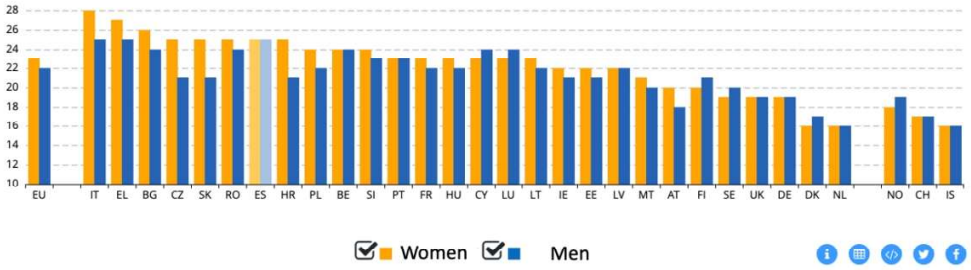
452x239mm (72 x 72 DPI)

	Population				Active population* in thousands			
	15 to 24 years old		25 to 64 years old		15 to 24 years old		25 to 64 years old	
GEO/SEX	Men	Women	Men	Women	Men	Women	Men	Women
European Union (EU)	29,116,411	27,757,839	137,451,938	138,899,428	12,404	10,437	115,692	99,350
Belgium (BE)	672,737	651,219	2,996,105	2,975,523	219	176	2,421	2,105
Bulgaria (BG)	370,080	348,193	2,035,811	2,009,589	110	72	1,634	1,460
Czechia (CZ)	556,198	530,874	3,021,239	2,948,513	204	142	2,696	2,159
Denmark (DK)	373,323	356,621	1,465,571	1,450,424	228	221	1,272	1,138
Germany (DE)	4,452,557	4,200,559	22,515,527	22,253,460	2,192	1,902	19,734	17,289
Estonia (EE)	72,372	68,398	351,518	366,275	31	25	307	291
Ireland (IE)	290,959	279,537	1,230,529	1,270,335	146	125	1,060	889
Greece (EL)	566,197	546,583	2,889,773	3,008,474	148	131	2,473	1,986
Spain (ES)	2,289,512	2,183,083	13,205,411	13,130,466	831	723	11,401	9,812

* The active population is defined as the sum of the employed population and the population in search of work (unemployed)

A part of the table that presented population by gender and by age bracket (15 to 24 and 25 to 64 years old) in the different countries; and active population in thousands by gender and by age bracket (15 to 24 and 25 to 64 years old)

447x197mm (72 x 72 DPI)

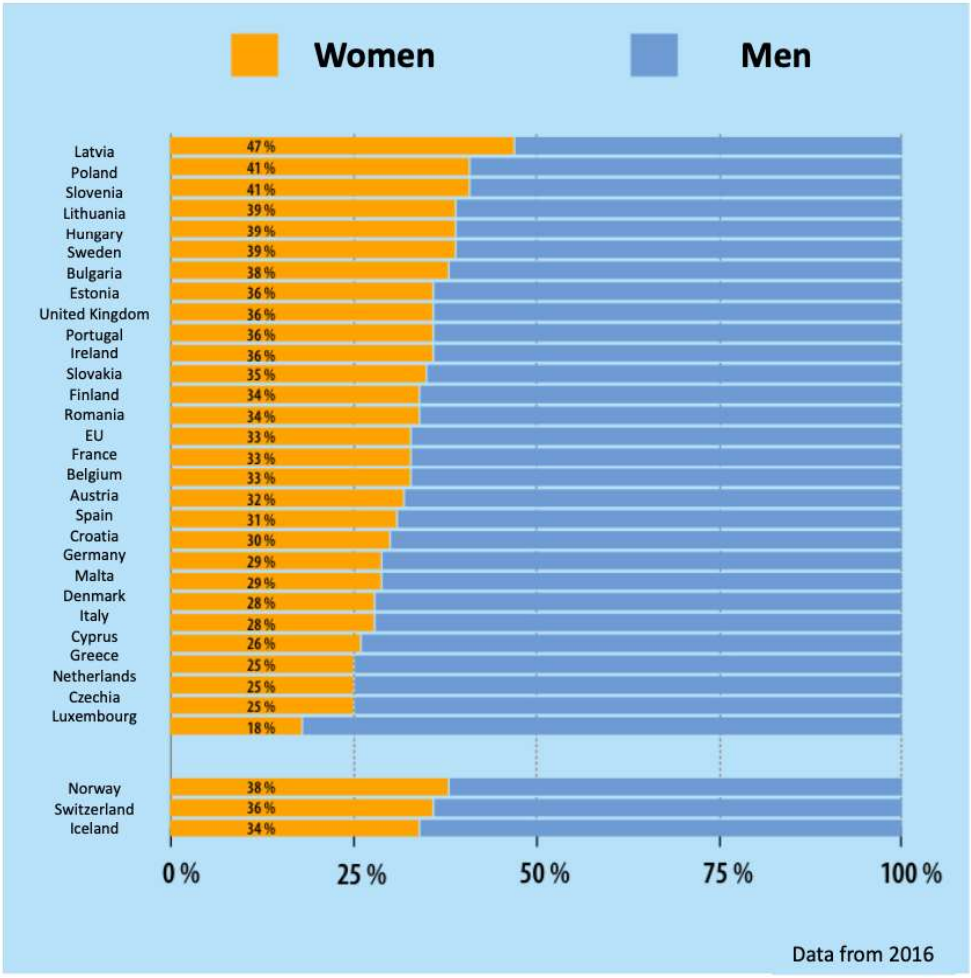


Bar graph showing the mean age of entry into working life by gender in the various EU countries

437x125mm (72 x 72 DPI)

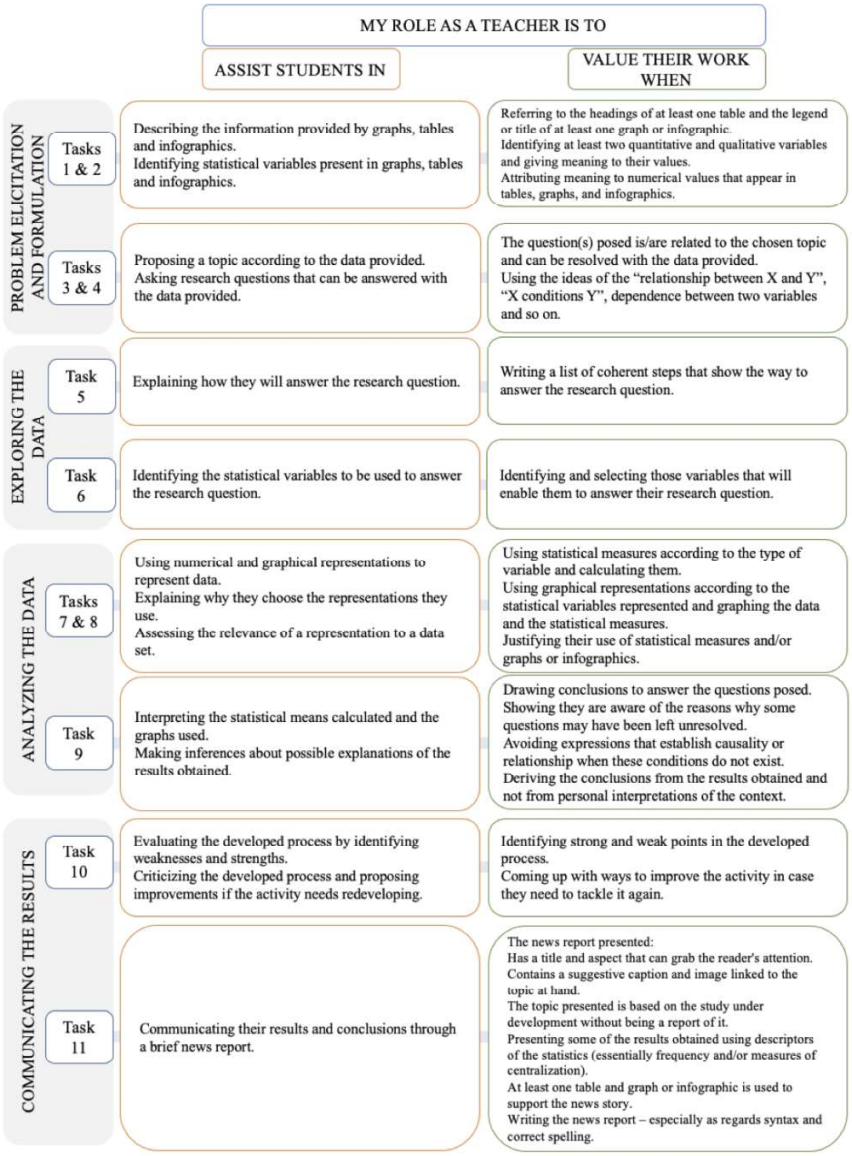
Infographic showing the gender pay gap in the various EU countries

208x302mm (72 x 72 DPI)



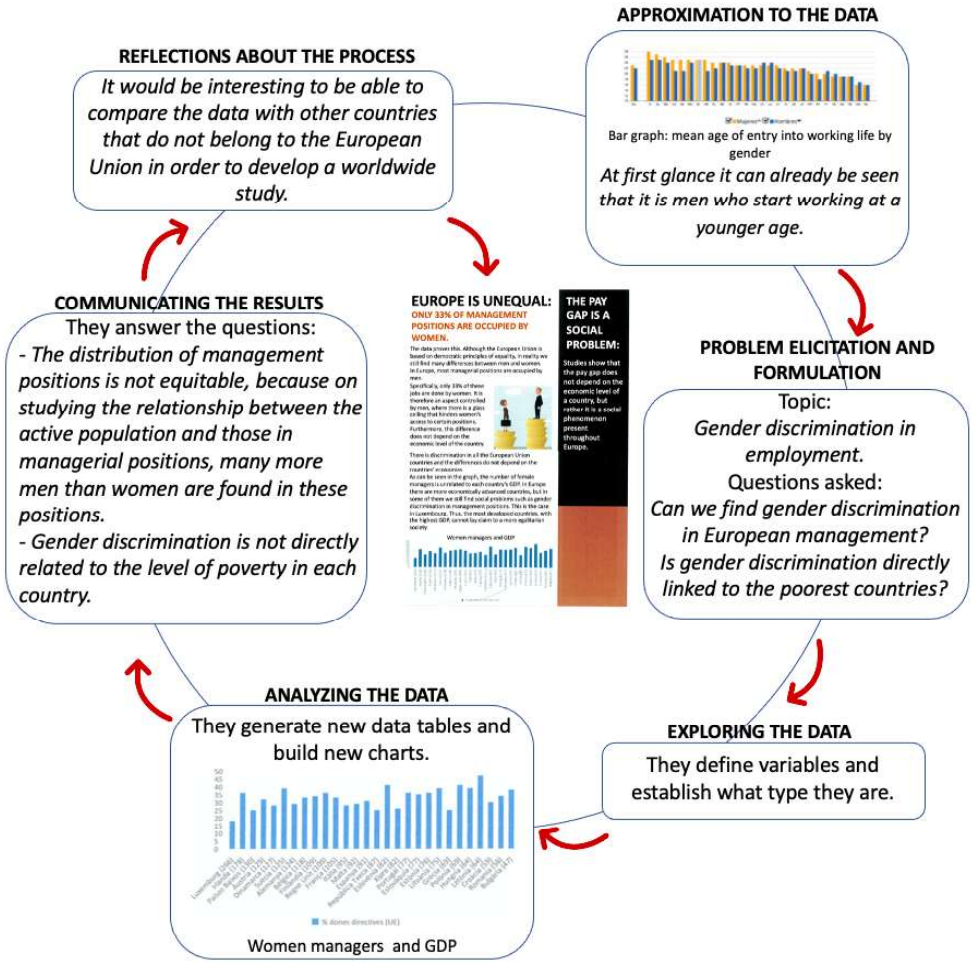
Bar graph showing the distribution of managerial positions between men and women in the various EU countries

296x298mm (72 x 72 DPI)



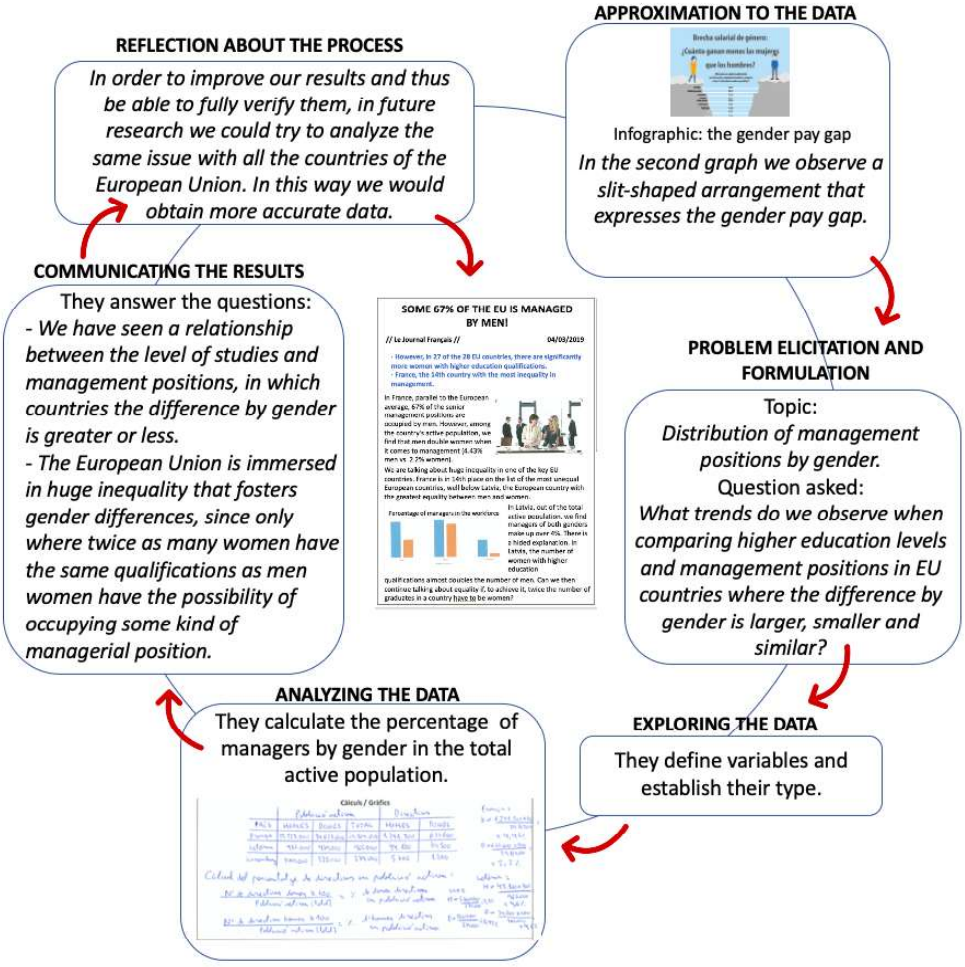
Teacher's blueprint for action in relation to the goals and assessment criteria of the tasks

188x252mm (150 x 150 DPI)



Group 1 – basic cycle of learning from data

315x313mm (72 x 72 DPI)



Group 2 – basic cycle of learning from data

314x313mm (72 x 72 DPI)

The brief news report prepared by Group 1

408x308mm (72 x 72 DPI)

SOME 67% OF THE EU IS MANAGED BY MEN!

// Le Journal Français // **04/03/2019**

· However, in 27 of the 28 EU countries, there are significantly more women with higher education qualifications.
· France, the 14th country with the most inequality in management.

In France, parallel to the European average, 67% of the senior management positions are occupied by men. However, among the country's active population, we find that men double women when it comes to management (4.43% men vs. 2.2% women).

We are talking about huge inequality in one of the key EU countries. France is in 14th place on the list of the most unequal European countries, well below Latvia, the European country with the greatest equality between men and women.

In Latvia, out of the total active population, we find managers of both genders make up over 4%. There is a hided explanation. In Latvia, the number of women with higher education qualifications almost doubles the number of men. Can we then continue talking about equality if, to achieve it, twice the number of graduates in a country have to be women?

This is only the most extreme case in a EU where only in Luxembourg (one country out of 28) are there more male than female university graduates. However, this is precisely the country with the highest gender inequality in management positions (18% women vs. 82% men).

Therefore, the European Union is immersed in conditions of great inequality that foster gender difference when it comes to higher management positions

OTHER NEWS REPORTS
Did you know ... only 10% of managers of large European companies are women?

Only in countries where twice as many women have the highest qualifications are, they more likely to obtain management positions. So here we are only speaking about increasing the numbers, but in no way positively increasing equality.

The brief news report prepared by Group 2

418x315mm (72 x 72 DPI)