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Contribution of the Teachers Collaborative Work to Innovative Context in Training Course to Promote Knowledge in Professional Practice of Statistical Education in Basic Education

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ABSTRACT

Statistical literacy and reasoning are prominent in international curriculum documents as an objective in teaching and learning of students. But this promotion in basic education is poorly consolidated in teachers' practices due to lack of their knowledge. Thus, the adoption of collaborative work in innovative teachers training is defended as essential to promote their necessary knowledge and professional development of statistical literacy and reason practices, to promote teaching and students learning. Thus, this qualitative and interpretative research is pertinent, aiming to understand the contribution of the approaches considered in this teacher training using a collaborative context to promote their statistical knowledge and professional practice of students' teaching. This study results show that the collaborative context carried out in the training course contributed to the necessary improvement in knowledge and professional teachers practices development of statistical literacy. So, this study is relevant to support international teachers from this educational community in their necessary experiences to provide the teaching of Statistics in innovative work of the collaborative context of the teachers training, to support their development and knowledge to understanding practices to improve educational contexts.

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Introduction

The need to develop students' statistical literacy and reasoning is currently highlighted in several international curriculum documents recognized as essential learning objectives, to having utility in everyday life as citizens and an instrumental role in several subjects [1-3]. In this context, as student learning depends on the experiences that teachers provide them in mathematics classes, it is relevant in their practices to give greater emphasis to these objectives, involving students in the development of this knowledge and to make them active [4]. And to meet the current curricular guidelines of the educational program, which emphasizes the development of students' statistical literacy and reasoning, an innovator significant change of first-year teachers in these practices is relevant to develop these essential themes in students. However, these Brazil practices are still poorly consolidated today, and are often challenging for teachers, who are unfamiliar with this knowledge and professional development of this component of statistical literacy [5]. From this perspective, to support the needs and difficulties of teachers in this educational community to implement this change in integrating this topic into their practices, the context of collaborative work in teacher training is essential. Therefore, it is pertinent to carry out this presented investigative research, carried out in the training experience with the benefits of collaborative work context of practices, of the initial years teachers who taught mathematics in public schools in Brazil. Therefore, the objective of this study is to understand the contribution of the approaches considered in teacher training using the collaborative context to promote their knowledge and the professional practice of teaching students in literacy and statistical reasoning. The analysis results of this study showed that the proposed work carried out in this training collaborative context promoted the development of knowledge and understanding of teachers' practices to improve educational contexts for teaching statistical literacy and reason. Finally, this study is considered relevant to support international teachers in their practical experiences necessary to provide the collaborative context in the training of teachers in the initial years.

Theoretical Framework

Management Essential of Collaborative Work to Achieve Teachers' Knowledge

The collaborative work context is used appropriately in teaching practices to favor the teacher's interaction focused on development of collective discussions ideas with their peers and sharing of experiences about necessary objectives and actions that are part of teaching practice. It helps teachers to the necessary improvement of

new knowledge and actions to develop and achieve the objectives of statistical reasoning and literacy, in addition to reflection in the classroom on the essential expected learning of their students [6]. The importance of including specific knowledge of Statistics in training teachers need to study articles to master specific content knowledge, exploratory data analysis, and pedagogical knowledge, and for methodological aspects they need contact with activities in collaborative learning that engage in the collection, representation and analysis of data, to be able to later apply it in their Statistics classes [7].

So, in this favor context of teaching practice it is required proposing that participating teachers solve, plan, and select Statistics tasks considering investigative cycles, the use of technological resources to access real data analysis, data representations and calculation of statistical measures, with the formulation of questions and planning of data collection. To they intend the development of their students on the classroom [8,9]. And also work together to support each other by reading and discussion documents and sharing responsibilities focus on experiences in carrying out and resolving their actions of teaching practice, in order to achieve a common objective for all relating to the meaning of the skills and approaches to be adopted in the tasks to be proposed to students [10-13]. To be able to predict and understand their students' conceptions, teachers must also talk explicitly about asking questions and using language and mathematical representations. And it is proposed aspects of didactic knowledge linked to teaching practice: knowledge of Mathematics curriculum, organization of lesson planning of practices processes teaching related to students, preparation and conduct of tasks to the students Mathematics classes [14].

The biggest obstacle to the development of Statistical Education in Elementary Education in Brazil is linked to the fact that teachers do not yet have this specific training [15]. Based on these more demanding guidelines for teaching Statistics, it is adequate to consider teachers collaborative work practices established in Brazil to improve the quality and efficiency of their teaching.

Essential Teaching Statistical Literacy and Reasoning in the Early Years

In order for teacher in the initial years of schooling to be able to essentially exercise competence in their role in the element's promotion of this statistical knowledge of students, it is necessary to be properly prepared to encourage the use of this knowledge on different topics and in real situations [16,17,5]. And so that knowledge and skills are be acquired, teachers are recommended that students between the ages of 5 and 8 carry out data analysis, including reading, interpreting and representing bar graphs, columns and simple tables, whether or not using technology to organize data, and have contact with intuitive notions of Probability, in order to better promote and deepen their knowledge and the development of statistical reasoning, and also the ability to argue, criticize and reflect their knowledge and results [1,18,19]. With a view to the development and progression of these contents and skills, that is presented in Table 1:

Table 1: Contents and Skills to be Developed in the School of Early Years

Year	Objects of Knowledge	Ability
1st 2nd year	Reading tables and simple column graphs; Personal records for communicating collection and organization of information.	Read data expressed in tables and simple column charts. Carry out research, involving up to two categorical variables of interest and a universe of up to 30 elements, and organize data through personal representations. Compare research information presented through double-entry tables and simple column graphs
3rd 4th year	Reading, interpretation and representing data in double-entry tables and bar graphs and column charts and pictorial charts. Collection, classification and representation of research data carried out referring to categorical and numerical variables, through tables and graphs.	Solve problems analyzing data presented in tables, graphs or column and pictorial charts involving significant research results. Interpret and compare terms frequently, using language to understand significant aspects of reality. Carry out research involving categorical and numerical variables, organize the collected data into lists and tables, producing its analysis in text and representing it in column graphs using digital technologies.
5th year	Reading, collecting, classifying, interpreting and representing data in double-entry tables, clustered column charts, pictorial charts and line charts.	Interpret statistical data presented in texts, tables and graphs, and produce texts to synthesizing conclusions. Carry out research involving categorical and numerical variables, organize data collected through tables, pictorial and line graphs, using digital technologies. And present written text of results.

Source: [18].

To ensure the teaching of Probability and literacy Statistics, it is important to consider the need of teacher to adapt the afore referred contexts and skills in their practice at different levels of Basic Education so that students' real contexts used in school to promote active learning, providing understanding of concepts and data analysis [18,20,21].

This involves the ability to remember perception and interpret definitions to establish statistical reasoning information, related to the ability to read, write and interpret school texts and also the ability to discuss and communicate the interpretations made to making of inferences [22].

Aiming to developing and reinforcing students' statistical reasoning, technological resources are highlighted as potential instruments to support them in exploring and analyzing the resolution of real data in statistical problems [21].

Teachers' Teaching Practice

Teachers' knowledge, beliefs and experiences influence teaching practices that are related to the activities teachers and students carry out periodically in the classroom, considering the contexts, meanings and intentions of their actions, such as classroom discussion, teacher questions, and presentation of individual and group work by students [23,24]. It is important to value the teacher's professionalization, taking into account their needs and potential linked to didactic knowledge, which requires knowledge of the mathematics curriculum combined between theory and teaching practices developed in activities directly linked to students [25,26]. When conducting the class, there are fundamental dimensions of teaching practice: they can the tasks selected by the teacher that he intends to implement for his students in the classroom, and guide this work in the communications to encourage the participation of students, and oral questions that occur in interaction with students to describe and present results and evaluate the tasks and their potential to achieve the expected teaching and learning [6].

Methodology

Context of Practice and Participants

This study was carried out over the course of an academic year, in 19 weekly work sessions (2h or 3h each) in a training experience carried out by the second author, focused on the necessary participation of Brazilian primary school teachers in a collaborative context. The participants who revealed availability and volunteered in this study were a group of 3 Brazilian teachers recognized and selected by the author as they taught classes in the 4th year of elementary school, and in participating in this study because they had not yet taught the Statistics subject. However, to comply with ethical issues, their anonymity is guaranteed, using fictitious names identified by: Cristina, Heloísa and Patrícia. In which they were actively involved in the work of the activities carried out and resources used as support in the collaborative work of the training learning sessions [27]. Therefore, the following activities were carried out in professional learning collaborative work sessions to data collection and support them in improving knowledge for their practices:

- They individually read annual curriculum documents analyzing the mathematics teaching program for the initial years [1]. And then they discussed together the contents, objectives and skills that are understood as Statistical Literacy to identify them as necessary in developing work with students on Tables and Graphs.
- Discussion, analysis and joint reflection to appreciate the experiences and materials used in class episodes of a 4th year class, observed on video, to support familiarization of the diagnostic task relating to the construction and interpretation of graphs of circular bars and simple tables developed, and student participation. To define aspects of the appropriate methodology to give importance in the selection and planning of the necessary tasks and objectives to be carried out to implement students in the classroom.
- Resolution of tasks proposed to teachers, where pictorial and linear data are presented in input tables and column graphs, and statistical content objectives, methodologies and resources to carry out research involving categorical and numerical variables, and organize the data collected to support your learning and reflection on appropriate tasks to be used in your students' classroom practices.
- They selected and planned tasks to be applied in classes, relating to the construction, reading and interpretation of bar graphs, pie charts and simple tables. They then presented and discussed collectively to reflect the potential of their contents and questions to support their skills or possible difficulties in carrying out these tasks adapted to work on the necessary statistics and how to propose and manage their adequate implementation in classes to support students in teaching Statistic.

Data Collection and Instrumentation Analysis

This qualitative study follows a descriptive and interpretative analysis aiming to understand the contribution and recognition of the discussion of the joint reflection and the work carried out by teachers in training practice of collaborative context, to improve their knowledge and preparation of literacy and statistical reasoning practices for teaching students in the early years [28,29].

The data collection analyzed by the researchers, to answer the objective of this study, included:

- an interview conducted by the second author, to understand their recognized perceptions about the contribution of the carried practices and collaborative training work to their knowledge for improving literacy and statistical reasoning practices
- an observation and video recordings by the second author educator of participating teachers work and discussion in collaborative work sessions in class teaching sessions to recognize the potential of their observed curriculum manuals and reading books, prepared lesson plan and selected statistical tasks to improve adequate teaching approach on students' practices.

The following section presents the results of the analysis exemplified based on the collection of the mentioned data.

Results and Discussion

In the requested interview, teachers reported their opinion during the sessions on pleasure and reinforced perceptions of the recognized contribution of frequently participating in training sessions in collaborative work, considering that was enhanced by mutual support, it contributed to supporting their knowledge and the necessary development of components to improve literacy and statistics reasoning in his teaching of student practices of 4th year by solving statistical tasks in different types of graphs. The teachers also valued these moments of reflection as a strategy to review future plans and actions in the classroom:

"My enjoyed participating in the progress of all the work, I understood together with my colleagues how should be proposed the tasks questions and the planning the classes. Was what helped me to improving what I taught weekly based on tasks"; "I prepared a game on paper, involving numbers and having something in return which is my students' knowledge and understanding of what I teach so that they can use it for better understanding" and "working with tables that have specific numbers and the graph to analyze what is best for them, it would be easier for students to understand" (Heloísa).

"My participation and discuss in the collaborative group work with my colleagues helped me to understand and be familiar with the type of questions present in the task carried out and how to planning them to propose in the students' classes, because if we didn't read this again looking the different perspective percentage, we would really get lost" (Patrícia)

"In the collaborative work with my colleagues, it was great and comfortable to share and discuss to improve the difficulty in reading texts and solving bar graphs in relation to the interpretation and meaning of the percentage. And I recognized myself as appropriate on how to build a bar graph and use it with students in the classroom, which I consider to be great" (Cristina)

In the observed work that were focused on solving calculations centered on the proposed teaching actions and the collaborative group progressed advances in the discussion of joint reflections on the training course sessions, became more dynamic to participate with each other and was evident that the teachers' actions and questions were gradually changing. Is recognized the potential of teachers, as they engaged and played a very important role in the carried practices moments of collaborative group work, expressing perceptions of concepts and questionings after their reading books and during the solving and selected more challenging statistical tasks that allow opportunities to their knowledge and understand of this work to prepare their adequate statistical literacy actions and lesson plans study, to anticipate difficulties that could have and improve and implement in teaching education practices of students work, chosen to their preparation to promoting interaction between themselves and students to encouraging students involvement to carry out in classes a direct reading of the representations graphics and the interpretation and justification of ideas. Was clear the interest of this work in investigations to allowed them to recognize the objective of the tasks included in the curricular documents to became more dynamic the knowledge or difficulties that students may face as they gained confidence in involving students. And show their suitability of the context and knowledge of statistical tasks for implementation with their students. So, this recognized referred potential of teachers work knowledge observed by the authors, was also considered and highlighted by teachers that expressed this importance to their knowledge and practices that influenced their teaching practices:

"Everything we are working dedicated moments to reflection and discussing in collaborative work group involved watching videos and using statistical tasks exploration and planning that were significant for teachers. This together with other teachers constituted moments in which helped me to have another look at how to apply planning tasks, so I believe that in the document (BNCC) statistics is related to everyday investigations evaluated to apply the statistics task and planning in today changing practice in classroom, because questioning students and teach to hope they use of these contents was not part of my planning and organization of the class in which I work in daily lives. So my behaviour in the classroom today has changed, now I learned how to teach communication with the students, as is needed to question and listen student, and worked statistic literacy tables with numbers and analyse. Now I think we should this work that definitely attract more attention and learning opportunities to knowledge of my students (Heloísa).

"As I am involved in the statistics work watching the videos to use in planning that were worked here by the group, for me it was a great behavior and value because help to have another look how to started planning and apply the tasks from the same our objectives and work requested in my students classroom changed today as there was no self-analysis yet. I learned that the Statistics appear in our annual Planning of our municipality to lot when we had more practice and dialogue with colleagues. So I improved my understanding of the class work that I need to prepare as a fundamental piece for student learning. Just now I knowledge how I have to correct and work on a graph together with the students, as depending on the way I conduct the class so that it looks good. Generally, this way of building a table that is in the book was interesting to introduce the tasks for the student proceed to collectively construct the graph, and now I see my practice proposed in class as a way fundamental piece in student learning" (Patrícia).

"I try to justify that this collaborative sessions of proposed work is a very good way as I considered important to improve the understanding and knowledge of what was requested to my students practice, as I enjoy seeing the different forms of methodology of each one and recognized that the Statistics in our annual document (BNCC) is related to everyday investigations and Plan appear to be worked documents related to everyday investigations and the lived experiences of students, and enjoyed seeing the different forms of methodology from each of the colleagues who supported me. Seeing and doing the work that was positive and needed to be improved, I went back to class doing the same work with a necessary didactic sequence and give many learning opportunities to important introduce of tasks in detail for students using to see the result in a table that is in the book or bring more graphs to help reevaluate their ideas. As I did not have much clarification or access to this material before, was needed to know these worked documents which I found important to bring the skills to be developed and clearly informed us about the changes we need to make in a major adaptation of our students practice" (Cristina).

Conclusions

In this article is reported the observed evident relevant proposed context of collaborative work carried out in the training Brazilian teachers and their recognized opinions and perceptions about the text themes that they read and discussed in this valued sessions as contribution to promote their necessary motivation and knowledge of the statistics concepts worked in the tasks for development to promote the fundamental chances in teaching practices use of bar graphs and pictograms in early years students literacy and statistical practices.

The found results of the data analysis showed that the teachers work carried out in this context of collaborative sessions, providing a favorable space for important discussion and reflection based on official documents to sharing their ideas of experiences and doubts, establishing relationships of trust and mutual important support in which they reflected together and make agreements on graphic representations to supporting each other, including the selection and planning of tasks to improve their knowledge, as referenced as relevant by [11]. It was also indicated and recognized as necessary to make decisions about planning the skills and competencies to be developed, content to be worked on and aspects linked to the methodology, assuming responsibilities in their performance in the classroom, proposing student participation that motivate and favor their learning. And another moment of collaborative work in the reflection of the classes taught, gave their opportunity to develop their practices considering the participation and performance of students in solving statistical tasks in classroom and anticipating possible difficulties of students. Also showing the important upgrading work is taken by these teachers with a lower work in teaching this area in the students practice, was strongly recognized and also suggested their attending in this context to improve their knowledge work relevance in their practices, that also be noted by educational authorities as referred by [29].

Furthermore, we found that the results of this research study showed and allowed us to conclude that during the collaborative work, the teachers improved their knowledge, which confirmed the importance of giving this opportunity to develop their knowledge about literacy and statistical reasoning, as a salient aspect in the study by Pietropaolo et al. and also indicate that the type of work carried out in this training, particularly the discussion of theoretical texts on literacy and statistical reasoning (meaning, approaches) and the exploration and analysis of tasks proposed to students focused on these skills, contributed to deepening this necessary knowledge for their practices, taking into account that they chose to include more challenging tasks in their classes, in which this action was not usual in their teaching practice [30].

In summary, collaborative work contributed and provided the necessary professional development of teachers, highlighted by [11,6].

This study is therefore highlighted as relevant to support international teachers in their experiences necessary to provide the teaching of Statistics in the potential and innovative work of the collaborative context of early years teacher training, and also shows the need for it to be essential to use in initial teacher training future teachers in primary and secondary education, contributing to the necessary development of their knowledge and understanding of practices, to improve educational contexts [31].

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