ASSESSING AND EDUCATING PRESCHOOL TEACHERS ON PROBABILITY CONCEPTS IN THE CLASSROOM

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This study refers to an experiment on teaching probabilities, conducted in Greece at preschools in Athens and Ioannina. The aim of this study was to assess teachers on how they introduced common statistical concepts to children throughout the academic year of 2004-2005. Moreover, this study presents a new didactical model on the way we tried to educate preschool teachers on how to introduce to preschool children probabilistic concepts that are not contained in the official national curriculum. The majority of the teachers agreed that the study was interesting and that their intentions were positive, but they lacked the ability and specification to include those concepts in their everyday class curriculum.

INTRODUCTION

Several authors in their recent studies suggest that children are able to understand basic probability and statistical concepts because they can use them in their everyday activities (Pange, 2003; Shaughnessy, 1992; Schlottmann, 2001). In their work about children's intuitions of probability, these authors suggested that probability and probabilistic reasoning is a concept that can be introduced to young children.

Although it is fairly clear from many studies (Lewis, 1966; Offenbach, 1965; and Schlottmann, 2001) that young children can participate in activities concerning of probabilities and statistics, elementary school curricula in Greece have very few chapters about probabilities, statistics and their applications (Pange, 2003). These chapters include descriptive statistics and refer to sorting objects into classes by different criteria, calculating the mean, or drawing bar charts. In Greece, teacher undergraduate and postgraduate programs have recently included topics in probability and statistics. Therefore, in order for preschool children to be adequately prepared to understand probabilities in the elementary school, preschool teachers have to pay greater attention to probability and statistics teaching processes. Unfortunately, many in-service preschool teachers in Greece have little background in probability and statistics and they are trying to teach them in the way they teach mathematics.

Additionally, according to Pange *et al.* (2003), another scientific area where probabilities are directly correlated, is risk. It is well documented that risk is a topic of much interest nowadays. The 'sociology of risk' deals with how some individuals react and make decisions. Pange *et al.* (2003), say that adults and children take risks in many different ways in their everyday life, according to the way they perceive that risk. So, adults understand risk as a very complex situation and children take risks easily, as they do not have much prior information on risky situations and also they do not generally have any disappointing experiences of risk taking. Moreover, risk decisions presuppose probabilistic mathematical thinking, because in risk decisions we use mathematics for ordering, counting or estimating the different outcomes. In recent studies (Pange, 2005; Schlottmann, 2001) it was found that children who could take risks had a good intuitive way of counting probabilities and also of mathematical thinking. They investigated a small group of children about the development of children's decision-making abilities and the effects of age and gender differences on their use of probability, gain, and risky alternatives. According to these studies, the children were able to play games with risk and they were also able to use their prior information as much as they could. It was also found that children improved their answers to questions on probabilities when they had a reward for every right answer. Furthermore, children showed a preference for recent effects and an intuitive way of predicting the outcomes of a random experiment.

The aim of this study is to present an effective teaching process for teaching probability and statistics to preschool children using classroom activities and new technologies (especially the internet). Additionally, in order for preschool teachers to be adequately prepared to teach

probability in their classrooms, collaborative learning techniques were used, and a new learning method, 'learning from the nearest neighbor method,' was used.

METHODOLOGY AND PROCEDURE

For the needs of this experiment, twelve preschool teachers in Athens and Ioannina in 2004-2005 took part in this study and twelve groups of 15 children each also took part in their schoolwork. All teachers belonged to the same age group (25-36 years).

They attended a 30-hour course on probabilities and how they have to apply them in the classroom. We also conducted a six-week demonstration to the teachers on how to introduce basic probability concepts (probable, improbable and sample selection) to children. During this course, they completed a questionnaire concerning the innovation of probability and mathematical concepts in the classroom that are not included in the school national curriculum of Greece. All the questions were open-ended.

The questions that the questionnaire included were the following:
- *Which is the most interesting aspect while teaching probability in preschool education?*
- *Do you use the internet while teaching probability to preschool children?*
- *Do you introduce innovations in classroom concerning the teaching of probability and mathematical concepts?*
- *Describe a usual preschool game in probability on the web that children enjoy a lot in the classroom and that you enjoy a lot teaching.*
- *Do you feel secure enough while teaching probability in classroom?*

All preschool teachers decided to teach to children probability concepts (probable, improbable and sample selection, i.e., 'sample selection with replacement and without replacement'). Six teachers were free to choose at the beginning of the teaching process the method they liked in order to teach probability in their classroom. So, according to the teaching method they had chosen, they had to play a simple game in the classroom with children with probabilities and also to play another game on the internet with probabilities.

The other six teachers were asked to form groups in order to exchange ideas on how to teach probability using the internet in the classroom. They created two groups consisting of three teachers each. They decided as a group to use a common activity (for probable, improbable, sample selection) in their classroom, and to also use from the internet a dice problem (http://www.aboriginemundi.com/dicelab/) for teaching the probable or the improbable.

RESULTS AND DISCUSSION

Teachers were very cooperative while completing the questionnaire and while taking part in the experiment. According to their answers to the questions of the questionnaire we found that
- The most interesting aspect while teaching probability in preschool education was the children's interest in participating in these activities.
- They did not use the internet while teaching probability to preschool children (before this study) because they did not know how to find the right sites.
- They did not introduce innovations in the classroom concerning the teaching of probability and mathematical concepts because they did not manage the subject well, but they showed enough interest about innovating new concepts in probability in preschool classrooms.
- They described the following preschool games in probability on the web that children enjoyed a lot in the classroom and that they also enjoyed a lot teaching. The game in probabilities children liked most (87%) was dice.
    a) http://nces.ed.gov/NCESKids/Probability/dice_handler.asp this is a game where children can roll dices and see the different outcomes
    b) http://www.aboriginemundi.com/dicelab this is a game designed mainly for teachers in order to understand the probability of getting an outcome
    c) http://www.mathgoodies.com/lessons/vol6/intro_probability.html this is a simple game with a dice

    Using the web they showed solid understanding of the procedure but did not show enough confidence to handle the whole process on their own at a later date.

- They did not feel secure enough while teaching probability in the classroom because they were worried about the children's questions. Results also showed that their basic difficulty concerning the aforementioned procedure was that they did not feel confident and competent enough to introduce those new concepts (probable, improbable, sample) in the classroom when they worked alone.

But, the teachers who worked in groups found that they were very confident with the repetition of the whole teaching process. Responses of the groups of preschool teachers indicated though that they liked to introduce probability and statistical concepts in the classroom, but not in the way that they are mentioned and introduced in the school curriculum. The closest mathematical concept related to this study was the concept of equality and inequality, which helped children a lot to acquire a solid understanding of probable-improbable.

All teachers who worked alone taught the concept of probable and improbable using pens or cards with different colours. In this case, preschool teachers who worked alone seemed to struggle enough with the innovation and asked for more time on the specific topic. By contrast, teachers who worked in groups and planned the lesson a week in advance presented it better in their classroom, and made additional use of the web sites.

For the sample selection concept, all teachers did the same activity. They put in a box all the names of the children in the classroom and later they asked a child to choose four names. All children were expecting their name to be the first one selected. During the selection of the next name, they understood that in a 'sample without replacement' they did not have any chance to win if they had already been selected, while on the contrary, during the selection of a 'sample with replacement' they were expecting to be re-selected. So, every child enjoyed the process of sample selection and seemed to have developed an understanding of the aforementioned concept, although young children very often want their name to be selected without paying any attention to selection rules.

As a result, when we applied the 'nearest neighbour learning model,' teachers who were planning the lesson as a group were more confident while teaching it, although they taught it by themselves in different classrooms. The formation of groups of teachers, helped them to discuss ideas about probability, to express their anxiety, to be prepared for questions from children, and to decide how to teach probability using common ideas, the internet, and other materials.

It is concluded from this study that teachers work better on teaching probability at schools when they form groups working using the 'nearest neighbour learning model.' Compared to behaviorist descriptions of the learning process, only those outcomes which are observable or measurable are considered. Learners in this teaching style are encouraged by rewards and inhibited by punishments (Black, 1995; Brown, 1995; Skinner, 1953; Wilson, 1997). The learning-teaching system based on these principles is teacher centered, while the context in which learning would take place is often ignored and learners are given little opportunity to develop perspectives or undertake tasks, as they are not group oriented like the 'nearest neighbor' model. Our teaching model ('nearest neighbor') is also teacher centered and proved to be very good for teaching probability, because the teacher was not the 'master of knowledge,' with inflexible curricula of probability and statistics, but the person who represented a group in which he/she had worked for a long time. In the nearest neighbor method, all the participants are free to choose by themselves how to form the working groups and in all groups the tutor gives an introductory lecture about the course material and the aim of the course. During the course all groups have to do the same tasks but the way they will approach them may be different, depending on the participants of the group. This method is based on the collaboration of the participants without underestimating the different learning styles.

Moreover, compared to the constructivist learning method we found that it also focuses on the individual's learning cognitions and experiences but in a broader setting (von Glaserfeld, 1996). The advantages of both learning systems are that learners create their own knowledge and understanding through active engagement in real-world tasks using actual tools.

Further directions for this research could be to develop an adaptive method that teachers will follow as groups in order to be able to teach elementary concepts of probability to preschool children. Even though it is an easy task for young teachers, because they are still eager to learn, for teachers over their 40s the results might be disappointing.

Finally, we could point out that the school system can sometimes be responsible for the way children learn and behave later in their lives. A schooling system that accepts loss more easily and promotes mathematical thinking may help children not to be anxious when they are faced with risks. Rodriguez (1997) writes: *it seems that until we revise schooling to treat people as individuals in context and not as pawns or agents of a system, disparate treatment will continue and effective educational reform may be beyond our grasp*.

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