

## COLLABORATION WITH ORORUBÁ XUKURU TEACHERS:

### Reflecting about statistics education at indigenous schools

*Colaborações com professores Xukuru do Ororubá: refletindo sobre educação estatística em escolas indígenas*

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### Abstract

In this paper we discuss aspects of a research study which investigated collaborative experiences with teachers from a Ororubá Xukuru indigenous village in Pernambuco, Brazil. The study focused on the teaching of statistics related to daily live situations. Based on a qualitative ethnographical research design we tried to answer the question ‘if and how primary school teachers in an indigenous school context teach statistical content’. Methodological procedures foreseen in ethnographic research were integrated in the data collection: (i) participant observation, (ii) semi-structured interviews, (iii) diaries, and (iv) collaborative group. Theoretical concepts of Zone of Proximal Development (ZPD), background and foreground knowledge and statistical literacy were used to interpret teaching practices. After presenting initial results we can answer the question affirmative and confirm that teaching practices of Ororubá Xukuru teachers are grounded in the ZPD of students, they are related to the background and foreground knowledge of the students and they enhance the statistical literacy.

**Keywords:** Indigenous school education, statistics education, teacher education, mathematics education.

### Resumo

Neste artigo, discutimos aspectos de uma pesquisa que investigou experiências colaborativas com

professores de uma aldeia indígena Xukuru do Ororubá em Pernambuco, Brasil. O estudo centrou-se no ensino de Estatística relacionado com situações cotidianas da vida daquele povo. Com base numa abordagem etnográfica de pesquisa qualitativa tentamos responder à pergunta *se e como os professores de escolas indígenas dos anos iniciais ensinam conteúdo estatístico*. Procedimentos metodológicos previstos na pesquisa etnográfica foram integrados na coleta de dados: (i) observação participante, (ii) entrevistas semiestruturadas, (iii) diários e (iv) grupo colaborativo. Conceitos teóricos da Zona de Desenvolvimento Proximal (ZPD), *background*, *foreground* e letramento estatístico foram utilizados para interpretar as práticas de ensino desenvolvidas pelos participantes. Depois de apresentar os resultados iniciais, podemos responder à questão afirmativa e confirmar que as práticas de ensino dos professores Xukuru do Ororubá estão fundamentadas na ZPD dos alunos, estão relacionadas com *background* e *foreground* dos alunos e vinculadas a processos de letramento estatístico.

**Palavras-Chave:** educação escolar indígena, educação estatística, formação de professores, educação matemática.

## Introduction

In Brazil, indigenous peoples have been suffering from subaltern social positions and from being forced to experience an imposition of norms and values that tends to suppress their cultural specificities. During the last decade, Brazilian government has set up regulations to adjust the social and economic position of these oppressed people. With regard to the right of education and access to education, indigenous people stand up for their right of specific indigenous schools with a differentiated curriculum as way to break with homogenizing educational models, in favor of an education that respects the cultural background of indigenous people (NASCIMENTO; QUADROS; FIALHO, 2016). At the same time, Brazilian indigenous schools are allowed to teach codes and symbols of "non-Indian" culture. Therefore, indigenous schools seek through intercultural dialogues the strengthening and visibility of indigenous culture in the school and beyond (MAHER, 2006).

The National Curriculum for Indigenous Schools (*Referencial Curricular Nacional para as escolas indígenas*) – RCNEI (BRASIL, 1998a) is the official document to regulate the organization of indigenous schools and to guide indigenous teachers in their curricular practices. The National Curriculum for Indigenous Schools highlights three aspects about the importance of mathematics education.

- (i) The first aspect refers to the consideration that mathematical knowledge is essential to understand the world inside and outside the indigenous villages.
- (ii) The second is the recognition that there is much mathematics developed in different ways in all communities.
- (iii) The third aspect is the need to understand mathematics for the construction of other knowledge in all other areas of study.

The RCNEI curriculum furthermore suggests the teaching of mathematics considering three content blocks: numbers and operations; space and form; and quantities and measures. Although the concept of quantities can be related to statistics, the document does not explicitly refer to statistical topics. In contrast, the general National Curricular Parameters (Parâmetros Curriculares Nacionais – PCN) (BRASIL, 1998b), published at the same year, introduced statistics since the early years of primary schools.

Indigenous School Education represents an important public policy established in Brazil. It was from the promulgation of the Federal Constitution of 1988 that Brazil recognized the pluriculturality of indigenous peoples, ensuring them access to intercultural education based on the specificities of their values and norms in favor of the cultural preservation of indigenous communities (BRASIL, 1988). In line with the Federal Constitution, the Law on Guidelines and Basis of National Education - LDB (BRASIL, 1996) also guarantees all indigenous peoples the promotion of teaching and research through bilingual and intercultural education, with a view to reaffirm and value ethnic identities and foster access to information and technical and scientific knowledge of indigenous societies in the different stages and modalities of education.

It is fundamental the existence of the terminology *Indigenous Education* and its differentiation from *Indigenous School Education*. The first refers to the specific educational process that each indigenous community, through its traditions and rituals, carries out through its own pedagogy to transmit its knowledge for generations (SCANDIUZZI, 2009). The second term is result from indigenous peoples' fighting with the public power to make the school institution a space where the cultural specificities of each people can be legitimized in educational processes. In other words, it is an achievement of the remnant peoples to the right to learn and teach aspects of indigenous culture associated with the norms and symbols of "non-Indian" culture (MAHER, 2006). In addition to their interest in interacting with other cultures, indigenous peoples seek through intercultural dialogues to strengthen and visibility indigenous culture in school.

According to the Field Education Dictionary (CALDART et al., 2012), the term *indigenous peoples* is used to designate specific human groups that have similarities capable of identifying them as a community. The word *indian* for indigenous peoples is appropriate and is re-signified "in the affirmation of the right to difference, in which Indian is equal to white, not by similarity, but by equivalence of rights" (CALDART et al., 2012, p. 600).

Therefore, the expression *indigenous peoples* is a term that contemplates a notion of ethnic diversity. The Ororubá Xukuru communities, who are participants of this study, are protagonist and pioneering indigenous people in the political and social trajectory. They strongly rely on their internal organizations like the Council of teachers, in order to guarantee of their rights by demanding and proposing an education that suits their interests.

### **Theoretical framework**

The aim of this paper is to investigate if and how primary school teachers in an indigenous school context teach statistical content, even though there are no specific curriculum guidelines for this particular area. We analyze findings from an empirical study in the village schools of the Ororubá Xukuru people in Pernambuco, Brazil. Previous research about these indigenous people indicated that they try to develop pedagogical activities to give visibility and preservation of their cultural characteristics through intercultural practices (CAVALCANTE, 2004).

Ororubá Xukuru people have collective mechanisms which allow them to support educational actions and initiatives in their schools. Key example is the council, Ororubá Xukuru teachers developed to facilitate continuous discussion processes in which they evaluate if the educational projects of the schools are corresponding to the values and desires of the community. The empirical investigation is embedded in the theoretical framework that refers to the concepts of Zone of Proximal Development - ZPD (VYGOTSKY, 1978), background and foreground knowledge as developed by Skovsmose (2005, 2014) and the differentiation between knowledge elements and dispositional elements of statistical literacy as formulated by Gal (2002).

We rely on the socio-cultural learning theory, elaborating on the Russian theory of learning developed by Lew Vygotsky (1978) and its concept ZPD to show the importance of connecting to the pupil's knowledge they bring to school, emphasizing that indigenous pupils don't come to school as empty barrels. All peoples bring background knowledge to the school. The idea is that education works in a cognitive field which can be spotted at the fringe of the out-of-school worldview (FRANÇOIS; PINXTEN, 2017). Vygotsky (1978) defines the concept ZPD of the child as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (VYGOTSKY, 1978, p. 86). The concept of background knowledge is adapted from critical

mathematics educations (CME) with its central concepts of background and foreground (SKOVSMOSE, 2005). Skovsmose explains how education has to be set up with roots in the background knowledge of the child (equivalent to the ZPD), and at the same time, how we have to look for the foreground knowledge sphere, where the pupil will be able to connect easily and insightfully to new knowledge (SKOVSMOSE, 2005). Applied to statistical knowledge Cazorla and Castro (2008) emphasize the importance to connect statistical content to daily life as a possibility to meet the social demand of statistical literacy.

Gal (2002) argues that in addition to conceptual understanding and skills, statistical knowledge contributes to statistical citizenship (RUMSEY, 2002), since citizens develop attitudes and critical postures in relation to statistical information, such as those often presented in graphs and tables in several media situations. The teaching and learning of statistics need to be investigated from a socio-cultural point of view.

Vygotsky (1978) underlines the importance of complex interactions during the processes of teaching and learning. Skovsmose (2014) emphasizes the importance of mathematical activities based on a conception of dialogic and problematizing interaction. This learning situation can be created by bringing meaningful and relevant problems in the math classes to enhance the learning process and to implement embedded mathematics and statistics into the classroom. In the next section we investigate the method used.

## **Method**

An important methodological principle to study indigenous teaching practices is the interaction between the knower and the known (COHEN; MANION; MORRISON, 2011). It is important that the indigenous situation is well understood by the researchers. They have to enter the universe of the subjects studied and they have to understand the diverse information that emerges from the sociocultural environment of indigenous individuals. Therefore, the empirical investigation will be conducted as a qualitative ethnographical research. Methodological procedures foreseen in ethnographic research were integrated in the data collection: (i) participant observation, (ii) semi-structured interviews, (iii) diaries, and (iv) collaborative group.

The participant observation (i) can be understood as the overall research stage that supports the understanding of the research environment, the school settings, the teachers involved and the way to set up the collaborative group. It is a way to start interacting with the indigenous teachers and to set up the trajectory of the research. Participant observation

facilitates the understanding of the context during the visits at the indigenous villages, the interactions with teachers and the leadership of the school, the participation in meetings and the conviviality with the collaborative group.

The semi-structured interview (ii) was carried out following a previous script, consisting of questions linked to the profile of the interviewees (initial and continuing teacher education), previous knowledge about Statistics (their meanings of Statistics), lesson planning for statistics contents, statistical activity development (textbooks, statistics content) and construction and interpretation of graphs. The interviews were carried out with three indigenous teachers from the initial year of elementary school. Interviews were conducted at different times and in different places, considering the availability of each participant. All interlocations were recorded and the data transcribed and organized for further analysis. To preserve the identity of the interviewees we use the fictitious names *Toipa* (means mother), *Jetuin* (girl) and *Sacarema* (woman). These names are part of *Xukuru* language that is almost lost due to imposition of Portuguese language throughout centuries (ALMEIDA, 2001). Informed consent was given by the participant of the research design.

In order to broaden the information obtained from the interviews, we also investigated the class diaries (iii) of two teachers who were interested in granting the material: *Jetuim* and *Toipa*. The purpose of this methodological procedure was to identify how the content of statistics was presented in the pedagogical plans and in the teaching practices. Collection of the data was based on the use of a photo camera and video camera to register each page of the diaries for later analysis.

Finally, a collaborative group (iv) was set up to allow a close relationship between researcher and school settings (leadership and teachers). Special attention was paid to the already existing Ororubá Xukuru council of teachers as the place of co-constructing meaning and the evaluation of the outcomes of the educational projects. This council supports the collective mechanisms which allow them to support educational actions and initiatives in the schools. The option for this methodological approach was given by understanding that collaborative practices in teacher education can contribute to the role of teachers, since they begin to play an active role in the production of data. At the same time, we observe that this is the practice already carried out by Ororubá Xukuru teachers during their general assemblies and in the council of teachers.

Collaborative work is an important tool for in-service training of indigenous teacher which enable them to reflect on their pedagogical practice. The advantage of a collaborative

group is reflected in a more significant development of the teaching and learning processes of mathematics in-service training of indigenous teacher. Therefore, collaborative work presents itself as a possibility for the indigenous teacher to become the main protagonist of his or her professional development and to pass the knowledge to the community (BERNARDI, 2011, p. 87).

Regarding the formation of the collaborative group, it was previously decided in negotiations with the coordinators of the teachers of the Ororubá Xukuru schools, that during the first meeting with the participants, the group's objectives and the methodological practice to be developed, would be established collaboratively. Four face-to-face meetings were held, with five hours fixed without lunch break, totaling 20 hours of workload during the months of June to August 2015. The collaborative group consisted of nine teachers from the initial year of elementary school and two primary school coordinators of the indigenous schools of Ororubá Xukuru people. Participation was on voluntary basis. At each meeting the group discussed and decided on the content to be worked on. The goal of the meeting was to have conceptual discussions, and to prepare lesson plans about Statistics. In addition, it was sought to enhance a critical attitude of students through pedagogical practices that reverberate the cultural specificities of Ororubá Xukuru people.

In order to systematize and socialize the work done by each teacher, the group decided that it would be necessary for the teachers, after conducting their lesson planning with the contents of Statistics, to prepare a report to describe how the actions were developed during the teaching.

During the (1) first meeting we discussed statistical and statistical literacy, using collective analysis and discussion of actual data presented in graphs and tables.

The (2) second meeting focused on discussions about critical reading and expectations of learning in statistics from national curricular guidelines.

During the (3) third meeting, the focus was on the treatment of information, in particular on the conceptual aspects of the construction and interpretation of graphs and tables and an elaboration of lesson planning. After this meeting the teachers carried out their school planning and shared the results in the final meeting of the collaborative group.

The (4) final meeting was aimed at sharing the results with all the participants, and to evaluate the individual development of the activities of the group.

Through the aforementioned research instruments: (i) participant observation, (ii) semi-structured interviews, (iii) diaries, and (iv) collaborative group, we collected the qualitative data

and analyzed the obtained data by categorizations that allowed us to develop a systematic work in accordance with the objectives of the study, on ‘*if and how primary school teachers in an indigenous school context teach statistical, even though there are no specific curriculum guidelines for this particular area*’. In the next section we present preliminary results of this ongoing research and we discuss the methodological analysis of our results.

## Results

We will report initial results related to the methodological instruments that were used to collect the data in order to keep track on our interpretations and to guarantee empirical evidence.

Based on the interviews, we conclude that *Toipa*, *Jetuin* and *Sacarema* are pedagogues with a degree from private higher education institutions. Only one of them, *Jetuin*, said that she received guidelines for the teaching of statistics during her teacher undergraduate course.

We observed that there is a lack of implementation of public policies that meet the specificities and demands of indigenous teacher education regarding Statistics. In general, regarding the pedagogical work, all the teachers mentioned that they tend to relate the content of regular education to specific contents of the Ororubá Xukuru people. This approach is part of a tradition in the context of the villages, where intercultural practices are usually developed.

All interviewees reported that they have already taught statistics topics, either with research or with the construction and interpretation of graphs in the classroom. The bar graph is the statistical representation that they use most in classroom activities, because they are most familiar with. The following excerpt from *Jetuin*’s interview illustrates this practice:

*Jetuin*: I work differently, I will not be saying this is statistics, but I take practice. Field lessons, comparatives, quantities, and the trails that we do, which is a didactic project that is called *Xikão*, Xukuru peace warrior. We use the trail as a strategy, to see the community, water issues, land issues, planting. So when we go back to school, everything that has been seen is reported in graphs, for example, somebody's plantation has such thing, but we do not have it, so why not? So we report this on pie charts and bar charts, why it's startup so I work the construction and interpretation along with them. (own translation)

*Jetuin*’s speech suggests that she teach Statistics focused on research scenarios. This finding was supported by the teacher's report, where we observed that her students carry out research based on real contexts, which can contribute to the development of a critical reflection.



*Jetuim* also reported to be concerned about didactics for the teaching of statistics that puts the student as protagonist of the learning process.

Therefore, she gives special attention to contextualized work based on the daily life of the students in the community. The educational process of Ororubá Xukuru students seems to be permeated by the school environment and it runs through the daily life in the village, it does interrelate with their socio-cultural activities.

Based on the analysis of the class diaries of two teachers (*Jetuim* and *Toipa*) we gained some insights in the topics taught. *Jetuim*'s diary consisted of a material sent by the Pernambuco Education Secretary to describe its planning throughout the school year. 139 classes were registered during the period February to October 2014 directed to a 5<sup>o</sup> year class group. In addition to a characterization of the classes, we could find a model of organization that includes three items called *Earth, Identity and Interculturality*, in which the teacher should describe the thematic axes, contents, themes and objectives to be built by the students.

*Toipa*'s diary consisted of a personal notebook reserved for this purpose, in which she identified her students (by describing name, sex, age, and series), and the discipline records, such as: contents, class purpose, methodology, teaching resources and assessment criteria. Both teachers presented plans with activities that included specific aspects of Xukuru culture. The most frequently mentioned subject was Portuguese, followed by Mathematics, Sciences, History, Interdisciplinary classes, Geography and Arts. Specifically, in the planning of Mathematics, the contents of Statistics are minimally investigated, to the detriment of subjects related to Numbers and Operations Block.

The two teachers presented teaching plans with activities that included specific aspects of Ororubá Xukuru people's culture. The diaries analyzed contained class plans that more frequently covered the subjects of Portuguese, followed by mathematics, sciences, history, interdisciplinary classes, geography and arts. In the teaching planning of mathematics, the contents of Statistics are minimally contemplated, comparing to those contents related to numbers and calculations topics. This reduction of mathematics curricular contents in relation to the other disciplines, then we conjecture that in some way students are being socially excluded because school teaching does not approach essential contents to understand and act in social contexts.

Regarding the formation of the collaborative group, it was previously decided in negotiations with the Ororubá Xukuru teachers' coordinator that during the first meeting with

the participants, the aims of group and the methodological practice would be established collaboratively.

The collaborative group had the voluntary adhesion of nine teachers from the initial years of elementary school and two primary school coordinators. At each meeting the group discussed and decided on the content to be worked on at the following meeting, having as a goal the conceptual discussion and the preparation and individual realization of a lesson plan directed to the work with statistics contents. In addition, it was agreed to promote a critical formation in students through pedagogical practices according cultural specificities of the Ororubá Xukuru people.

In order to systematize and socialize the work done by each participant, the group decided that it would be necessary for the teachers to prepare a report to describe how the actions were developed in the work with the students.

In the first meeting we discussed statistics education and statistical literacy, using collective analysis and discussion of actual data presented in graphs and tables. The second meeting focused on discussions about critical reading and expectations of learning in statistics from national curricular guidelines. During the third meeting, we focused on data handling, mainly on the conceptual aspects of the construction and interpretation of graphs and tables and elaboration of lesson planning. After this meeting the teachers carried out their school planning and socialized the results in the last meeting of the collaborative group. The last meeting was aimed at the socialization of the results with all the participants and also for an individual evaluation on the development of the activities of the group.

Based on the formation of the collaborative group and the observations and interactions we did, we can illustrate in a systematic way how the four sessions went and what content was discussed. Table 1 gives a general description of the actions as developed in the collaborative group.

**Table 1 - Summary of activities developed in the collaborative group**

Meetings	Contents	Methodology
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1°	What is Statistics? What is Statistical Education? What is Statistical Literacy?	Welcomed; Presentation of participants; Decisions on the methodological approach; Analyzes of statistical data.
2°	Critical reading; Discussions on national and state curricular guidelines.	Resumption of the discussion of the previous meeting; Reading of text; Discussion of the topic for the elaborate of the intervention.
3°	Types of charts and tables; Suggestion of sites for graphs construction; Building charts and tables in Word and Excel.	Resumption of the discussion of the previous meeting; Text discussion; Discussion on statistical data representation; Elaboration of the intervention proposal.
4°	Presentation of the planning carried out by the participants; Socialization of the activities carried out in the classroom.	Resumption of the discussions of the 3 meetings; Presentation of the lesson plan done individually by each teacher; Delivery and socialization of the report; Oral and written assessment of the group.

Source: research archives.

During the preparation of the lesson plan, teachers proposed a research project on the water resources in the villages. They listed research as the structuring axis for the development of the plans. In addition, they presented a proposal of contextualized activities from the reality of the villages addressing specific elements of Ororubá Xukuru culture based on debates, researches and involving an interdisciplinary work on statistic allied to other curricular subjects like Sciences. Regarding analyzes of activities carried out by the students attached to the teachers' plans, we consider that they were able to experience meaningful and critical learning.

They experimented with the opportunity to carry out the stages of the research cycle through group work and field research, discussing the theme based on the focus of their villages and collecting data through interviews with the community. In addition, they demonstrated a reasonable numerical sense to express the research results, since they estimated quantities and represented them graphically through sectors and bars. However, specific conceptual aspects in the construction of graphs are still necessary to improve students' statistical literacy, particularly

those related to the organization and systematization of statistical information and the use of scale in the bar graph.

We consider that the participants of the collaborative group, when carrying out the lesson plans, provided situations that contributed to the strengthening of the indigenous identity of the students, allowing the expansion of statistical knowledge based on the experience of the stages of statistical research such as identification of the problem, collection and processing. The collaborative group seemed constructive and fruitful in developing critical stance and preliminary notions of statistical literacy.

### **Final considerations**

Turning back to the initial research question *‘if and how primary school teachers in an indigenous school context teach statistical, even though there are no specific curriculum guidelines for this particular area’* we can answer the *‘if’* question affirmative based on the analysis and the presentation of our qualitative data. The *‘how’* question is more complex and relates to the central concepts from the theoretical framework, ZPD, background and foreground knowledge and the differentiation between knowledge elements and dispositional elements in the broad meaning of statistical literacy. In general, the teachers of the Ororubá Xukuru schools sought to develop an initial work with Statistics valuing the cultural characteristics of the community.

Although the students did systematize the research data with some difficulties, it was possible to perceive that they developed the activities in a teacher-student & student-student dialog and extended this perspective by including interactions with people from the Ororubá Xukuru community. In addition, an effort was made to systematize knowledge about concepts, methods and procedures that involve statistical research.

We can infer that the activities of collaborative group motivated the participants to develop a teaching practice that sought to problematize critically some aspects of the life context of the indigenous community. In addition, the collaborative experience favored the understanding that the statistical content has a social function, enabling, that daily themes can be brought into the classroom regardless of the students' level of education.

We emphasize the importance of statistics topics in teaching and learning school processes, problematizing the students' life context to contribute to the development of statistical thinking and literacy. A critical comment can be formulated about the minimal investigation in Mathematics and Statistics, as was shown in the analysis of the diaries. Since

school is a space that favors the formation of citizenship, it is possible to perceive that there is a reduction of the mathematical contents in relation to the other disciplines of the curriculum.

We conjecture that students, to a certain extent, are being excluded socially since the school environment does not favor the learning of essential content to stimulate and develop a critical posture. Skovsmose (2008) argues that knowledge capable of fostering criticality is complex in nature and not one-dimensional. Therefore, it may not be enough for the school to work with students only on numbers and operations, since it is necessary to combine mathematical knowledge with other knowledge to allow a reflexive attitude. The analysis of the collaborative group outcomes gave evidence that investigations about Statistics were integrated in the real-life context of the Ororubá Xukuru community (water resources in the villages and interviews with Ororubá Xukuru people).

These are examples of how to apply the theoretical concepts of ZPD, background and foreground knowledge and the broad meaning of statistical literacy. The teaching practices of Ororubá Xukuru teachers are grounded in the ZPD of students, they are related to the background and foreground knowledge of the students and they enhance the statistical literacy. We hope to have contributed to reflections on the insertion of Statistical Education in the scope of Indigenous School Education and to the reflection about the work of the teacher, to confirm the possibility to enhance a critical attitude of students, through pedagogical practices that reflect the specificities of the different indigenous communities in Brazil.

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