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Statistical variability: Comprehension of children in primary school

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This study examined the understanding of 48 Brazilian students of 2nd and 5th grades (seven and ten years old) of statistical variability of data in bar charts. A Piaget's clinical interview was conducted involving four activities of variability: description or explanation of the variability; representation of variability; prediction results from the variability of the data; comparison between data sets. Students showed ease in recognizing endpoints, but did not make predictions based on what they had observed. The representation of the variability was shown to be an important factor in data interpretation. Make comparison between data sets was complex for most students. Therefore, it is necessary to promote interrelationship among different aspects in order to make students reflect on the data and predictions.

Keywords: Data variability, teaching of primary school, graphs.

CONCEPT OF STATISTICAL VARIABILITY

The variability concept is essential to statistics, since there would be no need to do statistics if the data does not vary. Despite the centrality of the concept, few studies systematically investigated conceptions of students from primary schools, with activities involving different aspects of variability with the same students. According to Garfield and Ben-Zvi (2005), a deep understanding of the concept of variability requires the exploration of its components since the early years, which justifies the need of the present study. Aspects of such components were selected and explored in four activities with students of public schools in Recife - Brazil. These activities were adapted from previous studies of Watson & Kelly (2002), Watson (2009) and Kader & Perry (2007).

The first activity consist of a bar chart about children's arrival at the school and explored the explanation

of variability, mode, prediction from the mode and comparison of categories. In the second activity, manipulated cards were offered to the students. These cards represented a number of books read by the children. They were asked to explain variability and make predictions. The third activity was asked to compare quantitative data sets presented in bar graphs and in the fourth activity was asked to compare qualitative data.

A description or explanation of the variability shown in graphic was possible for most individuals in the 5th grade, but not for individuals in the 2nd grade ($t(46) = 3.93$, $p < 0.001$). When the activity discussed representation of data explanation, both groups were able good performance.

The representation of the data variability was also significantly easier for students in the 5th grade ($t(46) = 2.75$, $p = 0.009$). It was noted that only individuals in the 5th grade were able to organize cards by drawing a bar graph.

Although students in the 5th grade had shown a significantly superior performance compared to individuals in the 2nd grade when asked to identify the mode on the graph ($t(46) = 2.75$, $p = 0.009$), at the moment of the prediction from the mode, the performance was as low as it was for the group in the 2nd grade. Regarding the prediction of results in situation of representation of variability (from the highest point), half of students in the 5th grade were able to prove them appropriately, with a significant difference to the 2nd grade ($t(46) = 2.17$, $p = 0.035$).

Finally, there is the aspect related to comparison between data sets. For both groups, these activities were complex, regardless the type of data presented to be qualitative or quantitative. Kader & Perry (2007) argued that the comparison of qualitative data (cate-

gorical) would be something intuitive. Thus, a better performance from students in the 5th grade could be expected in the comparison between these sets, but that was not confirmed. Hence, this may suggest that even in the case of qualitative data, comparisons between sets are not as intuitive as they could imagine.

This study has as main contribution the analysis of different aspects related to variability investigated with the same students, showing degrees of difficulties within the aspects observed. We emphasize the need to lead students to establish the relationship between different aspects of variability so that they are able to make prediction results from what they observe.

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