CHILEAN PRIMARY TEACHERS CHALLENGED TO BUILD PCK FOR STATISTICS

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This paper analyzes three questions about teachers understanding of teaching statistics as part of a study that addresses the relationship between the pedagogical knowledge of statistics in primary teachers in Chile and its impact on students learning. This work is part of a study that looks for evidences of the association between teacher Pedagogical Content Knowledge and the effectiveness in teaching statistics that is focuses in 4th and 7th grade. Thirty-one teachers from different schools of Valparaíso district were tested after reading a short text referred to non typical values and properties mean. They answered the questions showing a rigid understanding of statistic, as part of mathematics, like a formal discipline. This account evidences primary teachers' privilege procedural approach than understanding problem solving approaches.

BACKGROUND

At present, in Chile, diverse presumptions exist in particular about the main variables that affect the efficiency of the statistic education. This ambiguity complicates the Educative Systems that requires empirical support to favor the consistency and the relevance of tools for the improvement of education and the teacher evaluation and promotion.

Beyond the stable or in the long term changeable variables like socio-economical level of the students families, there exists unfixed characteristic of teachers, like for example their knowledge and beliefs about teaching that could favor the quality of the education. Literature recognizes that one variable associated to the teaching effectiveness is teacher knowledge about the content to teach, in the case that concerns to us, the statistical knowledge of professionals who teach mathematics in Chilean primary school. The literature also recognizes the importance of the "Pedagogical Content Knowledge" (PCK), see Park and Oliver, (2008), this is the dimension that we focused in our study.

The PCK attribute constitutes a teacher knowledge domain that allows the teacher to articulate the understanding of the content and the pedagogical scene in which the content is organized, represented, and adapted to the interests and the diverse capacities of the students (Shulman, 1987). This knowledge is associated to the teacher's ability to transform the content into pedagogically powerful forms. It is adapted to diverse students in experience and capacity (Baxter & Lederman, 1999). The PCK is the base of the knowledge for the action. It constitutes the beliefs and the rationality of the teacher, one that determines its action and decision making in the classroom.

A partial coincidence in Literature exists about the main components of the PCK. In the first place it is "the teaching knowledge", which meets to the knowledge, beliefs and judgments that affect the decisions and the plan of action of the teacher in classes (Fennema & Franke, 1992). At present, Parks and Oliver (2008) distinguish two compatible components to this dimension: "the knowledge of the teacher about the strategies of instruction" and "the teaching orientation of the contents knowledge".

From the point of view of Krauss et al. (2008a, 2008b), these components refer to "the teacher knowledge about the mathematical tasks" and "the teacher knowledge on useful representations, analogies, illustrations, or examples about the mathematical content to teach. An, Kulm and Wu (2004) assert that the knowledge of teaching, the knowledge of the curriculum and the content, is the main factor of the PCK.

Another factor regarding the PCK is constituted by "the teacher knowledge about the previous knowledge, the difficulties and the errors and misconceptions of the students". For Parks and Oliver (2008) the understanding of the student mistaken ideas is the main factor of the PCK, which leads the way of planning, conducting and assessing the teaching. For An, Kulm and Wu (2004) this component constitutes the teacher's knowledge of the student's relation to the content, and it would be for them the most important factor of the PCK. According to Hill, Lewenberg &

In C. Reading (Ed.), *Data and context in statistics education: Towards an evidence-based society. Proceedings of the Eighth International Conference on Teaching Statistics (ICOTS8, July, 2010), Ljubljana, Slovenia*. Voorburg, The Netherlands: International Statistical Institute. www.stat.auckland.ac.nz/~iase/publications.php [© 2010 ISI/IASE]

Shilling, (2008), the teacher knowledge about the way in which the students understand the content is significantly associated to the teaching effectiveness.

In relation to the statistical PCK, the majority of the documents analyzed suggest giving greater emphasis to the selection and proper use of graphical data representation and measures of center and spread. Additionally, in Chile national teachers' standards also suggest as important the proper selection and use of teaching strategies and inference of students' understanding from their work and discourse. Sorto (2006) suggests that teachers need to understand the meaning of measures of center for preparing students learning materials. The teacher should a) understand how students are thinking about the data when they use different strategies and models to find the mean; b) respond to students who think that is impossible to have many data sets with the same mean, and c) anticipate students' answers or interpretation to an investigation question and be able to pose questions to students that lead them to see the effect of outliers or/and new data values have on the distribution and the mean. In a pedagogical sense, teachers need to know how to lead students to the discovery of the algorithm of the mean and why it works.

The National curriculum in Chile (MINEDUC, 2003; MINEDUC, 2004) establishes that students should learn statistics in primary school, focusing on central and dispersion measures and data presentation using tables and graphs.

In the statistics domain, there has already been a move towards emphasizing statistical literacy and developing statistical thinking and a general acknowledgment that learning occurs most effectively when students engage in authentic activities. Statistics educators should push their courses that put more emphasis on conceptual understanding rather than procedural tasks. This has caused a movement toward curricular frameworks emphasizing exploratory data analysis and real-world applications of statistics (NCTM, 2000; Stein, 2000; Everson, Zeiffler & Garfield, 2008).

According to this world movement, we reflect about how much Chilean primary teachers appreciate this teaching approach of statistics as opposed to the classical mathematical view. The aim of this paper is to look for evidence that teacher understanding of statistics teaching in Chile focuses on a procedural approach rather than on a conceptual view as national curricular policies.

METHODOLOGY

Thirty-one primary teachers from different schools of the Valparaíso district were interviewed and tested twice, before and after reading a short text about outlier values and means properties. The teachers answered three questions, considered by Garcia Cruz and Garret (2008), providing evidence of their understanding of statistics and their pedagogical content knowledge. The three questions referred to the mean calculation in contextual situations, and required corresponding discussions. The reading text asserts people need to consider and to be careful with some exceptional data, outlier values which need to be considered before using the data.

RESULTS

Table 1 below summarizes teachers' answers to the questionnaire after reading the outlier values text.

This study allows us to verify that teachers do not observe data within a context. They lack the notion of atypical value, and therefore they do not know to come with this data type in the calculation of the arithmetic mean. Procedural knowledge is not integrated with conceptual knowledge about the mean. In addition, by the teachers the mean as a central measure does not enclose the best estimator property. Apparently teachers have not been familiarized with the conceptual aspects of the mean.

Most of the teachers in this activity demonstrated their knowledge about the influence of the null values in the calculation of the mean. Some of the teachers, in spite of recognizing the change that this value exerts in the total of observations and in the calculation of the mean, rounded to an integer number, which seems to show that they do not accept the mean as a decimal value.

Table 1. Summary of questionnaire answers

Ítem	Content
"Time passed in the 100 meters" At the request of a physical education teacher, 10 students recorded independently and simultaneously, the running time by a student on the distance of 100 m. The recorded times (in seconds) were: 15,05 14,95 15,05 15 10 15 14,9 15 14,95 15 What time must the teacher consider as an estimation of the real time passed by the student and why? Good answers: 2 Errors: 29	The knowledge of the mean as the best estimator of a measure in the presence of measurement errors; the detection of outliers and its influence in the calculation of the mean.
A small object was weighted on the same scale separately by nine students in a science class. The weights (in grams) recorded by each student are shown below. 6,2 6,0 6,0 15,3 6,1 6,3 6,2 6,15 6,2 The students want to determine as accurately as they can the actual weight of this object. Of the following methods, which would you recommend they use? a. Use the most common number, which is 6,2 b. Use the 6,15 since it is the most accurate weighing c. Add up the 9 numbers and divide by 9 d. Throw out the 15,3, add up the other 8 numbers and divide by 8 Good answers: 8 Errors: 23	The knowledge of the mean as the best estimator of a measure in the presence of measurement errors; the detection of outliers and its influence in the calculation of the mean.
"Caught Fish" The number of fish caught by six students in a special activity of that week, is 3, 4, 5, 3, 1 and 2 respectively, that an average does of 3 fish by a student [(3+4+5+3+1+2) /6]. Later it was discovered that in the activity another student had participated who did not fish any unit. Do you think that the mean value of the fish caught by each student will change when considering this last student? Justify your answer. Good answers: 25 Errors: 6	Knowledge of the influence of the null values in the calculation of the mean.

CONCLUSION

Most of the teachers answered the questions showing a rigid understanding of statistics, as a part of mathematics, like a formal discipline. This account gives evidence that teachers have scarce reflection about teaching content knowledge and consequently they might not be able to follow curricular guidance.

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