

THE CHALLENGE OF TEACHING PROBABILITY TO ELDERLY PEOPLE

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In Argentina, the elderly people mostly have difficulties to interpret information, and especially that related to statistics. This is why this extension project carried out by teachers of Biostatistics of the Faculty of Veterinary Sciences provides a response to this problem encouraging elderly people to act actively in the changing society in which we live, stimulating the interest to approach Statistical knowledge. At this stage the problem of probability is addressed. We work using an active methodology where each participant constructs his own concepts supported by problematic situations of the real life. The impact achieved is based on the trust acquired by elderly people to be able to exchange informed opinions using probability that allow them to occupy an active place in society.

INTRODUCTION

A Probability Teaching course for adults was proposed in the Faculty of Veterinary Sciences of the National University of Rosario, based on the Zero project and Teaching for Understanding (TFA) developed at Harvard University during 2015.

Why is it necessary to teach probability? Mathematics serves to model situations that arise in everyday life. There are deterministic situations and others not. Probability has the enormous quality of adequately represent the reality of many social and natural processes and therefore its knowledge allows us to better understand and predict the world we live in (Perez Serrano,1999); only then, it will be possible to train a person who handles the basic knowledge of the 21st century.

Fischbein (1987) argues that a scientific culture is not reduced to a deterministic interpretation of events, he claims for an education in statistical thinking and probability.

Probabilistic intuition does not develop spontaneously, so it is necessary to train it. The probability and the uncertainty must be reconsidered from a more suggestive mathematical treatment as Bressan and Bressan hold (2008). For this reason, to elderly adults, professors should give them problems that include uncertainty, that encourage them to collect data so they can take decisions in situations of chance; in this way, they study probability with the tools they have before a fortuitous event. The influence of the events of daily life means that in the adult's mind the idea that must be experienced for which it is not possible to say what is going to be verified, is developed. Elderly adults face reality governed by laws of chance, the probabilistic nature of gambling, for example. Chance is equivalent to unpredictability. If the number of possibilities is small, probabilistic judgments can be made in the sense of an intuitive estimate of possibility in favour of an event; chance is present in the environment of everyday life: in the state of time, in the results of sports, in board games, among others. This issue is of growing international interest and is the subject of research that is currently being developed. Knowing the problems of teaching probability is essential to find the easiest way to teach elderly adults.

The didactics of probability was studied by many authors as Kahneman, Slovic and Tversky (1972), Sáenz (1998), Langrall and Mooney (2007), Chernoff and Sriraman (2014), and by specific groups (TSG14) in the ICME Congresses (International Congress of Mathematics Education), in the IASE Satellite Conferences and ICOTS Conferences. Research conducted by Batanero (2000) shows the use of non-probabilistic strategies when you want to make a judgment about non-probabilistic situations. These strategies are acquired through experiences of daily life and provide arguments to make decisions that are important and practical for the individual. Kahnemann, Slovic and Tversky (1972) observed that the probabilistic judgments of people who use few information patterns or heuristics generally correspond to heuristics of accessibility and representativeness. It is very important to know these heuristics in order to teach so that the older adult understands and can correctly use the probability. Sáenz (1998) considers that the accessibility heuristic consists of estimating the probability of an event by the ease with which examples are remembered in which this event has happened. With respect to the heuristic of representativeness, it is observed that the probability of an event is estimated according to the

representativeness that it has in the population; he also analyzes 2 biases of equiprobability and deterministic conception of chance and defines the likelihood of equiprobability as the belief that all events associated to a random experiment have the same probability and the deterministic conception of chance as causal explanations at random and suggests starting with problematic situations to introduce concepts related to probability. Godino (1996) studies the structure of objects and forms and how to understand them. In relation to probability, he suggests taking into account the epistemological aspects of basic concepts of probability as well as the use of probability theory, specifying the type of problems that may arise and what are the solutions, the methodology and the conception of probability to teach as a theoretical framework.

THE DEVELOPMENT OF THE EXPERIENCE

This experience was carried out in 2015 at the Faculty of Veterinary Sciences of the National University of Rosario as an extension project to the community participating in it teachers and students of Biostatistics.

After analyzing some problems that arise when teaching probability, the class approach is started following Teaching for Understanding.

1-Generative Topic: Probability.

- Central for life
- To connect with familiar situations to the adult
- Engaging to adults
- Accessible for adults via multiple resources and ways of thinking.

To add a probability problem of the real life can add new points of access to the subject in question, causing interest to students.

To motivate adults on the subject, we propose a video where real-life situations are shown where chance provokes unforeseen moments. After seeing it several times, it is requested to say which are the events in which possibilities of occurrence are not significant. It is requested to discuss in groups which events have the least chance of occurring and to explain why. Then, it is indicated that these possibilities are called probability and the teacher tells the history of Probability and again presents a video located in the seventeenth century in the life of the Knight of Mere.

2-Understanding goals

To explore the generative theme the professor develops comprehension objectives. Adults will understand probability but they need to organize their thinking through questions. Teacher begins by introducing the notion of chance associated with an experiment that is not known. It is part of a soccer game since in the class there is a majority of males. It is discussed who can win, tie or lose but until it is played it is not known. They get excited thinking about the next class who will win. It is emphasized that chance is associated with unpredictable results.

Without giving definitions, it is said that experiments whose outcome depends on chance are called random experiments. A large number of experiments are presented and they must think in groups about whether they are random or not. For example: to measure the length of the table where they are sitting now; to see if throwing a basketball goes into the goal or not; by throwing a dice which number can come out; before a baby is born if they can know the sex; when the TV is turned on at 6 pm on a given channel, which is the program; to know if the bus "15" has the same route; number of grandchildren they currently have.

3-Performances of Understanding.

Throughout the course, adults must be involved in the interpretation of comprehension, through activities that develop and demonstrate their current understanding. The initial performances are quite simple, but are guided by the teacher and these activities can develop the understanding of adults and reveal what they know about this probability issue. Adults throughout the course can be involved in interpreting, understanding and demonstrating their progress in a spiral manner as the teacher through more complex problems guides the student to achieve a new understanding. This is how different problematic situations arise.

For example: The professor presents this experiment: He asks an adult to throw a dice. It is random because we already know the possible results but it is impossible to predict the result before doing the experiment. The concept of random experiment already presented is emphasized. Possible results are raised and they start calling them sample space. Thus, in the experiment drawn of a dice the sample space consists of 6 elements and each of them is called an event. Other randomized experiments are proposed as a group, the sample space and the events are requested, without giving definitions since older adults have little memory and this would be an obstacle to learning. Examples of certain and impossible events are given and their possibilities of occurrence are discussed in groups.

The classes with elderly adults last 45 minutes, so the contents that allow meaningful learning are developed in each one. To start with probability, we begin with absolute, relative and percentage frequency. You pull a piece 300 times and you can see the results: Absolute frequency: Face: 162, Cruz: 138. It is explained that the absolute frequency is the number of times the event appears and the relative frequency the number of times it appears on the number of times the real experiment is performed.

As seen in the probability calculation, phenomena are studied where chance intervenes and these phenomena are linked to random experiments. Each time we do a random experiment we can assign probability to each event in the sample space. Probability is a number that indicates the tendency to occur of the event when performing a random experiment. That is, given an event A,

$P(A)$ is assigned. Random experiment: Roll of a coin; $P(C) = \frac{1}{2}$. How is the probability calculated? We resort to the relative frequency. We return to the coin toss many times, we already throw it before 300, now more times and we calculate it from the relative frequency.

In groups they roll a dice 100 times and calculate the relative frequency of occurrence of the number 6. It is said that to perform it many times the experiment is unfeasible, so you need a formula for your calculation, the Laplace formula. It is part of a random experiment where all events have the same probability of occurrence (equiprobable events) and the $P(A) = \frac{N^\circ \text{ of favourable cases to the event } A}{N^\circ \text{ possible results}}$. When students know this definition they begin to play cards and dice in groups, cuts of newspapers and magazines are brought to take probabilities of forecasts of time, of soccer matches, of tennis. Thus the concept of probability has been introduced and its understanding has been facilitated by engaging in group games and discussions.

4- Ongoing assesment

Instead of evaluating the results at the end of each class, teachers provide feedback based on learning criteria and opportunities for reflection during teaching.

Comments from teachers and students and self-assessment can help to advance the work of adults, especially when:

- The evaluation criteria are presented to the elderly people.
- Feedback is provided on a regular basis
- Teachers and students have possibilities to reflect on the students' understanding and the remaining obstacles.

Generative themes can be taught with the aim of developing learning and support communities. Promoting collaboration is a challenge for the teacher who assumes teaching. TFA provides a framework to guarantee teaching with these components in a systematic way.

RESULTS

Of the 30 elderly adults, who started the course, 28 completed it. The remaining 2 could not attend the last classes due to health problems.

Following this active methodology, they were evaluated at the end of each class, through questions that were answered as a group and gave guidelines for a good understanding of the subject. It was fundamental to position ourselves in the study of the learning problems that could be observed and to take them into account for the development of the classes.

One of them at the end when making the feedback of the course commented: "Now I have the base to predict the result of my football team and they will not laugh at me". "I will be able to shelter my granddaughter and say that the probability that it is cold is 80%".

It was an enriching experience that benefited everyone. Students of Biostatistics as tutors of the elderly adults created bonds of friendship and strengthened the university link at the service of the community and the teachers involved allowed them to strengthen their work towards the community evidencing a close relationship with the Municipality of Casilda to provide a communication outlet to elderly adults arrived at this town from the major problems of violence and lack of attention in nearby urban agglomerations as Rosario, Villa Gobernador Gálvez, among the most cited.

CONCLUSION

The impact achieved is based on the trust acquired by elderly people to be able to exchange informed opinions using probability that allow them to occupy an active place in society.

In conclusion, the elderly people developed a critical spirit that allowed them to feel useful for society.

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