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The probability subjective view: developing teachers' knowledge to give sense to students' productions

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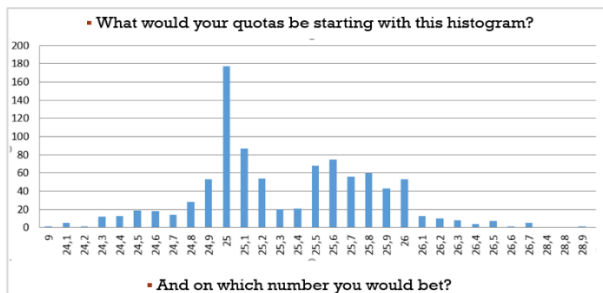
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In the last years, the importance of probability in the context of teaching mathematics is increasing together with its weight in the International Assessment Project. In particular, the presence of the content of “uncertainty and data” in the PISA framework has motivated the trend toward the relevance of this topic in the mathematics curricula all over the world. The epistemological peculiarities and the difficulties related to teaching and learning probability, is also related with the complexity to catch the differences and, at the same time, the intrinsic coherence between the three different approaches to be considered within such topic. This crucial aspect puts probability in a core position within the topics to be focused on researches in the Mathematics Education field. In particular, the subjectivist approach (de Finetti, 1931), hailing a subjective judgement influenced by a person's information and knowledge, is hardly considered in the international panorama of the school curricula, as stressed by Batanero (2015): “the subjective view, that takes into account one-off decisions, which are frequent in everyday life, and where we cannot apply the frequentist view, is hardly considered in the curriculum” (p. 43). Furthermore, we can recognize in the subjectivist approach to probability a powerful link with the psychological and cognitive attempt to measure the degree of reliability that an event occurs in the form “how much I am minded to bet on it”. Following the perspective pointed out by Batanero (2015), the subjective view of probability could support the teachers in designing meaningful educational contexts in this topic. Indeed, it is well known that teachers' knowledge has a great impact on pupils' knowledge/learning and it is essential to focus on teacher education if we want to improve pupils' learning. To make this possible, it is necessary to think about what kind of tasks in teacher education can be conceptualized and implemented in order to support teachers in developing knowledge about probability that includes also the subjective approach to it. Starting from these premises we present here a task, that is a part of a wider research project that has the goal to conceptualize and to implement tasks for teacher education in the context of probability. With this task we want to address a first research question that is: which kind of difficulties or potentialities do teachers show during the work with this task?

The task was conceptualized including pupils' productions, in order to develop the so called teacher's Interpretative Knowledge (Ribeiro, Mellone, & Jakobsen, 2016). The Interpretative Knowledge allows teachers to give sense to pupils' productions, even if such productions are considered as “non-standard, adequate answers that differ from those teachers would give or expect, or answers that contain errors” (Mellone, Tortora, Jakobsen, & Ribeiro, 2017, p. 2949). In this frame we would like to address a second research question: What kind of interpretative knowledge

teachers need to recognize crucial elements to re-design the class work according with pupils' knowledge?

In particular, the task we are referring is conceptualized starting from a practice-based approach, that means to assume that teacher education should be in a direct relationship with practice. One of the ways of achieving this aim is to include pupils' productions to be discussed in the task. In particular, in this case we insert some pupils' productions came from previous research developed by the first and third authors in a fourth grade (Di Bernardo, 2017). During such research, one of the



activities developed was to involve pupils in a measuring process of the length of a set of spaghetti out of a commercial box (about 1000 of spaghetti) and representing the outcomes by a bar graph (Figure 1).

The subjective approach of probability was faced using a betting game. In fact, after the measuring activity, the pupils were invited to imagine a game

in which they had to guess the length of a spaghetti. **Figure 1: bar graph from previous research** Figure 1 only extracted from the box they were took off during the measuring activity. To do that, pupils were divided into two groups: *i*) the group of bookmakers, who had to create “quotas” for each event; *ii*) the group of players, who had to choose their preferred bookmaker and bet on the chosen event. We hypothesized that the pupils can use the previous representation by the bar graph evaluating in a qualitative way the inverse relationship between the frequency of a length with the “quotas” they are available to pay for a betting on this length. Starting from this educational path, we built the task for teacher education. In the first part of the task we asked teachers to create “quotas”, on the base of the bar graph in fig.1. The request was quite open in order to leave teachers free to attribute quotas for the precise measure or in terms of ranges of measures, and to express it in additive or multiplicative way. Therefore, they had to decide “how many times” to pay the player's stake both in case the player bets on a precise measure of the length of the spaghetti and in the case the player bets on a range of measure of the length of spaghetti.

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