

BRAZILIAN RESEARCH CONTRIBUTIONS TO THE INVESTIGATION FIELD AND TO THE PRACTICE IN STATISTICS EDUCATION IN EARLY CHILDHOOD

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In the last years, the Statistics Education investigation field has driven curricular reforms, public policies and pedagogical practices in the Brazilian Basic Education classroom. In order to understand the impact and the comprehensiveness of the insertion of this field in the educational studies, this investigation sought to map the studies about Statistics Education in early childhood developed in Brazil, highlighting their themes, theoretical and methodological references and main results and conclusions. The work brings significant contributions to the understanding about the research advances, the recognition of a theoretical and methodological diversity of investigation, about privilege themes, as well as the gaps still to be investigated.

INTRODUCTION

The understanding that the statistics and probability are necessary to the reading and understating of the world, of which they are part of the literacy process. It was not always a truth in the Brazilian education that their teaching must happen since the beginning of schooling. In Brazil, the insertion of contents related to statistics in the math curriculum in the first years of the Elementary School happens effectively after 1997 due to the publication of the National Curriculum Parameters (PCN). In this document, the “information processing” was considered as one of the blocks of mathematical contents to the whole Elementary School, on the side of “numbers and operations”, “space and form” and “magnitudes and measures”, that already had a guaranteed place in the math curriculum in the first years of schooling (6 to 10 years). Such consideration resulted in changes in the curricula, that now include the contents of statistics, combinatorial and probability in textbooks and guidance publications of Ministry of Education.

Believing that the same movement happened in research in education, this article intends to know and to point the Brazilian studies on the teaching of statistics in childhood, more specifically in the first years of Elementary School, registered in the portal of the Coordination of Improvement of Higher Education Level Personnel (CAPES). It was driven by the beginning of the writing of the PhD thesis of the first author of this text: the desire of knowing the contributions of what has already been done in this area of knowledge and what are the paths taken by the studies, the institutions in which they are concentrated and their publication dates in order to have an overview of the productions. We will still look at the theoretical references used and investigate what the research findings conclude.

We consulted the thesis and dissertation database of CAPES from November 2017 to January 2018. As we look to the different nomenclature used for reference to the teaching of statistics for children in the first years of Elementary School, we used the following key-words: statistics, stochastic, data analysis, information processing, all of these were inserted in search filters in the field of the science and math teaching and education. Even so, we realized that the words are very far-reaching and present in several areas, apart from math education. There are various approaches, that, in a certain way, was expected, after all the statistics is interdisciplinary, because it includes data of different natures, in varied contexts. The first selection was made through the reading of abstracts in order to choose those that focused in the teaching, learning, literacy or education in statistics, or stochastic, or data or information processing in the initial years of Elementary School.

By believing that to start a data search it is important to consult other researchers that have already performed the same exercise, the Rodrigo Medeiros dos Santos thesis – “State of art and history in research in statistical education in Brazilian postgraduate programs” –, defended in 2015 at Unicamp, advised by professor Dario Fiorentini, was essential in this process, because it has approached a state of art about statistics in Brazil. In order to inventorying, systemizing and analyzing

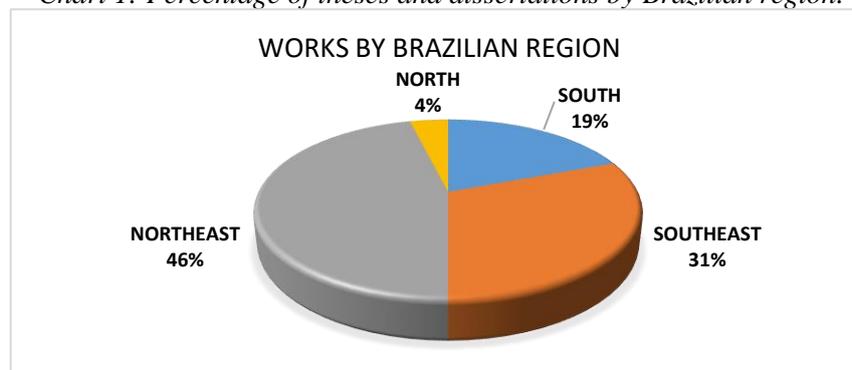
the configuration of Brazilian research in Statistical Education, it is, without doubt, much broader than we intend to bring in this article, since 258 thesis and dissertation were inventoried. In addition to assisting in the organization of data, it contributed to our understanding of how statistical education has become a field of research in Brazil, highlighting that "Statistical Education is the area of Education that deals with the investigation of problems related to teaching and learning of concepts and procedures of Statistics, Probability and Combinatorics, in order to promote the development of literacy, thinking and statistics reasoning" (Santos, 2015, p.17). The thesis is an important reading to guide the studies of those who intent to start in the area, because it brings different definitions about statistics, information processing, statistical literacy, etc., which contributed to direct our research in the database, with different keywords.

Next, we presented the physical aspects of the data of a thesis and 24 dissertations found regarding the teaching and learning of statistics in the initial years of Elementary School, and then we analyzed the studies and their contributions to the field of investigation in Statistical Education in the initial years of the Elementary School in Brazil.

PANORAMIC VIEW OF STATISTICAL TEACHING IN INITIAL YEARS

The 25 studies analyzed point in their abstracts or introductions the citizen need to understand statistical information, indicating the importance of analyzing and interpreting data conveyed in the means of communication. They also quote the National Curriculum Parameters (1997), that advocate the need of the teaching of the Information Processing since the first years in the Elementary School. The PCN were widely disseminated, however the greatest frequency of studies in statistics teaching focused on the initial years has happened almost ten years later: 2006. Regarding the production regions of those studies, it stands out: north (1 work), south (5 works), southeast (8 works) and northeast (12 works), according to the chart:

Chart 1: Percentage of theses and dissertations by Brazilian region.



Source: data collected by the authors in the CAPES catalog of theses and dissertations
<http://catalogodeteses.capes.gov.br/catalogo-teses/>

It is possible to notice that the greatest concentration of works is in the northeast, more specifically, in the Federal University of Pernambuco, made by the professors Gilda Lisboa Guimarães (2010, 2010, 2011, 2011 2014, 2016) e Liliane Maria Teixeira Lima de Carvalho (2013, 2014, 2016). Together they add up to 9 dissertations advised. In the second place, it is the southeast, in the University Cruzeiro do Sul, São Paulo, where the professor Celi Espasandim Lopes (2007, 2009, 2010) has advised 3 works and in the Paraná state (south of Brazil), there is the professor Guataçara dos Santos Júnior (2014, 2016) of the Federal Tecnologic University of Paraná, Ponta Grossa, that has advised 2 works. The professor Gilda Lisboa Guimarães is the leader of the Research Group of CNPQ (Research Group of Statistical Education in the Elementary School and the professor Celi Lopes is the leader of the Studies and Research Group in Statistics and Math Education (GEPEEM) and the coordinator of the Center of Studies and Research in Math and Statistic Education (CEPEME). This information shows that, from north to south and in a continental extension country, the research professors' effort, in order to increase the growth of the area, generates a multiplication of the concept of the importance of teaching statistics in childhood,

because, in a way, each research that begins is a mean of dissemination of statistical education around the country. A proof of this is that most studies analyzed refers to the works of these professors, who are leaders of Brazilian research groups and their participants – which imposes a certain unity in the references that also quote international researchers such as Batanero, Garfield e Benz-Vi.

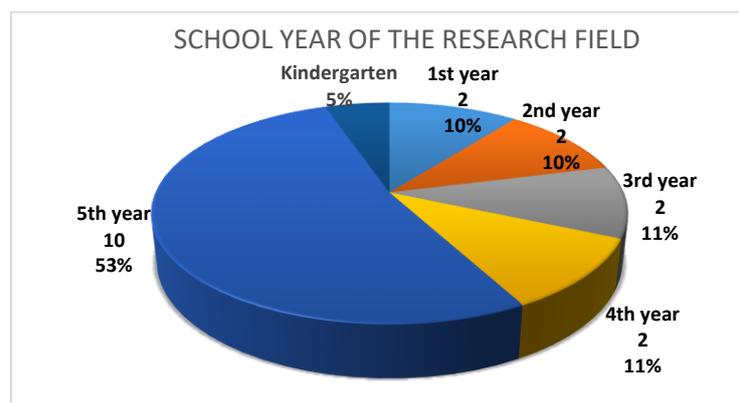
A SIGHT OF HOW IT IS DONE...A LOOK TO THE METHODOLOGIES

The studies analyzed are all qualitative, and only one (14d) being considered qualitative-quantitative. There are 3 case studies (5t, 18d, 24d), 2 surveys that take place in collaborative environments (2d, 19d), others say that part of the research was done with content analysis, documentary analysis and most do not specify a "type of research", but it is explicitly "how" the research was made. The research instruments used were classroom observations, questionnaires, interviews, exercises, tasks and testimonials from / with students and teachers. The choice of such instruments shows that all the studies are carried out in the field: classroom, teacher groups, student and teacher training processes.

It is notable that in 5 works (3d, 7d, 12d, 21d, 25d) the author performs pre-tests with students, after it makes a didactic intervention and then a post-test to analyze comparatively the results. The research that presents this type of methodology, mostly, concludes that the students have little knowledge about statistics and that after the interventions they begin to interpret, analyze and represent data in an efficient way, which shows the need for a more effective teaching work in the area, in the initial years of Elementary Education and in the training of its teachers.

In order to deepen the readings in the methodologies used, we observed that 15 of the 25 studies focus their data collection on a specific year or series of Elementary Education, and four of these (8d, 11d, 17d, 20d) compare the performance of two school years, simultaneously, showing that at all levels of education students have the ability to learn statistics, provided that they have a proper teaching. Two studies have equated the statistical performance of adults and children (9d, 16d), showing that the difficulties that students have in statistics of "Young and Adult Education" and the difficulties of the teacher educators are similar to those of children; and one research (23d) conducted a teaching experience with children in Early Childhood Education (5 and 6 years old), showing that, since there is contextualization, young children are capable of problematizing, developing instruments, collecting, organizing and analyzing data.

Chart 2: Percentage of concentration of research fields in certain school years



Source: <http://catalogodeteses.capes.gov.br/catalogo-teses/#/>

The concentration of research in the last year of the initial years of Elementary School is significant data: 53% of the surveys that mention one school year. The reason for choosing the fifth year can be very diverse, from the fact that it is the transition period between initial and final years, or that the students have a greater maturity or ability to relate data, or that the fifth year gets closer to the age (10 years) in which mathematics teachers work, graduated in mathematics degrees. Thinking that "the teaching of Statistics, at any level of education, has been presenting problems for some time, being responsible for many of the difficulties faced by students in their curricular

activities" (CAMPOS, 2011, p.9-10), we can conclude that there is an existence of the need for study and research on the subject in the first years of the initial years, so that in the fifth year and at more advanced levels, students already have a more elaborate prior knowledge on statistics.

It is worth noting that two analyzed dissertations (1d, 20d) occurred in different school environments such as rural and indigenous schools and the results showed that statistical teaching is possible in these environments when contextualizing students' reality.

Six studies allied the use of technologies to the teaching of statistics (1d, 6d, 7d, 10d, 11d, 24d) and concluded that technological resources can generate a wider learning with different perspectives of visualization, analysis and, consequently, interpretation of data, while requiring greater knowledge of such resources by teachers.

Although the focus of our research was not on teacher training, some studies that worked with teacher training were included in our analyzes (2d, 10d, 14d, 18d) because of their collaborative work characteristic, or the teacher testimony, aiming at the production of didactic materials, or of lesson plans for the teaching of statistics in the initial years of schooling.

Bianchini's (2013,2d) dissertation, for example, used the oral history of teachers as an instrument and thus identified the practices of teaching statistics in the early years. Based on the analysis of the interviews with the teachers, we found out that they have little knowledge about the area and the overvaluation of teaching of numbers and operations and the beliefs related to the linearity of mathematical contents and a necessary "maturation" for children's learning. The conclusions of Bianchini (2013) reveal the important relationship between teaching practices and teachers' beliefs about content, because although statistics have been a part of PCNs since 1997, "being part of a document and the consensus of teachers does not guarantee the daily action of the classroom, with regard to the teaching and learning of contextualized mathematics" (Buehring, 2006, p.21). Another issue brought by Lopes (1998) is that the Parameters should have given greater evidence to probability and statistics, since the theme has never been addressed before in Brazilian curricular proposals nor in teacher training.

CONCLUSION

The teaching of statistics in the early years of Elementary School as a research proposal on multiple realities presents itself as a very broad field in education, since it can (and should) be treated in a flexible and interdisciplinary way among the sciences. The studies analyzed show that the teaching of statistics in the initial phase of schooling is a little researched and known field in Brazil.

The National Curricular Common Base (BRASIL, 2015), a document recently published in Brazil, states that in order to the student to succeed in Mathematics it is necessary to attribute meaning to the concepts learned in the school and it demands a contextualization of mathematics that is related to situations of several contexts (social and scientific). Thus, the teaching of statistics needs to be surrounded by contextualization and meaning. Data collection and its organization make sense to students when they start from needs or when they involve important social, cultural, historical or economic issues to the context. The studies show that statistics provide the contextualization of mathematics with such questions and also with other mathematical knowledge that are the teaching goals of the early years. According to Barreto (2003, p. 2), "The activities with descriptive statistics in the initial grades are of great importance to the research spirit and serve as a rich context for the study of number, since it provides contact with real problems." Considering the premise of the contextualization of mathematics with other disciplines and mathematics itself and its contents, the work with charts and tables elucidates innumerable advantages for interdisciplinary teaching and learning because it brings with itself contexts and subjectivities of the individual, the group and their realities. However, such need needs to be elicited by the teacher in challenging and research situations about reality.

Most teachers, according to Souza (2016), have weak knowledge about statistics, which is reflected in their teaching that is usually limited to the construction and interpretation of tables and charts, leaving aside research processes and research. Souza's (2016) studies show that the possibility of randomness is a fact that makes teachers insecure and, therefore, hardly venture in data simulation experiments, since they will not be able to deal with situations of uncertainty. This feeling of insecurity becomes understandable if we think that statistics and probabilities are fields worked

within the teaching of mathematics, which is and has been historically known for its accuracy. Dealing with likely situations, the improbable, the out-of-randomness pattern may, in the view of these teachers, put mathematical determinism in “check”, destabilizing the "power of the right answer" that the teachers have in their hands.

The existing studies have already revealed the scarce knowledge of teachers about statistics and how to teach it and reveal a broader and dilemmatic reality about Brazilian education: the need for teaching emphasized by official documents, and on the other hand, the lack of conceptual and didactic knowledge of teachers. The dissertations and theses tell us that teachers that are pedagogues, responsible for educating in the first years of schooling, did not study statistics or practices of their teaching in their initial formation and throughout their career. This is a big problem, which demands a lot of research, study and active participation of teachers and researchers.

We have, then, in the teaching of statistics in the early years, in training their teachers and producing their curricula, a large network of emerging research problems. We believe that the profile of researchers for such a challenge is composed by flexible people who believe in the education of critical citizens, who have a critical stance and engage in collaborative work between university and school, between mathematics and other sciences.

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APPENDIX:

No	REFERENCE
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