OPPORTUNITIES, CHALLENGES AND STATISTICAL COOPERATION IN THE IMPLEMENTATION OF A STATISTICAL LITERACY PROJECT IN MENDOZA, ARGENTINA

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Nowadays, in many countries, national statistical offices are developing projects to introduce citizens to data analysis methods which are useful to describe the real socio-economic situation in each country. The International Statistical Literacy Project (ISLP) has supported this kind of work around the world. Under the ISLP framework, the Government of Mendoza (Argentina) specialists have begun to develop a project called Statistics Literacy in Mendoza (AEM) which includes a Web Page with statistical tools to train citizens. This Web Page takes into account not only the needs of general potential users (like glossary, links to other related pages, stories) but also the needs of school curricula. In this paper we describe the motivation for the project , some consequences and difficulties found, the interaction with other institutions, its implementation, and new lines to develop in the future.

INTRODUCTION

The issue of Statistical Literacy began to arise many years ago in different countries. J. Sánchez (2008) states that statistical literacy is not just a problem that belongs to the field of education. In her book, she considers "*Statistics as the science of data and as a collection of methods to make sense of the numbers that describe the world that surrounds us*" (Sánchez , 2008). This book also explains the process through which some national statistical offices began to create programs aiming to educate citizens. This book presents experiences in developed countries as well as collaborative activities within some less developed ones. Implementation methods, obstacles and consequences of these programs are presented too. In particular, it recommends that a Statistical Literacy program needs to have the support of the national government in order to be successful. We took this suggestion and we were able to have this support in Mendoza.

The notion of Statistical Literacy is underdeveloped in Latin America, but there are some academics that collaborate actively with Spanish speaking teachers interested in this field. Among them, I would like to mention Carmen Batanero, Juana Sánchez, Martha Aliaga, M. Gabriella Ottaviani, Audy Salcedo, Ernesto Sánchez and Jorge Luis Romeu.

The author's interest in Statistical Education started with her Master thesis (D'Amelio 2008). The participation in different congresses such as CLATSE 2000, 2002, 2008, ICOTS 2006, and the JOINT ICMI-IASE STUDY in Monterrey 2008 led her to study the subject and to develop a program within the Economics Statistics and Investigations Office (DEIE) taking into account the needs and expectations of the Spanish speaking community.

The author's deep interest and her personal engagement allowed the Statistics Literacy in Mendoza (Alfabetización Estadística en Mendoza or AEM) project to arise (www.deie.mendoza.gov.ar/aem). The author presented AEM to the Director of the DEIE, who approved its implementation. The project, coordinated by Adriana D'Amelio started in November 2008. A web-page was developed that was uploaded on the DEIE internet server on 20th March 2009.

In July 2009, an agreement to work in conjunction with the Ministry of Education was submitted for approval of the Directors of different areas of the Ministry such as: Planning, Primary Education, Secondary Education and Higher Education. Their Directors supported it and proposed a focus on the involvement of school students in the project.

THE PROBLEM

Although Statistical Education has grown during the last years, one of the main problems is the lack of material in Spanish. Statistical Education in Latin America, according to del Pino (2006), is still in an early stage of development, where initial progress has been attained mostly by

isolated individual actions. Even though, plenty of educational materials and research findings on statistics education are available, and they are expected to increase even more in the coming years; most of them come from developed countries, with a very low percentage from less developed countries.

An important source of materials and information is the web-page of the International Association of Statistics Education (IASE), together with the International Statistical Literacy Project (ISLP). They provide useful elements for the development of statistics culture at all levels. The American Statistical Association (2005) also offers useful suggestions about different aspects of statistics in education.

In Latin America, language is a great barrier as generally there is not much material available in Spanish. This is not simply a problem of communication and translation, but a problem of culture. In fact the material prepared in one country very often has no sense in another and local statistics educators need to develop materials that are useful and consistent with their own country. That is the reason why one of the AEM goals is to increase content, activities and resources in Spanish in the context of Latin American culture, following the example of the Acçao Local de Estatistica Aplicada (ALEA) project (Campos, 2008) in Portugal (www.alea.pt).

STATISTICAL EDUCATION IN MENDOZA (Argentina)

The starting point to select material for the web page was to analyze the development of the Statistics curriculum in Mendoza.

In 1995 the curriculum commission of Mendoza decided to introduce a chapter on Statistics in the Mathematics curricula based on the investigations carried out by Piaget and Inhelder (1951), who considered a minimum age at which children are able to deal with probabilistic ideas.

As it is well known, according to Piaget and Inhelder's investigations (1951) for 7-8 year-old children nothing is foreseeable, they are not aware of randomness and their thought oscillates between what is foreseeable and what is not. However, it is convenient to motivate students with dice games and to ask them questions to introduce them into probabilistic knowledge as different from deterministic knowledge. In addition, it is at this age that children should be introduced to graphics such as pictographs. Children between 12-14 years of age are able to work with some properties of probability along with the use of basic combinatorial analysis and some descriptive statistics tasks, such as the organization and summary of data. Luis Santaló (1993), an Argentine mathematician, promoted revision of the Education Law's curricular contents and suggested their modification to incorporate from early ages the concepts of randomness and probability. Based on his ideas, the 1995 curricular commission of Mendoza became a pioneer in Argentina to decide, in 1996, the introduction of statistical content in the primary education curricula at the age of ten (Alderete, Iturroz & Santander, 1996). This action was accompanied by a teacher's book and teachers' training book all included in the Mathematics teaching improvement program in Mendoza.

Currently, the Education Ministry of Argentine National has its a document Priority Learning Nucleus (NAP) in which probability and statistics are incorporated from the age of twelve years. Nevertheless, this advance was cut short by subsequent governments that denied attention to statistics education. The situation changed again only two years ago.

With respect to the high school curricula, 33% of the mathematical content is allocated to statistics.. However, different research studies carried on statistical content taught by teachers at the secondary schools of Mendoza (that is the content taught before students enter the Mathematics faculty), indicate that it is very poor.

At the college level, future Math teachers and elementary school teachers take Statistics I (Descriptive Statistics) and Statistics II (Statistical Inference) in their curricula. Nevertheless this learning experience has no effect in the classroom since statistics is always postponed till the end of the last term and there is never enough time to develop the subject properly.

Other research studies have shown that also at the primary level teachers do not teach statistics This may happen usually either because they do not know the subject or because they avoid to teach what it is not clear to them (Rossman & Chance, 2001).

THE WEB PROJECT AND ITS CHARACTERISTICS

The AEM project started in November 2008. The coordinator Adriana D'Amelio, developed the educational material and selected the sections for the web and the designer organized the web site. These are the only two people involved in the project.

On March 20th, 2009 the page was uploaded to the web into the server of the Government of Mendoza, within the web portal of the Ministry of Production, Technology and Innovation, on the DEIE web-page (www.deie.gov.ar/aem)

The AEM project allows free access because all of its resources are available to anyone willing to reach them. The free distribution of the program on a CD has been considered, in order to reach those places where there is no access to Internet. Its content can be easily installed with an auto-executable CD, if there is a computer lab available.

The initial idea of the project was to make all the information provided by the DEIE available to the whole society in a way that was simple and easy to understand.
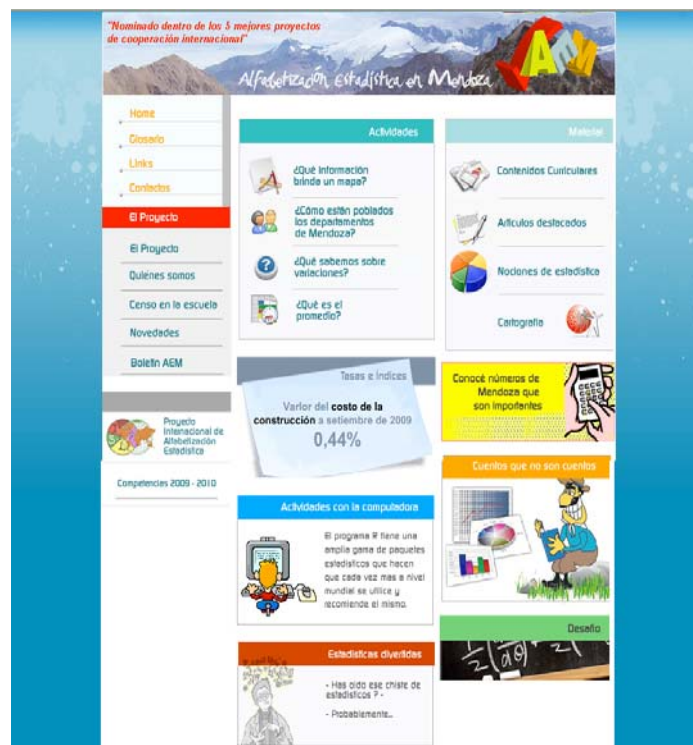

Figure 1. Main web page of the AEM Project

Figure 1 shows the main web page of the project. The page contains:

- Activities related to the use of digital cartography, available in the web page, concerning charts and graphics of different topics presented by DEIE , taking into account statistics correctness.
- Glossary with some definitions from the Institute of National Statistics and Census (identified with the letters INDEC) and other definitions from the DEIE's annual publication "Situación Social" (ie. Social Situation) which covers the following topics about Mendoza: population, health, education, leisure time, family and home, women's situation, housing, jobs, incomes, electoral participation, cooperatives.
- A large number of links relating the province and the world of statistics.
- Humor referring to statistics.
- Challenges and questions about topics published in local newspapers and magazines to promote the participation of primary and secondary students.
- Curriculum: curricular content from the NAP (Higher Priority Learning Nucleus. Ministry of Education of Argentina)

- Indices: unemployment, building, prices; all indices updated to the last current quarter.
- Stories for primary level children, aiming to introduce them in a simple and mediated way to the world of statistics.

The Project coordinator hopes that the activities will become wider in the future with the participation of all the teachers willing to share their proposals, ideas, interests and developments with the project.

Furthermore, the project also considers the national curricula, whose content is available on the page "AEM" (www.deie.mendoza.gov.ar/aem).

Statistical Literacy competitions are also among the activities proposed on the page, and these are directly linked to the ISLP.

ACTIVITIES

The activities are based on statistical data and information appearing on the DEIE page. Every activity is divided into two parts: one for students and one for teachers. The teacher portion includes information to be considered in order to avoid statistical mistakes.

Example of activity :

What information is given by a map?

In this activity a map of the province and of the population density for each department are shown.
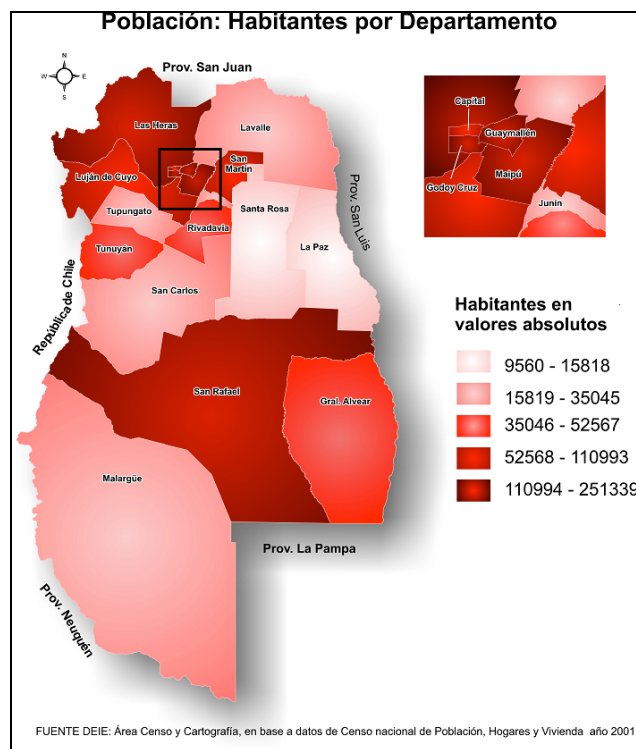

Figure 2.

1. What is the title of the graphic?
2. What does the graphic indicate?
3. Where are the most populated departments located?
4. Are these departments close to each other?
5. Where are the least populated departments situated?

The teacher's activity indicates: goals, what the students should know and common mistakes they must avoid.

Through this activity, students are introduced to the analysis of cartographic charts with statistic information. There are several things to be taken into consideration in doing this as Geography has its own language, which can be interpreted in different ways.

Students must know that the map's title allows identifying the variable represented on it and the year or period of reference. In the reference there is information about the measures that have been used on the graphic or chart (percentages, proportion, absolute values, relative values). Fig. 2 presents absolute values (population). The intervals are shown in the reference. Each interval size is different as the interval cuts are decided by the user. This procedure is called natural cut. Natural cuts are the classification method by default in ArcView. This method leads to important advances in the sequence of values to create classes; it enables to observe groupings and patterns of distribution inherent to the data. Convention suggests the use of lighter colours for lower quantities; colour intensity increases as quantities rise, reaching darker colours.

In the map of figure 2 the colour of each department indicates the number of its inhabitants and colours range from pink to dark red.

OPINIONS

As stated in the introduction, the project was presented to government officers in charge of different sectors of education. Once the presentation was finished, they were surveyed. Among the questions posed, one was: What suggestions would you make for this project?

Most of the officers had no doubt about the importance of the project and the need of its implementation in schools. The main suggestion was to spread it out among school directors, teachers and students in order to develop and disseminate it. As an immediate consequence, there is a need for specific and systematic training for teachers and the implementation of strategies to motive them.

Other suggestions from the survey:

- To help students and teachers understand the huge fields of applications that statistics has;
- To take into account the allocation of time for statistical content in the curriculum and make the appropriate alignment;
- To reach schools where there are still Spanish language limitations;
- To award teachers and students participation;
- To present "AEM" in school local meetings to both supervisors and directors;
- To coordinate the actions to be followed in inter-ministries councils;
- To identify teachers interested in the project, to arrange meetings to implement the project in schools and to create net in order to achieve greater diffusion;
- To educate politicians and government officers;
- To enhance greater motivation to students through a system of incentives.

OPPORTUNITIES AND CHALLENGES

It is very difficult to make our political leaders understand how important it is to have a statistically literate society and to invest resources on this type of programs.

Nevertheless, in March 2009, "AEM" went under the evaluation of experts like Juana Sánchez, Director of the International Statistical Literacy Project (ISLP), from University of California, Los Angeles (UCLA), who decided to nominate it among the 5 Best Cooperative Project Award. In August it was presented in the 57° ISI in Durban, South Africa.

In October 2009, in Catamarca province, Argentina, the Seventh Congress of Official Statistics was held. In this congress Adriana D'Amelio was introduced to the Director of the "Statistics Direction the province of Misiones". This province is developing the program "El IPEC y la Comunidad Educativa" (IPEC and the Education Community) which consists in visiting primary and secondary schools in Posadas and different towns of Misiones, in order to approach rural schools to promote statistical literacy for civic education, through exhibitions, brochures and educational material. Both institutions are interested in creating mutual links in the web page, with interactive and educational games for children and teenagers.

In December 2009, the coordinator of the AEM project received the "Juarez Lincoln Martí" annual award, given to a Latin American teacher that promotes statistical education at every level.

These international awards and recognitions show the interest to collaborate with Latin American countries, strengthening the initiatives that already exist, creating at the same time synergy among the institutions.

The challenges to overcome are the common difficulties every body has when using the Internet and when implementing a new program in schools.

Training course is planned for 2010 with a free distance learning course through the network. The Education Ministry has implemented other courses in different fields. Courses have proved to be very convenient since they fit teachers' time availability. They are free and they are expected to increase teachers' knowledge.

CONCLUSIONS

The beginnings of this project were difficult because not everybody understood how important is for citizens to be statistically literate. There is a need to generate a social conscience on the subject, but we are in the right track now. The promotion and diffusion of AEM in provincial and national congresses has created interest and has increased consciousness that a governmental organization, not exclusively dedicated to Education, can give a strong contribution to statistical education.

The goals yet to be attained include: teachers' training on the educational resources contained in the web page, trying to make the most of the advantages given by modern technology for statistical education; promote kids competitions with posters; promote statistical literacy contest for university students; generate educational activities contests.

All the resources are available now: web page, infrastructure, etc., but we need more experts in the statistics field willing to be involved in the project and to work hard for its accomplishment.

ACKNOWLEDGMENTS

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