University-School Leadership in Teacher Education

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ABSTRACT

Background: Research on teacher formation and professional development are beginning to increase, considering various theoretical and analytical perspectives. We operate in a research project that includes the participation of researchers from universities located in the Northeast and Southeast Brazil regions, aiming to identify and analyse facilitating elements for the accomplishment of formative processes in the scope of the school that propitiate the professional development. **Objectives**: to analyse what is revealed as influences of university-school leadership in the formative process for teaching and professional development of mathematics teachers who teach statistics. **Design**: qualitative research. **Setting and Participants**: two teachers, two pedagogical coordinators, a pedagogical articulator (university-school leadership - Lue), of three municipal public schools that are part of the same training process in the state of Bahia. **Data collection and analysis**: after the formative process, an interview was held with two teachers who participated in the meetings and carried out all the activities, two pedagogical coordinators, and the pedagogical articulator responsible for the training process in the three schools. The audio recording of the interviews was transcribed and analysed following the principles of the Textual Discourse Analysis with emerging categories. **Results**: the results show positive influence of the university-school leader on the planning of teaching sequences to address statistical concepts to be developed in the classroom, on the renewal of the teacher's teaching practice in the classroom, on the participation of students in classes and the relationships between the university, school board and their pedagogical relationship with the school teachers. **Conclusions**: training processes are suggested in the school with articulation for actions.

Keywords: professional development; formative process; university-school leadership; statistical concepts.

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Liderança Universidade-Escola na Formação do Professor

RESUMO

Contexto: as pesquisas sobre formação de professores e desenvolvimento profissional vêm crescendo considerando várias perspectivas teóricas e de análises. Atuamos num projeto de pesquisa, que conta com a participação de pesquisadores de universidades localizadas nas regiões Nordeste e Sudeste do Brasil, visando identificar e analisar elementos facilitadores para a realização de processos formativos no âmbito da escola, que propiciem o desenvolvimento profissional. **Objetivos**: analisar o que se revela como influências da liderança universidade-escola no processo formativo para o ensino e o desenvolvimento profissional dos professores de matemática que ensinam estatística. **Design**: Investigação qualitativa. **Cenário e participantes**: dois professores, dois coordenadores pedagógicos, uma articuladora pedagógica (liderança universidade-escola), de três escolas públicas municipais integrantes de um mesmo processo formativo no estado da Bahia. **Coleta e análise de dados**: após o processo formativo, foi realizada uma entrevista com dois professores que participaram dos encontros e realizaram todas as atividades, duas coordenadoras pedagógicas e a articuladora pedagógica responsável pelo processo formativo nas três escolas. As entrevistas, áudio gravadas, foram transcritas e analisadas seguindo os princípios da Análise Textual Discursiva (ATD) com categorias emergentes. **Resultados**: os resultados mostram influência positiva da liderança universidade-escola, na realização do planejamento das sequências de ensino, para trabalhar conceitos estatísticos, a serem desenvolvidas em sala de aula, na renovação da prática de ensino do professor em sala de aula, na participação dos estudantes nas aulas e nas relações entre a universidade, a gestão escolar e sua relação pedagógica com os professores. **Conclusões**: sugere-se processos formativos na escola com articulação para as ações.

Palavras-chave: desenvolvimento profissional; processo formativo; liderança universidade-escola; conceitos estatísticos.

INTRODUCTION

With the experiences of participation in teacher education projects and programmes at the national level, such as the Pacto Nacional de Alfabetização na Idade Certa - PNAIC (National Pact for Literacy in the Right Age), at the state level, such as Pacto com Municípios pela Alfabetização – PACTO - Bahia (Pact with Municipalities for Literacy), and at the local level, such as the extension project, ongoing since 2016, entitled Formação Colaborativa de Professores da Educação Básica (Collaborative education of basic education teachers), we observed that, despite investments in research in basic education, the results indicate that it is necessary knowledge building that favours teaching

practice that can ensure teachers' and students' learning. We emphasise that our experience is circumscribed in the area of mathematics. In general, continuing teacher education programmes are anchored in courses or workshops offered outside the school and carried out by trainers from outside the school, bringing ready-made teaching proposals, where the teachers attend, carry out some activities, and return to their own school (Ponte, 2012). In this formative model, teachers rarely participate actively in the process, and what they are presented is often disconnected from what they need when teaching the contents of the school curriculum. In general, the organisers do not take into account school working hours and space, the teachers' activities planning in school, and school contents to be taught (Day, 2001). Neither do they consider the daily difficulties that the school board faces within the community where the school is inserted, arising from demands for public policies and education departments, in other words, the school culture in its broad and daily context.

The results discussed in this article come from an ongoing research project that aims to understand how a formative intervention collaborates with the professional development of teachers who teach mathematics in elementary school (their statistics knowledge and teaching) and affects their students' knowledge of statistical concepts.

This formative intervention is developed by a research group external to the school that, in implementing this project, takes the proposal to the school, seeking to motivate teachers to work from the perspective of a collaborative group formed by teachers, pedagogical coordinators, and members of the research group (researchers, undergraduate and masters' students, and teachers of the public school system). The formative experiences Santana and Correia (2011), Santana, Alves and Nunes (2015) and Santana, Lautert, Castro Filho and Santos (2018) carried out in their research works indicate that as the research group is external to the school, there is a natural temporal distance between the formative meetings. Such a situation may prevent the teachers from developing actions in their classrooms; consequently, their professional development will be influenced by the formative intervention. Given those results, the research group has been seeking alternatives to minimise the negative effects of the distance between the face-to-face meetings. This means to understand the possibilities of articulation between university and school (university-school leadership) from the perspective of the education and professional development of teachers who teach mathematics. In this study, we propose to answer the following research question: How does the university-school leadership influence on the formative process for the teaching and professional development of mathematics teachers who teach statistics?

THE SCHOOL AND THE UNIVERSITY IN THE FORMATIVE PROCESS

To exercise professional actions, teachers who teach mathematics need to have experiences and knowledge associated with teaching practice, called didactic knowledge, that we can separate into four strands of knowledge: knowledge of mathematics, of curriculum, of the student, and their learning, and working processes in the classroom (Ponte & Oliveira, 2002).

This knowledge is a relevant element for the formative process of the teacher who teaches mathematics, as well as the need for construction, mobilisation, reflection, socialisation, and analysis of knowledge that refers to the theoretical, methodological, and practical issues. School, the place for teaching and training, could provide the teachers with conditions, during planning time and in collaboration with their peers, to plan tasks for the classroom, and reflect collectively on the results of this process, aiming at their learning and their students. This type of formative process is a strand to promote the professional development of teachers who actively participate in it.

Implementing this process in school can contribute to the professional development of teachers by improving their practice and their professional learning (Imbernón, 2011). In this sense, Marcelo Garcia (1999) understands that professional development activities modify not only the teacher but also those who have responsibilities with the school. We can infer that the activities planned do not happen in a fixed and isolated way; instead, they are articulated in the context in which they are immersed, in a dimension of a productive alliance, as Anderson and Herr (1999) call it, aiming to strengthen common areas and promote collaboration between the two cultures - university and school, researchers and school teachers, constituting a collaborative field of learning from each person's experience (Lüdke, 2001).

According to Day (2001), professional development does not happen as the only aspect of the professional career. It presents itself with a holistic view, as something that interferes with the teacher's action, influencing on his/her ability to grow professionally and to develop skills to improve education and school results. Teachers' professional development depends on their personal and professional trajectory, on public policies and school contexts, as places where they perform teaching activities, considering them as opportunities offered to teachers in formative activities, in an attempt to review,

reflect, undo and redo their experiences and actions and, above all, their professional commitment.

Clarke and Hollingsworth (2002) present an interconnected model of teacher professional development whose structure allows analysing phases of a training process. The structure presented by the authors is composed of four different domains: (i) *external* domain (source of information, stimulation and support); (ii) domain of *practice* (professional experimentation); (iii) domain of *consequence* (in student learning); and (iv) *personal* domain (includes teacher knowledge, beliefs and attitudes). In this model, professional development will occur through processes of reflection and implementation or appropriation (*enactment*) of actions that the teacher can take in the interlocution processes between the domains.

This model describes the movement we make in schools to carry out the formative process. We act in the external domain, because the research group is placed within the school as a source of information, stimulus, and support. It is a source of information when it means to encourage the teacher to embrace and experience, in their practice, the content studies and the elaboration of teaching sequences from a collaborative group perspective. A group of teachers, pedagogical coordinators, articulators, and researchers supports the conceptual issues of content, planning of the teaching sequence, development of classroom actions, classroom organisation, evaluation, and systematisation of activities, not losing sight of the teaching content.

The development of classroom activities with teaching sequences planned in this perspective places the teacher and the student as active and participatory agents, which can be seen in Santana, Serrazina, and Nunes (2019). It is a source of stimulus when it proposes to maintain experimentation, within the domain of the teacher's practice, to understand the students' learning, which implies the domain of consequences, that is, it reflects on the students' learning. However, the research group has been trying to identify the best way to monitor the teachers to support the development of their actions. Often, with the distancing of the research group, which stays in the sphere of the university, the teacher finds difficulties that may arise from their teaching knowledge or are inherent to the school daily actions, such as: planning, indiscipline, conflict management with school board, or with pedagogical coordination. This almost daily monitoring of these activities demands that the university research group get as close as possible to the school teachers during the development of the actions planned.

In a training process, when considering the external domain (source of information, stimulus, and support) and the domain of practice (professional experimentation), proposed by Clarke and Hollingsworth (2002), we assume that in the external domain the school professionals are not present. However, when the research group approaches the school to carry out a training process there, there is a natural division of tasks among people, since each group assumes a role in this process.

Another aspect is that, between a formative meeting and another, there is a detachment from the external group that does not happen during the implementation of the domain of practice that occurs in the classroom. In addition, if the demands arising from this process are not aligned with the actions of the school culture, with the pedagogical coordination, and school board, there is a risk that the actions are not performed as planned.

In the development of the training, based on the formative model of Clarke and Hollingsworth (2002), the personal domain is also present, considering the teacher's knowledge, beliefs, and attitudes. The beliefs can be characterised as "the way a person guides her/himself in the world, as an "*expectancy*" or "*predisposition*" of that person to action, in view of what is presented to her/his spirit" (Guimarães, 2010, p. 88).

In this sense, in the development of the actions of the practice, the beliefs in the way the teacher thinks of the world, knowledge, teaching, and the social function of the mathematics contents, the student, the school, the relations in the school, etc., are apparent. And these beliefs indicate certain attitudes in the relationship with people, with the contents, the curriculum, and their formation.

In this context, in an attempt to move between the two cultures, we propose the constitution of a leadership that is part of both the external group (university) and the school, which we call university-school leadership, the one that assumes the role of coordinating at school the actions and propositions placed by the external group, or planned in the formative process, seeking to ensure the success of formative actions that enable the teachers' professional development, and accompanying the development of teaching sequences planned in the formative meeting, talking and motivating teacher and students, guiding on conceptual and methodological issues, among others.

Figure 1 presents Clarke and Hollingsworth's (2002) formative model, with the addition of leadership that has its action directly related to the external domain, school board, and the domain of practice.

Figure 1

Formative model with university-school leadership. Adapted from Clarke & Hollingsworth (2002).
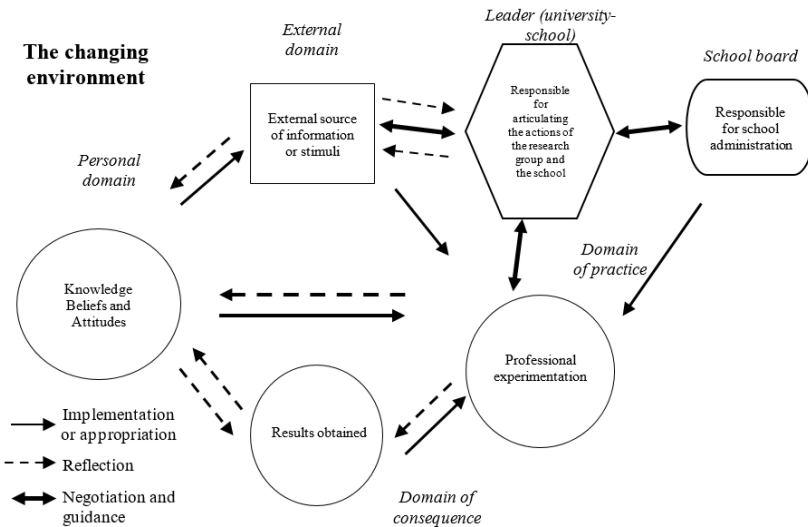
In this formative model (Figure 1), the action of leadership contributes to negotiations between the university (researchers), school board, and the teacher, to simplify the realisation and (re)construction of theoretical and methodological concepts indicated by the external group and the plans made with the teachers in the formative meetings. From the negotiations that the leader implements with teachers, they can reflect on the planning and changes in their teaching practice and the development of student learning.

Another point to be highlighted is how important the role that the school board plays in this model is, since the support and encouragement of both the pedagogical coordination and school board are necessary elements to create conditions for the success and appropriation of the ideas and planning carried out during the teachers' formative process for their teaching practice and, consequently, the student's learning.

ELEMENTS OF TEACHER PROFESSIONAL DEVELOPMENT IN SCHOOL

In our study, professional development activities motivated in the formative process aiming to increase critical and reflective capacity seems to be a possibility to promote equity in teaching and society (Zeichner, 2008), contributing to the teacher's better knowledge of the results of this construction of knowledge for and in their professional experience. This condition makes more flexible the profession and the professional and enables the coexistence of the work carried out in teaching and the different teaching modalities, and coordination and the school board (Day, 2001).

Thinking about the formative and the professional development for mathematics teaching (especially the contents of statistics) goes beyond the conceptual issue, in a perspective of training of mathematics teachers who are prepared to "work inside and outside the classroom to change the inequalities that exist both in teaching and in society as a whole" (Zeichner, 2008, p. 17), expanding the possibilities to reflect on their purposes and practices. Thus, "working together with other teachers in preparation time, focusing on children and keeping the focus on them, is a valuable way to solve [...]" (Fullan & Hargreaves, 2000, p. 40) problems of teaching, learning, and professional development, under the following conditions:

> [...] give voice to the teachers' purposes; actively listen to and really support their desires; establish opportunities for teachers to confront the beliefs and assumptions underlying their practices; show readiness to listen and learn from what teachers have to say about change; avoid creating a culture of dependence among teachers, overestimating the experience of research published and underestimating the teachers' practical knowledge; avoid fads in the form of 'top-down' implementation of new teaching strategies, the value and appropriateness of which are administratively treated as above any criticism; strengthen teachers and their schools to regain substantial decision-making responsibility over the curriculum (the main place of purpose and value) as well as teaching; create a community of teachers who jointly discuss and develop their goals, over time, to create a common sense of mission in their schools. (Fullan & Hargreaves, 2000, p. 40-41, author's italics)

Those conditions indicate that learning and professional development are not a monopoly of teachers' wisdom (Fullan & Hargreaves, 2000), but need to be valued, allowing for the construction of moments of listening, in which the teacher has a voice and encourages a critical and reflective dialogue, from a perspective of articulation between teacher, pedagogical coordination, direction, and researcher in university.

The teacher's voice needs to be considered so as to provide opportunities for their learning experiences. And, expanding the results of the studies of Santana, Serrazina, and Nunes (2019), it is possible to describe that in a formative process developed within the school, in which the teacher's professional development is sought, we can place as elements: a) trust within the group constituted in a collaborative perspective (teachers and trainers); b) confidence in the results of the formative process for their teaching practice; c) planning of activities to be carried out in the classroom; d) management of actions with the school board and pedagogical coordination; e) development of activities in the classroom (teacher practice); f) reflections in and on practice. Those six elements that are inherent to this model of formative process within the school need to be articulated by the university (research group) and the school to enable the experience of teachers and, consequently, to reach all domains presented in the interconnected model of teacher professional development (Clarke & Hollingsworth, 2002).

When considering, in the formative model, the participation of all teachers in a specific area (mathematics), the coordination and school board, we were emphasising the teacher professional development and a context of the development of the school itself. Also, when we have teachers from different school units participating in the same formative process, we can create a network of schools to build a formative process based on research about teacher professional development and student learning. In suggesting the creation of research-based school networks, Michael Hubermann (1995a, p. 193 apud Day, 2001, p. 268) infers that we must have "the purpose of establishing a link between the exchanges of experiences between peers, the interventions of external people as a source of resources and the increasing likelihood of real change at classroom level." The participation of people outside the school in the constitution of a group formed by teachers from different school units and university researchers can intensify the exchange and socialisation of experiences and the better acceptance of external resources regarding the theoretical contribution and the opportunity to experience new elements for the teacher's practice.

METHODOLOGY: THE EMPIRICAL FIELD

This study is part of a broader, qualitative research, as the researchers attended "the places where phenomena of their interest occur, focusing the data collected on natural behaviours: conversations, discussions, etc." (Bogdan & Biklen, 1994). This research was developed in a network of public universities in the Northeast and Southeast regions of Brazil.

For this study, we outlined the research in three public 6th-to-9th-grade elementary schools (middle schools). The teachers involved taught mathematics, and the focus was on the work with statistics content. The research project was submitted to the Ethics Committee on Research with Human Beings at Plataforma Brasil and approved by review CAAE: 85950217.6.1001.5526 on April 11, 2018. The implementation of the formative process brought together professionals from the three schools, with the face-to-face participation of two pedagogical coordinators, the university-school leader, eight mathematics teachers and the members of the university's research group.

The university-school leader has a mathematics teaching degree and acts as mediator and articulator between the university research group, in this case the Research Group in Mathematics, Statistics, and Sciences Teaching (GPEMEC, in Portuguese), the mathematics teachers of the three schools, the pedagogical coordinators, and the school board. Regarding the research, we call the school articulator university-school leader (liderança universidade-escola - Lue). Her workload in the municipal school system is meant for her to articulate the mathematics area in the schools. This condition favours her move back and forth between the three schools and her participation in the GPEMEC activities.

For the production of empirical material, interviews were conducted with two teachers, two pedagogical coordinators, and the Lue (see Figure 2 and Figure 3), who will be identified as Teacher1, Teacher2, Coord.1, Coord.2 and Lue (university-school leader). The criteria for choosing the two teachers were: a) having more than 75% of participation in the formative meetings; b) having performed all the activities of the formative process; c) and being available to participate in the interview. The criteria for choosing the coordinators were: a) to have followed the formative process; b) and to be available to participate in the interview. The criteria for interviewing Lue were: a) her being available to participate in the interview; b) the need to know what Lue shows about the follow-up performed.

Figure 2

The script of the interview with the pedagogical coordinators and teachers

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The script of the interview with the pedagogical coordinator and teacher

1- Influence on planning

1.1 How do you plan the actions with Lue for the development of mathematics classes and activities, from the perspective of the approach of statistical concepts?

2- Influence on the relationship: school and university (research group)

2.1 How do you characterise the relationship that Lue establishes between the school board and the university (research group)?

2.2 How do you characterise the relationship that Lue establishes between the school teachers and university (research group)?

3- Influence on the relationship: pedagogical coordination and teachers

3.1 How do you characterise the relationship that Lue establishes between the pedagogical coordination and the school teachers?

4- Relationship between Lue and teachers

4.1 How do you characterise the relationship established between Lue and the school teachers?

5- Influence on the monitoring of teaching practice

5.1 In your opinion, Lue's monitoring of the classes that were planned in the formative process to address statistical concepts influence the teacher's practice? If so, what are those influences? Otherwise, why not?

6- Influence on the monitoring of teaching practice

6.1 Do Lue's actions influence on whether teacher professional development occurs? If so, what are those influences? Otherwise, why not?

Figure 3.

The script of the interview with Lue

The script of the interview with Lue

1- Influence on planning

1.1 How do you plan the actions with the pedagogical coordination for the development of mathematics classes and activities, from the perspective of the approach of statistical concepts?

1.2 How do you plan the actions with the teachers for the development of mathematics classes and activities, from the perspective of the approach of statistical concepts?

2- Influence on the relationship: school and university (research group)

2.1 How do you characterise the relationship you establish between the school board and university (research group)?

2.2 How do you characterise the relationship you establish between the school teachers and university (research group)?

3- Influence on the relationship: pedagogical coordination and teachers

3.1 How do you characterise the relationship you establish between the pedagogical coordination and the school teachers?

4- Relationship between Lue and the teachers

4.1 How do you characterise the relationship established between you and the school teachers?

5- Influence on the monitoring of teaching practice

5.1 In your opinion, your monitoring of the classes that were planned in the formative process to address statistical concepts influence the teacher's practice? If so, what are those influences? Otherwise, why not?

6- Influence on the monitoring of teaching practice

6.1 Do the actions you developed influence the occurrence of teacher professional development? If so, what are those influences? Otherwise, why not?

7- Influence on Lue's professional development

7.1 How do you see your professional development in this process?

For data analysis, we chose the Textual Discursive Analysis (TDA) (Moraes & Galiazzi, 2011) as a methodology to seek to understand the movement developed during the formative process carried out at school, involving university researchers, teachers, and the pedagogical coordinators. Thus, at first, we "read the interviews, disassembling the text to understand the statements [of the respondents] and find the units of analysis. They portray the meaning and the sense of the formative movement that is now happening at school" (Santana & Couto, 2020, p. 50).

The meaning is linked to a system of relationships that was formed objectively in the historical process and ends in the word. A stable system that is found in every word, in the same way for all people (Luria, 1986). It is linked to social experience and a particular set of relationships. The sense is of an individual character, that is, what each respondent reported, but has a different relationship for each person, in this case, in the situation of the formative process at school, in a specific case (Luria, 1986). With the disassembly of the text of the interviews, with its new organisation, we identified the units of meaning and thus constituted a new text that was submitted to analysis. We proceeded to interpret it to seek to understand, in the light of the theoretical

framework, the movement of the formation and professional development that is being proposed and thus capture the new emerging that arises from the analysis. Due to the nature of this work, we chose the following guiding questions to proceed with the analysis: a) how does the articulation with planning actions occur? b) how does the articulation occur when following the teaching practice (teaching conception)? c) Does the articulation between university, school, and teachers occur? d) Does the university-school leader influence on the professional development? These guiding questions are presented, as well as the emerging categories obtained through the TDA.

RESULTS AND ANALYSES

The presentation of the analysis follows the order of the relationships identified in the guiding questions, which we organised into four sessions: University-school articulation with planning actions; Articulation and monitoring of teaching practice; Articulation between university, schools, and teachers; and, Influences on the professional development.

University-school articulation with planning actions

Paraphrasing Fullan and Hargreaves (2000), we worked with a system, which was composed of: two teachers, two coordinators, one area articulator (Lue), and three schools. The empirical material produced in the research allows us to identify that the articulation between the university and the school (teachers, coordination, and school board) influences on the planning of activities to be developed in the classroom.

When asked about how Lue plans the actions with the pedagogical coordination for the development of the classes and the mathematics activities from the perspective of the approach with statistical concepts, the answers of the five respondents show that in the articulation made there are elements inherent to the planning and elements that reveal influences (Table 1). It should be noted that for exposure purposes only the categories below are presented in the column preceding the unitarizations. And, this will be reflected on all the charts present in each stage of this presentation. However, because they are emerging categories, at the time of obtaining them via TDA, what first occurs is unitarization. Because it is from this emergence of meanings that the categories are being constituted.

Table 1

Elements of planning and influences

Category	Description (unitarization)
Planning (elements)	- Socialisation of sequence planning with the pedagogical coordination - Adaptation of the initial planning with the school reality (plans from the content) - Innovation for teaching practice - Dialogue to establish planning and obtain a diagnosis of students' knowledge - Plans, negotiates, articulates, guides, challenges, monitors the teaching practice, and gives the teacher autonomy - Responsibility in carrying out the activities scheduled
Influences	- With her knowledge of the experience for planning actions and for changing the practice of the pedagogical coordinators - For a movement with teachers who are out of the formative process - Teachers' professional and personal life

The analysis made it possible to identify evidence that in the articulation between university and the school to carry out the planning, the leader talks to the pedagogical coordination and teachers about the need to insert the statistics contents throughout the school year. Those insertions are received as challenges for teachers who are not used to working with those contents or with research for work with scientific thinking, which mobilises students' interest and active participation.

After socialising and reviewing the planning of activities with the pedagogical coordination in the three schools, Lue works with teachers, adapting the content to be approached with the course planning initially carried out by teachers; guides them to carry out an initial diagnosis with the students; articulates so that the plan is carried out in the classroom, and monitors the development of activities. Teachers and coordinators indicate that Lue's responsibility with the times and days scheduled for their meetings is a strength that intensifies confidence in the work and the sharing of planned and valuable actions. During planning, based on her experiences, Lue's actions influence on

the practice of pedagogical coordinators and teachers from other areas that are outside the formative process, configuring the brand of the personal domain with the articulator's knowledge and attitude, demonstrating her role in school and her vision of mathematics as a mathematics *of* and *in* life (Clarke & Hollingsworth, 2002, Guimarães, 2010).

In the actions Lue developed to carry out the planning of activities for the classroom, trust is established within the group to seek good results in the implementation of the proposed teaching practice.

Articulation and monitoring of teaching practice

When asked about the possible influences of Lue's monitoring of the classes that were planned in the formative process to approach statistical concepts for the teacher's practice, the respondents indicate elements that influence on the teaching practice, student learning, and teacher's knowledge about student learning processes, as shown in Table 2.

Table 2

Elements that influence teaching practice

Category	Description (unitarizations)
Teaching practice (elements)	- Decreases teacher resistance and insecurity - In the articulation between planning and practice - Understanding the teaching process of the statistical concept - Change in teaching practice - In reflection on the practice - In the perception of students' learning processes - Students' behaviour

The five respondents indicate that by participating in the classes, audio-recording them, and then analysing excerpts from these classes with the teacher, Lue 'breaks' the teachers' resistance to being watched, or monitored, in their classes, and reduces their insecurity concerning the challenge of changing their teaching practice. She also creates conditions for teachers to reflect and not to stand as the holders of knowledge, allowing students to actively construct knowledge and take a stand during classes, changing the teacher's perception of the students' learning processes.

The two teachers tenaciously state that their practice and their perception of the students' learning processes have changed substantially with Lue's guidelines and the reflections made from the dialogues established regarding the practice observed. This condition indicates the idea that working together in school helps to improve the practice and solve problems of students' teaching and learning (Fullan & Hargreaves, 2000).

Another point highlighted by the respondents is that students start to have a behaviour of greater involvement with the presence of the leadership in the classroom. At first, just as the teachers, students resist the presence of the leader in the classroom, but over the days, they change their behaviour and start requesting audio recordings of their notebooks and their speeches.

By following the teacher's teaching practice, Lue contributes so that the teacher trusts the results of the actions of the formative process in their practice, in the development of activities in the classroom, in the reflections in and on the practice. The attitudes of Lue, the teacher, and the students show that working together inside and outside the classroom helps to reduce situations of inequalities in teaching and learning, establishing opportunities for teachers to confront beliefs in relation to their practice, listening, and learning with teachers and students in the school (Fullan & Hargreaves, 2000, Zeichner, 2008).

Articulation between university, schools, and teachers

The articulation between the university (researchers), teachers, and the teachers with each other was indicated in the speech of the respondent teachers as a condition *of listening to their experiences* (Fullan & Hargreaves, 2000) and that the monitoring carried out jointly - pedagogical coordinators and the articulator - indicated that it began to be evident that the teachers were treated equally. The actions developed by Lue in planning situations with the research group (university) and teachers at school showed that Lue assumes the function of planning, monitoring, and assessing classes (Table 3).

Table 3.

Elements of the articulation between university, schools, and teachers

Categories	Description (unitarization)
Relationships established	- Construction, confluence, integration, partnership, monitoring, collaboration, support, motivation, trust - Mediation

	- Trust in the work of the university – represents the university
	- Treating teachers equally
Articulation: university-school-teachers (elements)	- The school board to manage the actions to be developed in the classroom
	- When carrying out the planned actions in the formative process
	- establishes trust
	- Issues of teaching practice and specific knowledge
	- Establishing elements for the understanding of teachers to develop the proposal from the theoretical perspective of the research group (university)
	- Articulating
	- Teachers overcoming challenges
	- Splitting tasks
	- Articulating between teacher and coordination

According to the analyses made, we can infer that Lue plays a role with the direction of the school and the pedagogical coordination that makes them trust the university and enables them to encourage the implementation of actions to be developed within the classroom. Establishes partnerships with the pedagogical coordinators and the school board, seeking the confluence between the objectives set out in the school program and the proposal of the formative process. Articulates the relationship between pedagogical coordination and teachers, guiding them to overcome challenges for the organisation of research activities that are planned as methodologies for working with the statistical concepts. Also, she treats teachers equally, motivates them, and divides the tasks between the team of coordinators and teachers for the development of the actions. In this movement, the four domains of the formative model proposed by Clarke and Hollingsworth (2002) are present, insofar as they value the processes of reflection and implementation or appropriation of the teachers' actions in the processes of dialogue between the external, practical, consequential, and personal domains.

Lue manages the actions with the school board and the pedagogical coordination, and between them and the teachers, aiming to intermediate the interests of the university (research group) – external domain - and the planning made in the formative process - domain of practice. Those are actions that

articulate, in the daily life of the school, information from the external domain, with the elements of school board and the teacher planning, so that the perspective of what was predicted in the formative process occurs in the classroom – the domain of the consequences that mobilise student learning (Clarke & Hollingsworth, 2002).

Influences on professional development

The formative process was structured to stimulate professional development. When the respondents were asked whether Lue influences the professional development of the participating teachers, all said she did. The leader exerted a positive influence to renew elements of the teacher's practice, their self-confidence, and to expand the studies, see Table 4.

Table 4

Elements that influence the professional development

Categories	Description (unitarization)
Revisit, renew or extend teaching purposes (elements)	- Change in teaching practice and intervention processes in classes - Change in student perception and student learning processes
Learning experiences (elements)	- Decrease teacher resistance and insecurity - Support for teachers' decisions - Influence on the articulation between planning and practice - Confidence to develop activities in school - Influence on reflection on the practice - To broaden the studies

With the analyses, we can infer that teachers were encouraged to plan actions for their classroom practice and conduct experiences for their own learning. They revisited and expanded the intervention processes in the classroom and the way to monitor and mediate elements for student learning. The elements that offer evidence to think about the learning experience refer to the stimuli to broaden their studies with regard to specific content and methodological theoretical elements for the work with statistical concepts; change in resistance to participate in the experiences of a teaching centred on

the students, and be confident to make this change; and learn to reflect on the practice performed (Clarke & Hollingsworth, 2002).

Those elements evidenced in the interviewees' statements indicate that the university-school leader influences the professional development of the teacher, since the monitoring and guidance provided certifies the planning of activities for the classroom and stimulates efforts to achieve the results of the formative process in the teacher's own teaching practice. Such actions strengthen teachers and schools in (re)conquering their place in the community (Fullan & Hargreaves, 2000).

Metatext

Concerning the analysis guided by the issues arising from the **articulation between university and school with and in planning actions**, two categories (planning and influences) were obtained. Those categories consisted of **unitarization** that identify the occurrence of socialisation of planning, that is, there was an interaction between the university-school leader that enabled the involved to accept to adapt the initial planning "to the new one," starting from the school reality. In this way, it was possible to start planning from this consciousness. This reflected in an innovation that comes from this planning that allowed the appearance, or emergence, of actions that negotiate, articulate, guide, challenge, and monitor teaching practice. Those actions give the teacher autonomy. In turn, when performing the unitarization of the actions that were presented by the teachers, the ideas about a maturation of the planning that occurred in the school were noticeable. With each guiding question analysed, greater was the confirmation of the intensity of the influence of the university-school leader on teachers. What can be observed in the respondents' statements: Often, the person does not even realise that it is she [Lue] who is leading. "Couldn't it be like that? In such a school, it was so, in such a fair [mathematics fair] it was so." She always has an example to give of what worked and what did not work. She always has everything "tied up" with the teacher. (Coord.2). "You [the teacher him/herself] must plan for this [decrease the indiscipline] and I talked a lot with her [Lue] and, she gave me *feedback*, so to try to make a pleasant and a differentiated class, in which you have to call the students toward you." (Teacher1). "For example, [in the planning of the teaching sequence] in relation to the basic basket 'what will we do? do you think it's best

if we go to three markets?' So, we discuss together how we will establish problems, how we will raise the student's awareness." (Lue). Planning was done in partnership with teachers, always guided by the elements provided for in the formative process. Still, in relation to the influences, the teachers showed that Lue, with her knowledge of the experience, managed to constitute a planning that also changed the pedagogical practice of the pedagogical coordinators, and this action extended to trigger a movement with teachers who were outside this formative process, and this influenced both the professional and the personal life of the teacher. This was ratified in "[...] this work and the experience that it is enriching my practice, in relation to the monitoring that I need to give to the teacher. Even I, as coordinator, am seeing [mathematics] in a different way." (Coord.1). "[...] there comes the articulator [Lue], but why? "Why can't this Portuguese teacher, this English teacher who is working on the names of the fruits, bring the weight, and mathematics? Can't they partner with the math teacher?" But she kept scoring. She spoke to Teacher 3, brought the teachers, it came to the knowledge of the school board that the other teachers could participate in the fair, bringing the mathematics knowledge too." (Coord. 2). Regarding the guiding question that deals with the articulation when following the teaching practice, the teaching practice category emerged. This category evidenced the presence of elements related to reducing the resistance and insecurity of the teacher, which could occur when articulating planning and practice in the teaching processes related to the teaching of the statistical concept. This action triggered a change in teaching practice, causing a necessary reflection on the practice from the teacher's point of view, at the same time that reflections on the students' learning processes (behaviours) are observed. Students become more disciplined, assimilate the content better, and are more curious and participatory. "We are doing a new approach, a new practice, a new work, trying to modify what we have rooted in those concepts, that fear of mathematics, of boys not wanting to know, and of the teacher, too, being somewhat insecure." (Coord.1). "She (Lue) could make us teach in a practical way, so that you could align what you are teaching with something that students will build. She [Lue] sharpened it a lot in me as a teacher, not just being the keeper of knowledge. She said this a lot: "ask the students, promote curiosity in the students, make them think, make them reason." And that's what I started doing in class." (Teacher1). To monitor, or to observe the teachers in the development of practical actions in the classroom, it was

necessary to win the confidence of teachers and also students, since Lue was, until then, strange to that classroom space. This trust permeated from the moments of planning, the conversation with the school direction board, reaching the classroom, and creating situations such as "ask students, promote curiosity in students, make them think, make them reason" (Teacher1). In this condition, Lue is helping the teacher to reflect on his/her practice. These statements depict the elements studied by Clarke and Hollingsworth (2002). With regard to the articulation between university, schools, and teachers, established relationships were identified regarding the construction, confluence, integration, partnership, monitoring, collaboration, and support, as well as mediation, trust in the work of the university, and treatment of teachers while maintaining equality. As for the influences related to teaching practice, they mentioned the issue of managing together with the direction board the actions to be developed in the classroom, as well as the issues of teaching practice and specific knowledge of statistics. "For us to trust the university, first we had to trust the person who brought the work here. Because if the university brought the work but did not bring a person who would make us fall in love with the work..." (Coord.1). "[...] it is a relationship of negotiation, of listening. Mainly listening, she comes all... and then suddenly she takes that burden [concerning Lue's listening], then she goes, not very happy, but she returns with another mood. So, it's a listening relationship." (Coord.2). "When she [Lue] arrived, the coordination called her to talk and everything she said was accepted. But initially, it wasn't. But then, they began to accept it, to believe what was being done, even because of the students' statements as they praised it." (Teacher1). Another moment in which trust is present between university (external and personal domains), school, and teachers (the practice, consequence, and personal domains). The personal domain, which deals with beliefs and attitudes, is present in university and school, since both instances need to believe in that model of formative process and, through listening and mediation, establish conditions for the elements of professional development to be effective in that action (Clarke & Hollingsworth, 2002). Regarding the guiding question about the **influences of the articulator on the professional development**, the university-school leader predominantly influenced the reduction of the insecurity of the teacher in a change of teaching practice, which reflected on the practice and a greater perception of the students' learning processes. This influence also occurred for the teachers' professional development,

being identified in support for teachers' decisions and in making them confident to develop activities in school, change in the students' perception and the intervention process in classes. Those changes are based on revisiting, renewing, or expanding, doing, undoing, and redoing the purposes to establish higher quality education and learning. "[...] my vision changed in relation to my classes, how my practice was and every day I prepare a class, I always remember the project. So, I stop and think they have potential, students have a lot of potential and we can demand it from them in a way that they can create this knowledge and we can only intervene" (Teacher2). "I have seen the teacher professional development in the students' participation, how the students, how the teacher coordinates an action, and how the students respond. The students are more interested in giving that answer, of looking for, "oh, teacher, I found it here, is that so? Teacher, I did it this way, is my chart, okay?" So, I realise that there has been a change over time about the context, how the teacher directs the class, how the student behaves, the answer that the student gives today, the issue of the student wanting to present the answer of what he/she did, show how he/she found it." (Lue). During the development and monitoring of actions in the classroom and school, there were two movements in relation to the construction of knowledge, that is: the knowledge of mathematics for teachers, coordinators, Lue and students; and the processes of teaching and learning mathematics in the context of the classroom, school, and school community. Those movements indicate another look at the curriculum (Ponte & Oliveira, 2002). Those actions indicate possibilities for the professional development of those who are immersed in this action, strengthening the university and school as a productive alliance (Lüdke, 2001), and creating conditions to learn the specific content (in this case, statistics), the pedagogical knowledge with the planning and the development of the teaching sequences, as well as the learning of practice among teachers, coordinators, and university-school leadership (Imbernón, 2011). Those actions modify and influence people at school and university (research group) (Marcelo Garcia, 1999), influencing the ability to grow together, personally and professionally, and develop skills to improve education and school outcomes (Day, 2001; Clarke & Hollingsworth, 2002). With this, as a notation of this moment, we can show how effective Lue's presence was in the realisation and scope of each action.

CONCLUSIONS

The results indicate that Lue's actions to carry out the formative process aimed at the professional development of mathematics teachers who teach statistics show positive signs, identified in emerging categories, made possible by the TDA. Those categories were signalled throughout this article so that the actions pertinent to planning were described one by one as to their relationships. Thus, we identified that Lue influenced the planning of the mathematics teachers to teach the contents of statistics in their classes, followed these teachers' practice, and encouraged them to go further and reflect on teaching practice.

With this way of acting, the teaching of statistics began to be thought about from its planning, evolving to the diagnosis of student learning, as well as the teaching practice carried out in classrooms. Thus, the movement that was developed between the university and the school showed that the actions are not fixed. This is because we worked with three schools, which have different dynamics; however, they create formative and professional development possibilities considering their context, their students, and their teachers' trajectories. Listening (giving voice) (Fullan & Hargreaves, 2000) was the aggregator point to understand this formative possibility as a productive alliance (Anderson & Herr, 1999; Lüdke, 2001).

The mathematics teachers, the pedagogical coordinators, and Lue indicated elements in their answers that show that the articulation between university and school requires leadership that, together with the school direction board, can create conditions that make possible to overcome the challenges posed to the organisation of research activities. Also, its role favoured the work with statistical concepts. This is because the leader established partnerships with the pedagogical coordinators and the school board, seeking the confluence between the objectives set out in the school program and the proposal of the formative process. She also motivated the team of coordinators and teachers to develop the actions.

This analysis of the empirical material indicates that the articulation, which we can also call leadership, developed among professionals at the university and at school, focuses on monitoring teachers, helping them to reflect on their classroom actions and, in this process, creating conditions to strengthen teachers and their schools on the organisation of classes with the contents of statistics, designing a community of teachers that jointly discusses and develops their formative strategies at school, as well as student learning (Fullan & Hargreaves, 2000; Clarke & Hollingsworth, 2002).

It should be noted that this monitoring seeks to treat teachers considering their personal and professional trajectories (Marcelo Garcia, 1999, Day, 2001), articulating the formative and educational purposes of researchers with those of teachers and the school. By following the planning, Lue encouraged the insurance of the insertion of the activities planned in the formative process, monitored the development of classroom activities, and assessed, with the teachers, the actions developed in the classroom and the students' learning (Day, 2001; Fullan & Hargreaves, 2000). This condition has been expanding the teachers' vision beyond content just for the sake of the content, but increasing their critical and reflective capacity to think about content in a context of active participation of students, aiming to promote equity in teaching and society (Zeicnher, 2008). This condition was planned, monitored, and reflected during the planning and realisation of the classes that were organised into teaching sequences.

However, the actions developed in this research do not have - considering the individuality of each community where educational management operates - an end in itself, as it enhances new actions, listed in the reality of each school and that have in Lue's presence this necessary articulation in the teachers' formative processes. Thus, this research will extend to other referrals raised by other school realities, in which Lue' role will again be encouraged, enhancing in this way other identifications for which the role of the university is redone, to contribute in an articulated way so that other actions of planning of the pedagogical practice can be constituted.

AUTHORSHIP CONTRIBUTION STATEMENT

E.S. and M. E. S. C. designed the idea presented, developed the theory and the entire process of data collection, analysis, and presentation of results. M.C.P. analysed the data and structured the presentation of the results.

DATA AVAILABILITY STATEMENT

The data of this research will be made available by the authors upon reasonable request.

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