AN INVESTIGATION ABOUT TRANSLATION AND INTERPRETATION OF STATISTICAL GRAPHS AND TABLES BY STUDENTS OF PRIMARY EDUCATION

José Carlos Carrión Pérez
University of Las Palmas de Gran Canaria, España
María Candelaria Espinel Febles
University of La Laguna, España
ccarrion@dmat.ulpgc.es

This work used a test to explore capacities, limitations and errors that students may have during processes of learning statistical graphs in Primary Education. We display some results of a test given to groups of students from schools in New Zealand and Spain, to investigate how they make translations between different types of graphic representation.

ANTECEDENTS TO OUR INVESTIGATION

People accept that as time passes society's way of life requires citizens to have some knowledge of statistics in order to understand better their environment and to exercise their rights. Statistical graphs are shown very often in scientific articles and are a common way of social communication; this is the reason for their inclusion as an important part of curricula in compulsory education. We question, as teachers, whether the usual curriculum content on statistical graphs is in fact enough for students to understand, for example, information given in graphs appearing in the media.

Some researchers in statistics have investigated the theory of the construction and perception of graphs. Cleveland and McGill (1984) give a list of basic perceptive elements, useful in the reading and understanding of graphs, such as scales, shadows, shapes or areas, and show a hierarchic ordering of them. However, even now there is not enough work done on the design and good use of graphs. A theory of graphic methods, about how different types of graphs are selected, made or compared, is necessary; even if common sense and intuition play an important role on it.

Research in mathematics education is endeavouring to find out what statistical knowledge primary teachers need, what they need to teach and how. At present, most school curricula require that students must construct and understand tables, bar and sector charts, histograms and frequency polygons. It is also known that many teachers need to improve their knowledge of statistics and its didactical aspects, including taking into account difficulties and errors experienced by students (Batanero *et al*., 1994).

We underline one work on Statistics Education about critical factors that have to do with graphical comprehension and its instructional implications (Friel *et al*., 2001). It shows a compilation of research about making and using statistical graphs, detecting those factors that influence comprehension, and suggests some features that should to be considered for further investigations.

Related to graph comprehension, and having to do with the "alphabetization capacity" or capacity to use written information to advance ourselves in our society, this work describes three behaviours: translation, comprehension and extrapolation/interpolation.

Three different levels have been identified for these behaviours in the process of graphical comprehension: an elementary level, with preference to data extraction from a graph; an intermediate level, orientated to interpolation and finding out data relations showed in graphs and; an advanced level that includes data extrapolation and analysis of relations implicit in graphs.

With the present work, we use a questionnaire that was designed to work at the intermediate level, with the aim to analyze which kinds of behaviours ten to twelve years old children use in the process of making and comprehension of graphs.

OBJECTIVES AND METHODOLOGY

We wish to develop an instruction process to improve teaching and learning of this topic. We hope, in particular, to help students to read, classify and use different types of data representations, identifying different or similar perceptions of them, and vice versa; and, to

actualize and improve statistical instruction of teachers, including some recent developments such as box plots and stem and leaf plots.

In a previous work, we have tried to identify and analyze which difficulties and limitations students in the primary education experience when they use representations often used for data analysis, such as histograms, box plots, dot plots or stem-leaf plots.

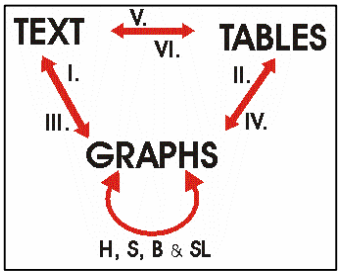
DESIGN OF THE QUESTIONNAIRE

A questionnaire about statistical management of information and use of graph representations was developed. We would like to find out how primary students read, understand and relate different types of representation from information given in data analysis. That is, can a student: a) read and understand a set of values given by tables or bars charts, dot plots, histograms, stem-leaf plots or box plots; b) elaborate those graphs from information given, or; c) relate different kinds of graphs from the same given information? The table and graph on the next page show different kinds of reading, relating and understanding information, and some graph representations that are often used in compulsory education.

The questionnaire was developed according to the table above; it includes six different tasks corresponding to the following translation options:

I text to graph
II table to graph
III graph to text
IV graph to table
V text to table
VI table to text

Graphs → / Activities ↓	H Histograms	S Scatter plots	B Box Plots	SL Stem-and-Leaf Plots
I. Text → Graph	√	X	√	√
II. Table → Graph	√	X	√	√
III. Graph → Text	√	√	X	√
IV. Graph → Table	√	√	X	√
V. Text → Table	√			
VI. Table → Text	√			



Each of the first four tasks (I, II, III and IV) has three items but tasks V and VI have just one; this makes a total of 14 items for the questionnaire. Each item shows three options, and the students must choose the one that they think is appropriate to the task situation. The questionnaire looks also for any kind of reasoning made by students when they select their answer.

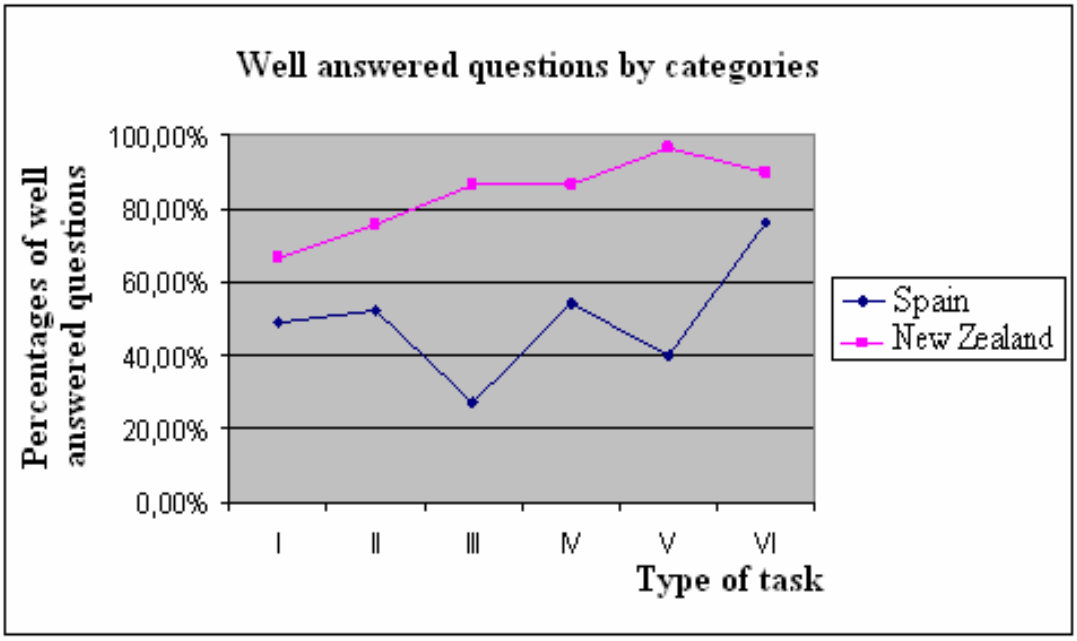
PARTICIPATING STUDENTS

The questionnaire was given to a group of 10 to 12 years old students in primary education. We selected two schools with Spanish as mother language, in Las Palmas (Spain) and two schools with English as mother language, in Auckland (New Zealand). We attempt with this, besides the objectives shown before, to identify how factors such as social and economic level or different educational systems may affect the process of teaching and learning of statistical graphs.

ANALYSIS OF RESULTS

The results showed the following picture. We observe a notable difference between answers given to the same questions by groups from Spanish and New Zealand schools; answers were better in New Zealand schools. This inequality may be due to the different educational systems, or to different social and economic levels of the schools that took part in the experience.

Generally, we may notice a notable distance in well-answered questions between the two systems; New Zealand schools have a higher level of good answers in all tasks. We find the bigger difference in those tasks related to translation of information from bar charts to text and from stem-leaf plots to tables. However, if we make an evaluation by items, the translation from text or tables to box plots, we may find a smaller difference between the systems. We need to analyze in detail every answer given by students to justify their selections, if we want to have a better knowledge about those differences.



We have detected that fewer students are able to understand relations between different types of graphs according to the same kind of information given. Although those students have a good aptitude to identify a graph representing a table, we think that this is due to more attention to the process of making graphs from a table being given during the educational practice than to other kinds of work. However, the process of translation from graphs to tables needs a more intense diagnosis.

Results from this survey will help us to develop a further pattern, using computer technologies, that will help students to read, classify, understand and relate different types of data representations, achieving finally an improvement in the processes of teaching and learning of statistics.

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