Census Vivo, a different way to teach statistics

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High Schools curriculum for mathematics in Portugal includes topics in Statistics such as "What is Statistics: Fundamentals", "Types of Variables and Graphical Procedures", "Measures of Center and Variation", "Scatter Plots and Simple Linear Regression", "Probability, Bayes' Theorem and Central Limit Theorem" and "Confidence Intervals for the Mean and the Proportion of a Population." *Census Vivo* is a hands-on project directed toward all high school students whose objective is to introduce statistics by means of a series of activities which the students can relate to, therefore bringing more awareness to the importance of statistics in their daily life. Some of the activities such as "Black Eyed Peas" or the "Valuable Mean" have the main goal of introducing concepts like "Population versus Sample" or "Simulation of the Sampling Distribution of a Sample Mean." Others are designed with real data sets taken from INE (National Institute of Statistics) about the regions where these students come from and which they are familiar with. Four different schools, namely *Escola Secundária Carlos Amarante*, *Escola Secundária de Caldas de Taipas*, *Escola Secundária Francisco de Holanda* and *Escola Secundária Martins Sarmento*, are part of this Project, and over 9 classes from grade 10 to 12 are involved. *Census Vivo* consists of four distinct phases: *Discovering Portugal*, *Getting to Know the Community in which We Live*, *Dealing with the Data* and finally, *Taking Command*, where the central theme for this school year is "How to Measure Growth and Development of a Region." The results from the individual classes will be posted on the *Census Vivo* website to encourage direct dialogue among the participants of the various schools. The activities for *Census Vivo* are meant to be complementary to the curriculum of each school year and are planned in a way that they can be easily incorporated into a class. They will be part of a book called "Guidebook of Practical Activities for the *Census Vivo*" and will be distributed to high school mathematics instructors throughout the country. With this project, we hope to expand, promote and reinforce the need of Statistics in Portugal and its importance in everyone daily life.

The Four Phases

Census Vivo is a hands-on project where we use the students' knowledge of the different methods and tools learnt in a math class and apply them to real data sets. We have divided this study into four different phases: *Discovering Portugal*, *Getting to Know the Community in which We Live*, *Dealing with the Data* and *Taking Command*.

Discovering Portugal has as its main objective the strengthening of students' knowledge of the various regions of Portugal in which they learn how to use the map of Portugal to represent the different characteristics of the population. In this phase, the students will learn and use graphical procedures to represent real data where, by using different colors, textures or areas, they will represent features of the population on the map. The students will then summarize their findings on the regions of Portugal and will discuss and compare the conclusions taken from the different classes in *Census Vivo*.

Getting to Know the Community in which We Live presents a discussion phase in which various municipal and/or national figures are invited to meet the students so that they can recognize the importance of a Census and see its relevance in the formation of laws and the making of decisions that affect Portuguese citizens on both the local and national level. For example, it is easy to see how the needs of a community of elderly residents would differ from those of a community with a high population of school-age children. Thus, the students will gain a greater appreciation of the concerns and needs of the various regions of Portugal and will obtain a better holistic view of their own country. At the end of the phase, the students will write public service messages in support of the Census.

Dealing with the Data is where students learn a variety of probability sampling methods, namely simple random sampling, stratified and cluster sampling and systematic sampling, among others. A series of activities will be done to explore the advantages and disadvantages of these methods and how to adequately apply them to the situations being studied. We will also introduce the concepts of statistical inference and its importance in a world where uncertainty is present and complex decisions must be made.

Assuming Command is the phase where students are now prepared to perform their own sampling studies on the population to which they belong. We will direct students to those issues of greatest concern or interest to them so that they will actively collect and analyze the data using the knowledge and skills developed in the previous three phases. Themes such as fashion, sport, music, marketing, new technologies and literature, among others, will be proposed. The results will be published on the *Census Vivo* webpage, promoting discussions among students, teachers and anyone that wishes to participate. The *Departamento de Matemática para a Ciência e Tecnologia* (DMCT) will promote several meetings so that students and teachers can come together for round table discussions of the results obtained at the participating schools.

In all the phases of *Census Vivo*, the use of real data sets will be a constant factor in the activities planned, and as such, we hope to make students more aware of the importance, relevance and potential of Statistics.

Main Goals and Final Comments

By presenting *Census Vivo* in class and as part of the curriculum, we hope to achieve a perfect symbiosis between the theoretical concepts and how they can be applied in real life. This will be accomplished by dealing and working with real data sets in addition to small activities that will make students reflect on the different aspects of the concepts involved.

An example of such an activity is called "Black Eyed Peas" which shows how difficult it is to deal with a population and how, in some cases, a good sample does a much better job at getting a truer picture of the population. The video "My Humps" (from the Black Eyed Peas) is presented, and after showing the first 30 seconds of the video, the students are asked "How many times did you hear the word 'humps'?". They immediately complain about the unfairness of the task, but they also realize the various inherent problems and the care needed when dealing with a population. This situation simulates some of the common problems which touch on the following issues: the individual does not fully understand the task being studied; the individual answers anything they want when they do not know the real answer; or finally the possibility of making several mistakes in data registry when dealing with large data sets. These problems will produce undesirable variability and will be clearly seen in the data collected from the students' answers. This experience continues, now in a more controlled environment, where the students need to count the letter 'u' from a text presented to them. After 30 seconds we registered their answer and compare the two data sets.

Although not all the answer are the same in the latter case, students clearly see the different behavior of the two data sets, where the latter shows much smaller variability. The moral of the story is that Population Studies require special attention and careful execution.

Working with real data sets will give students greater awareness of the importance of knowing more about the population in which they live, how studies can be made, and what the real consequences of a Census are for their families, their community and their country in every day life. *Census Vivo* is a project that exposes students of many different ages to the wide range of timely issues that touch on local and national themes, such as politics, social problems and contemporary culture. By involving well known figures in their community, students will be able to link the notions of local decision-making to the richness and diversity of statistics.

By implementing *Census Vivo* as part of the Mathematics Curriculum in High Schools we hope that in the future *Census Vivo* will be adopted in all classes nationwide.

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REFERENCES

Aliaga, M. and Gunderson, B. (2005). Interactive Statistics (3rd edition). New York: John Wiley & Sons, Inc.

Census at School, (2000). UK: http://www.censusatschool.ntu.ac.uk/results.asp.

de Sousa, Bruno (2006). "The Living Census", proceedings of 7th International Conference on teaching Statistics, Brazil.

The Quantitative Literacy (QL) Series. Dale Seymour Publications.

U.S. Census Bureau, (2000). Making Sense of Census 2000. Washington DC: Scholastic. http://www.census.gov/dmd/www/teachers.html.

ABSTRACT

Census Vivo (The Living Census) is a project addressed to high school students where questions such as "What is a Census?", "What purpose does a Census serve?", "How should a Census be conducted?", "What conclusions can be drawn from a Census?", "What consequences does a Census have for me?" will be discussed. Four different schools were selected in the North of Portugal and over nine class groups from grade 10 to 12 are part of this study. This project consists of the following four distinct phases: Discovering Portugal, Getting to Know the Community in which We Live, Dealing with the Data and finally, Taking Command. We will present several activities within statistics for each of the different phases and how they can be incorporated in the curriculum program of each high school academic year. Some results and feedback from teachers and students will be presented together with the

different results obtained by students. Presenting Census Vivo during the secondary career of these students will bring more awareness to the importance of statistics in students' daily life and will encourage them to more actively participate in their civic duties, such as a census or an election.