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Formation for the development of the LeME Transforma Project: contributions to the academic and civic life of undergraduate students

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Abstract: This article discusses the contributions that the LeME Transforma Project can bring to the professional and citizen formation of undergraduate students. Therefore, the narratives of these students, shared during the training period in which they experienced Statistical Learning Projects, were qualitatively analyzed using the methodology of the Collective Subject Discourse. The undergraduates recognized the tools that Statistics provides for daily and teaching activities, which may be a reflection of the developed pedagogical strategy. Furthermore, they associated Statistics with financial issues and Probability, relating the knowledge derived from these areas to daily tasks. Participation in the project proved to be important in the construction of teaching knowledge, not only of content but also experiential. Therefore, the project and the proposition of an investigative methodology can contribute to a formation focused on critical citizenship, as well as in the constitution of teachers concerned with the social role that Statistics plays in the lives of their students.

Keywords: Statistical Education. Statistical Learning Projects. Critical Exercise of Citizenship. Teacher Formation.

La formación para el desarrollo del Proyecto LeME Transforma: las contribuciones para la vida académica y cívica de los licenciados

Resumen: Este artículo discute las contribuciones que el Proyecto LeME Transforma puede aportar a la formación profesional y ciudadana de los licenciados. En este sentido, se analizaron cualitativamente, a través de la metodología del Discurso del Sujeto Colectivo, las narrativas de estos, compartidas en el período de formación, en el que experimentaron los Proyectos de Aprendizaje Estadístico. Los licenciados reconocieron las herramientas que la Estadística proporciona a las actividades cotidianas y docentes, lo que puede ser reflejo de la estrategia pedagógica desarrollada. Además, asociaron la Estadística con cuestiones financieras y la Probabilidad, relacionando el conocimiento proveniente de estas áreas con las tareas diarias. La participación en el proyecto resultó importante en la construcción de saberes docentes, no solo del contenido, sino también experiencial. Por lo tanto, el proyecto y la propuesta de una metodología investigativa pueden contribuir a una formación orientada a la ciudadanía crítica, así como en la constitución de profesores preocupados por el papel social que la Estadística ejerce en la vida de sus alumnos.

Palabras clave: Educación Estadística. Proyectos de Aprendizaje Estadístico. Ejercicio Crítico de la Ciudadanía. Formación Docente.

A formação para o desenvolvimento do Projeto LeME Transforma: as contribuições para a vida acadêmica e cidadã de licenciandos

Resumo: Este artigo discute contribuições que o Projeto LeME Transforma pode trazer à formação profissional e cidadã de licenciandos. Logo, foram analisadas, qualitativamente, através da metodologia do Discurso do Sujeito Coletivo, as narrativas destes, compartilhadas no período de formação, em que vivenciaram os Projetos de Aprendizagem Estatísticos. Os licenciandos reconheceram as ferramentas que a Estatística fornece às atividades cotidianas e docentes, o que pode ser reflexo da estratégia pedagógica desenvolvida. Ademais, estes associaram a Estatística às questões financeiras e à Probabilidade, relacionando o conhecimento advindo dessas áreas às tarefas do dia a dia. A participação no projeto se mostrou importante na construção de saberes docentes, não apenas do conteúdo, mas também experiencial. Portanto, o projeto e a proposição de uma metodologia investigativa podem contribuir para uma formação voltada à cidadania crítica, assim como na constituição de professores preocupados com o papel social que a Estatística exerce na vida de seus alunos.

Palavras-chave: Educação Estatística. Projetos de Aprendizagem Estatísticos. Exercício Crítico da Cidadania. Formação Docente.

1 Initial Considerations

This article highlights the contributions of the training in the Statistical Multimedia Literacy Program (LeME)[1], linked to the Innovation Center of Statistics Education (ICE), specifically in the LeME Transforma Project, to the professional and civic life of the licensing students[2] participating in the Project, who planned and experienced teaching in an informal teaching space. For this purpose, the evaluations of the licensing students were considered, who shared their understandings about the participation and impacts of the Project in a dialogue aimed at this purpose.

It is worth noting that LeME, presented more broadly in Porciúncula's book (2022) and also discussed in Porciúncula, Schreiber, and Giordano (2022), focuses on developing statistical competencies such as Statistical Thinking, Reasoning, and Literacy, through the methodology of statistical projects, recently known as *Statistical Learning Projects* (PAE). In this pedagogical context, the student develops research, based on themes motivated by their interest, bringing education closer to the issues that impact their daily lives, which is expected to reflect in the construction of citizenship, that is, in a democratic and more informed society (Porciúncula, 2022).

Moreover, LeME, since its formation in 2012, has been developed through different projects in formal educational spaces, such as municipal public schools in Rio Grande, RS, and informal spaces, such as the Centro de Convívio dos Meninos do Mar (CCMar), where the LeME Transforma Project was carried out. Under this pedagogical context, the student develops research, based on themes motivated by their interest, bringing education closer to the issues that impact their daily lives, which is expected to reflect in the construction of citizenship, that is, in a democratic and more informed society (Porciúncula, 2022).

Lopes (2013), when discussing the professional knowledge in Statistics of Mathematics

[1] Learn more about the LeME Program and its projects at: https://leme.furg.br/en.
[2] This research considers students from the Mathematics Teaching, Portuguese/Spanish Language Teaching, and Pedagogy courses enrolled in the second semester of 2023.

licensing students, observes that they need training that develops skills related to promoting the development of statistical thinking in their future students. Furthermore, the author highlights that the statistical training of these undergraduates requires changes, as it needs to provide, in addition to statistical knowledge in the context of problem solving, experiences in the execution of projects and research activities.

In a broader context, Souza (2017) discusses the statistical self-efficacy of undergraduate students, that is, how much the graduate student believes they are capable of taking actions in favor of solving tasks related to Statistics. Regarding the factors that influence statistical self-efficacy, the author highlights: the teacher, the methodology, previous experiences, both in Mathematics and Statistics, the social cognitive theory itself, and personal factors. In this sense, it can be stated that these are determining factors that directly influence how the individual acts in the face of Statistics in their daily life, whether for personal or professional issues. Once again, the teacher and their pedagogical choices, influenced by their professional training, show the impacts and the necessary emphasis on scientific research and teacher education courses.

In this context, the importance of methodologies that provide experiences in the field of Statistical Education, such as the PAE considered here, is highlighted. Goulart (2015) points out that, although statistical knowledge is present in the documents guiding Basic Education and Mathematics Degrees, these need to be related in order to provide a broad education, regarding Statistical Literacy. The proposed and analyzed training in this article, therefore, comes under this bias: contributing to the mastery of statistical knowledge; broaden the field of view regarding the importance and presence of Statistics in daily life; establish relationships between the objects of knowledge related to graduation and Basic Education in favor of Statistics teaching.

This pedagogical strategy - the PAE, dialogues with the LeME Transforma Project, as it allows the construction of teaching knowledge, such as: professional, when discussing practices based on theories and methodologies of the area; curricular, by presenting Statistics in the documents that guide Basic Education; and experiential, when skills with students are developed in practice. Tardif (2014) states that these are necessary knowledge for the educator to exercise their profession, in the face of the demands that arise in the classroom. Thus, the author defines teaching knowledge "as a plural knowledge, formed by the amalgam, more or less coherent, of knowledge derived from professional training and disciplinary, curricular and experiential knowledge" (p. 36).

Beyond teaching and the knowledge that guides it, participation in the LeME Program and related projects provides the construction of learning in the field of Statistics, necessary knowledge for the full and conscious exercise of the rights and duties inherent in citizenship. As described by Campos et al. (2011), in a society characterized by an excess of information and the demand for decisions in situations of uncertainty, the importance of the resources that Statistics can provide becomes undeniable, not only for scientific research and in the academic field, but also to promote an investigative, reflective, and critical approach by students in a globalized society.

In this sense, Statistical Literacy is crucial for people to read, evaluate, and make well-founded decisions in the face of statistical arguments they encounter daily (Gal, 2002, 2019; Weiland, 2017). From the perspective of an education focused on critical citizenship, investigative projects are seen as a pedagogical alternative for critical statistical education, as they value the intellectual and citizen formation of the student, who begins to reflect on themselves and the environment around them, as well as to understand and engage with the

social and political problems of the reality in which they are inserted, motivating them to question it (Campos et al., 2011).

Given the above, aiming to achieve the proposed objective here, a brief theoretical framework is presented that discusses aspects relevant to statistical education, whether for critical citizenship or for teaching. Next, the methodological path of the research is described, detailing the formative process in the LeME Transforma Project and how the understandings of the licensing students were recorded and analyzed. Following that, the results of the analyses are presented, based on the collective discourse of the licensing students, which is also discussed. Finally, considerations about these results are indicated, which are expected to contribute to discussions in the field of Statistical Education, in an academic and citizen sense.

2 Theoretical Framework

The theoretical section of this article will be presented in two stages. Firstly, aspects related to the integration of Statistics and training for citizenship, one of the themes addressed by the licensing students in the discourse to be analyzed, will be discussed. Then, the discussion about teacher training in the context of Statistical Education will follow.

2.1 Statistical education aimed at critical citizenship

Statistics plays a fundamental role in shaping individuals to develop an investigative, reflective, and critical stance towards their own reality. Curricular documents, such as the Common National Curricular Base (BNCC) (Brasil, 2018, p. 274), emphasize this by stating that "all citizens need to develop skills to collect, organize, represent, interpret, and analyze data in a variety of contexts, in order to make well-founded judgments and make appropriate decisions".

The skills mentioned in the BNCC are associated with specific competencies in the field, namely Statistical Literacy (Gal, 2002; 2019), Statistical Thinking (Pfannkuch & Wild, 2004), and Statistical Reasoning (Garfield, 2002; DelMas, 2004), which relate to the individual's ability to interpret and critically understand the statistical information they encounter daily. According to Campos et al. (2011), these competencies can be approached from the principles that guide Critical Education, aimed at a conscious and critical formation of citizenship. This integration is also seen here, as it is understood that Statistics must be accompanied by "the objective of developing students' critical thinking and engagement in political and social issues relevant to their community" (p. 483).

Statistics comes precisely to enable individuals, here students and future educators, to act in the face of reality, understanding and questioning it in a participatory and justice-oriented manner. As described by Weiland (2017), this formation that approaches critical citizenship can contribute to a fairer world, especially by promoting awareness and appreciation of the inherent plurality in society, as well as questioning the structures and social differences, which are sometimes unjust. Thus, statistical knowledge is seen as a tool not only for consuming data and information but also for a new worldview (Weiland, 2017).

From this perspective, the implementation of projects (or project-based pedagogy), such as the PAE (Porciúncula, 2022), is understood as a path to develop students' competencies and critical formation, as it makes them investigators of their own reality, based on topics that interest and motivate them. In the pedagogical proposal of the PAE, students are guided in the investigative process, which involves choosing the theme and obtaining data, as well as statistical analysis and sharing of results. Thus, the PAE provides an interdisciplinary pedagogical practice centered on student leadership in a playful manner, with the teacher

playing the role of a guide (Porciúncula, 2022).

2.2 Teacher education with a focus on Statistical Education

Statistics is a science present in various areas of knowledge and, as previously mentioned, contributes to shaping individuals, both academically and professionally. According to Lopes (2010), the frequency of statistical information appearing in citizens' daily lives has increased, highlighting the need to expand knowledge in this area. In this context, disseminating and working towards the advancement of Statistical Education is fundamental, since critical statistical thinking is essential for understanding the information available daily. Therefore, during the teaching and learning process, it is essential to provide an educational environment in which the individual plays a leading role in constructing their knowledge (Lopes, 2008). Thus, teaching knowledge and skills are mobilized and constructed in this educational process, as emphasized in this article, in this case, at a moment of initial formation.

Statistics in the school curriculum is largely attributed to the training of Mathematics teachers, who are responsible for the subject in the final years of Elementary School and High School. Although the development of Statistical Literacy is one of the fundamental roles of the area (Gal, 2002, 2019; Franklin et al., 2005), researchers have already pointed out the disadvantages that generic subjects without specific pedagogical content can bring to the training of these professionals (Costa & Nacarato, 2011; Rodrigues & Ponte, 2020). Additionally, teaching materials and textbooks in higher education often prioritize only specific content of Statistics, neglecting its pedagogical aspects, which are as necessary as support in the exercise of teaching in the classroom (Lopes, 2013).

In the Early Years of Elementary School and in Early Childhood Education, the pedagogue is the professional who, according to the curriculum prescribed for this stage, will develop with students, in addition to an investigative process, skills such as: notions of chance, randomness, calculation of probabilities, classification of variables, tables, and graphs (columns). Despite this, Conti et al. (2019) point out that, when studying the syllabi of Brazilian Pedagogy courses, more specifically in Rio Grande do Sul (RS), such skills are not present in a satisfactory manner, highlighting the need for an educational reform regarding knowledge of content and pedagogy in the field of Statistics.

In this perspective, the importance of teacher education is emphasized, in order to meet the different challenges related to their pedagogical practice. In the field of teaching knowledge, different researchers have described a range of specific and necessary skills for the profession (Gauthier et al., 2013; Shulman, 1986; Tardif, 2014), also specific to Mathematics (Ball, Thames & Phelps, 2008), Statistics (Burgess, 2008; Godino et al., 2011; Schreiber & Porciúncula, 2021), among other fields.

In this sense, Tardif (2014) argues that educators need a plural knowledge, involving knowledge acquired in professional, curricular, and experiential training. Furthermore, according to Fazenda (1991), the interaction between theory and practice is of great importance in teacher education, as it enables a better interpretation of concepts. This is the scenario in which the students and future teachers, subjects of study of this work, are inserted. The students experienced the theoretical context related to the training phase and the practical context, while developing the LeME Transforma Project.

In the theoretical framework presented, Tardif (2014) explicates these knowledges: professional, curricular, and experiential. Professional knowledge, or pedagogical knowledge, is what belongs to teacher training institutions, which can be produced by researchers who generally do not experience daily school life. This context produces knowledge that sometimes

distances itself from the reality experienced by educators, as it considers only theories and methodologies, neglecting variables related to the reality of each school. Also, curricular knowledge, present in school programs, guides teachers in the process of planning, teaching, and evaluating.

Regarding experiential knowledge, which is developed in daily work, it articulates with professional and curricular knowledge. According to Tardif (2014, p. 39), "it incorporates individual and collective experience in the form of habitus and skills, of knowing-how and knowing-to-be." Thus, the undergraduate student leads the development of statistical research in the classroom, with their role being to guide the methodological path of this pedagogical strategy and lead the discussions arising from the themes chosen by the students (Porciúncula, 2022). In this way, this teaching methodology allows articulating the various knowledges and the plurality advocated by Tardif (2014), which is constantly added to with each experience provided by the PAE.

3 Methodological Approach

This section describes the methodological characteristics of this study, explaining the connection between the definition of objectives and the results obtained, as well as the target audience, data collection, and analysis methodology. For this purpose, this section will be divided into two subsections: The LeME Transforma Project; and Research Actions and their Characteristics.

4 The LeME Transforma Project

The LeME social technology competed in the second half of 2021 in the *Transforma!* Challenge for the Reapplication of Social Technologies by the Banco do Brasil Foundation (FBB), named *Projeto LeME Transforma* (LeME Transforma Project). It was one of the five projects selected for support by the Foundation, which aimed to contribute to the development of projects over a two-year period to provide income generation opportunities for citizens in social vulnerability.

The LeME Transforma Project was developed at CCMar, a space that offers semi-annual pre-professional courses to approximately 150 young people, aged between 14 and 17 years old, in situations of social, economic, and environmental vulnerability. Over the two years of the Project, students from the teaching courses at the Federal University of Rio Grande (FURG), located in the same city, were invited to act as teachers, with 12 students being selected per semester, considering 10 days of activities at CCMar.

During the period in which the Project was developed at CCMar, the teachers developed the pedagogical strategy of PAE (Porciúncula, 2022). This strategy aims to develop activities that statistically educate students, in this case, through a statistical research that considers their preferences, curiosities, and pre-professional courses. This is because it is envisaged that students may have better conditions for income generation in their professions by understanding and producing, critically and consciously, the necessary statistics in their daily lives, both in work activities and in exercising citizenship.

For the development of PAE, specifically in LeME Transforma, the teachers went through a formative process, designed and developed by two of the authors of this article and members of the Project's management team. In the training, the teaching students were introduced to the steps related to LeME Transforma, statistical concepts (such as measures of central tendency and dispersion, structure of graphs and tables, among others), and methodologies with a ludic and active bias (such as interactive graph construction and quiz

questions and answers).

Luckesi (2005) states that ludic does not need to be linked to games or play, but rather to be something pleasant for the body or mind of those involved in the activity. In this sense, Votto (2018) believes that the LeME Program can be considered a ludic phenomenon, precisely because it develops a thematic of choice and interest of the student, making them the center of their teaching and learning process. Therefore, proposing pedagogical activities with a ludic bias is also one of the concerns of the LeME Transforma Project regarding the formation and experiences of the students and teaching students involved.

It is important to note that the formative process in LeME Transforma took six days, with one day for a more general presentation and five for training, in the afternoon, lasting about three hours each meeting. This followed the methodological path of PAE, with discussions on statistical research and the knowledge inherent in the investigative process. In addition, it involved dynamics focused on understanding and constructing data analysis, and finally, on preparing the material for presenting the results.

Therefore, the first formative meeting was reserved for choosing the theme and forming the working groups. On the second day, the teaching students constructed a questionnaire. On the third day, they conducted the statistical research. The other two days of training were allocated to analysis and presentation of the results to the other classmates. The training mediators sought to provide teaching students with the same experience that their students would have, experiencing the steps of PAE through dynamics and potentially ludic activities. It was expected that the training would impact the professional teaching development, as well as contribute to Statistical Literacy.

During the preparation of the teaching students, an additional five days were allocated to a collective planning of 10 meetings, prioritizing dynamics and ludic activities, in which the CCMar students could develop PAE. This planning sought to foster collaborative work among the teaching students who, during the LeME Transforma Project, worked in pairs or small teams. The Project provided teaching materials and stationery for students and teachers to use in the presentation and analysis of the research.

After this initial moment, the pairs or small teams of teaching students were assigned to each of the pre-professional courses at CCMar and conducted eight meetings, each lasting about three hours. These meetings aimed to conduct statistical research, also analyzing the data obtained. For this, dynamics and activities were carried out that addressed topics such as mean, mode, median, graphs, and questionnaire development. There were also moments dedicated to data collection and the preparation of posters, which summarized the results of the research conducted.

In addition to an opening ceremony, which aimed to present LeME Transforma and the professionals involved, the Project also had a closing ceremony, called the *Science and Professions Fair*. In this, the students, guided by the teaching students who acted as their teachers, presented the results of their research to their classmates, guests, and CCMar partners. In this ceremony, the students received certificates of participation in the Project and a professional kit to use at work, contributing to income generation in their new profession.

5 Research Actions and their Characteristics

This exploratory research is characterized by its qualitative and descriptive nature (Ludke & André, 1986). For this, a case study (Yin, 2010) was carried out, aiming to contribute to the theoretical construction and discussions about formative processes in the field of

Statistical Education. Under this understanding, the following research question was established: What are the possible contributions that the training for the development of the LeME Transforma Project provides to the professional and citizen life of the participating teaching students of the Project?

For this research, a Focus Group (FG) was carried out, which consists of an interview with a group of people, based on communication and interaction, differing from individual interviews, in which it is the researcher's function to propose an environment conducive to discussion (Minayo, 2000). As research subjects, there were 17 teaching students, from three different courses, nine from Mathematics, six from Pedagogy, and two from Portuguese/Spanish Letters, chosen from a selection that was open to all teaching courses at FURG, leading the applicants to undergo an online interview. The selected teaching students participated in six training meetings at LeME Transforma, described above, one for the presentation of the LeME Transforma Project and five for training.

At the end of each formative meeting of the Project, a moment was dedicated to the FG, in which one of the mediating teachers of the LeME Transforma Project asked questions about the contributions of the activities developed. In each FG, one question was asked, leaving the teaching students free to answer when and if they wanted. The questions aimed specifically to: ascertain the teaching students' expectations, before and after the training; understand how the students felt prepared and where they saw Statistics in the educational context and beyond; and understand the learnings related to PAE. In this article, considering the proposed research objective, the third meeting, held on November 7, 2023, was analyzed, recorded in audio and later transcribed.

It is worth noting that, on this specific day, the training involved a discussion about the types of variables, knowledge necessary for the continuation of PAE. For this, the mediators developed a dynamic called *hot potato*, in addition to analyzing questions and classifying them as: qualitative, ordinal, and nominal; and quantitative, continuous, and discrete. After that, as a practical exercise, the teaching students were invited to construct a questionnaire that contained at least one question for each of the mentioned variables. After the conclusion of this formative moment, the FG, analyzed here, was conducted, in which the teaching students were asked: Where do you see the usefulness of statistics in your personal and/or professional life?

It is important to highlight that the choice to analyze this meeting is due to the multiplicity of questions raised by the teaching students, who described how they saw the tools provided by Statistics in everyday and professional tasks. Furthermore, it is understood that the Project is not limited to the statistical education of the students involved, but also so that they can use this knowledge for a critical and conscious experience of citizenship. In this sense, analyzing the students' speeches in the FG proved to be an effective way to understand them, as well as to evaluate their participation in the Project.

The transcriptions were analyzed using the Discourse of the Collective Subject (DCS) technique. The DCS is a methodological proposal that organizes and tabulates qualitative, verbal data, which are gathered into synthesis discourses and written in the first-person singular, representing a collectivity (Lefèvre & Lefèvre, 2005). The methodological operations characteristic of the DCS involve the construction of two tables. The first - Instrument for Discourse Analysis (IAD1) - contains three columns: Key Expressions (KE), Central Ideas (CI), and Anchors (AN).

In the initial analysis phase, the audio transcriptions went through a selection process, in which excerpts from the dialogues that expressed the essence of the discursive content and met the general purpose of the research were highlighted. These KEs were marked with the

same colors that exhibited the same CI (Lefèvre & Lefèvre, 2005).

Subsequently, the KEs were named, called CI, which summarized in the most summary, precise, and faithful way possible, the discursive content exposed in each one or in a homogeneous set of KEs. Four CIs were indicated: Recognizes the presence of Statistics in IBGE; Recognizes the importance of Statistics in the professional teaching formation; Recognizes the presence of Statistics in everyday life (citizenship exercise); Recognizes the presence of Statistics in research/university.

Following this, the ANs, which express a theory, ideology, or belief, were identified, considering the references described in the previous section. Therefore, two ANs were related, these being: Statistics for citizenship; and Teaching knowledge.

Finally, a second table was constructed - Instrument for Discourse Analysis (IAD2), in which the synthesis discourse is elaborated, bringing together, in a single discourse, the KEs whose CI or AN present the same content, equivalent or complementary sense, and that bring the thought of the collectivity. In this context, five collective discourses were elaborated, one for each formative meeting in which the FG was conducted. Only one of the meetings did not allow the construction of the discourse, for not containing sufficient discursive material. The other synthesis discourses will be analyzed at a later time.

In the case of the analysis presented in this article, the synthesis discourse sought to bring together the breadth of the themes addressed in the FG, considering that, on this specific day, the teaching students expressed their understandings about the role of Statistics in personal and professional tasks. It is important to highlight that there are no changes in the speeches that make up the discourse. Only linguistic connectors (underlined) were added, as Lefèvre & Lefèvre (2005) recommend, which provide structure to the text, without altering the meaning of the teaching students' speeches. The synthesis discourse is presented and analyzed in the following section.

6 Results and Discussion

Statistics plays a fundamental role in the civic and professional development of individuals. From this perspective and considering the purpose of understanding how the LeME Transforma Project can contribute to these social and professional aspects, the following is presented: a synthesis of discourse that exemplifies and reinforces the discussions presented here.

Table 1: Collective discourse *Reflecting on the experiences of the LeME Transforma Project: where do I see Statistics?*

In my personal and professional life, academically as well, statistics shapes our choices, from the moment we wake up until the moment we go to sleep. I see statistics in our daily lives, in IBGE census websites, always very useful, in supermarkets, and even for interpreting the information presented on television, in newspapers. It influences our choices, for example, who I will vote for in the election, which product I will buy, which is more worthwhile or cheaper, whether I will drive, whether I will not drive, whether I will walk, whether I will be somewhere else, whether I am going to college, whether I will go to a bar after college. We think about the weather, the probability of rain, of sunshine. We choose our clothes based on this, our shoes, where we will go. That is, I think that today, in my personal life, what I use statistics the most for is linked with Excel and financial mathematics, for expense control. In fact, it caught me off guard when a colleague of mine is going to open a market and I said: okay, but have you done research? Have you seen if this market can be placed in that location? If you will have a good return? But all with a quick brushstroke that I gave within the project that caught her attention, for her to see the public, for her to really see if the business she is going to implement will be successful, because it has to be based on something solid.

So, that's where I understood that statistics is in everything, not just in the subject itself, although when we are going to do research for some work and we look for data and these data have statistics and everything else, but in everything, everything you are going to do, from now on, and I think this way, it has to be researched, to see if it will bear fruit. Already within the teaching degree, I think statistics can help us in the classroom, to know which types of activities are more accepted by most students, like our research, what to do to keep students more entertained, what makes them more focused. I mean, for me, statistics is like another language. Just as you learn English and Spanish, it opens up a range of infinite possibilities, and having this knowledge of reading, of graphs, especially in the academic area, is very important because you can specialize much more, you can understand much more.

Source: Research Collection (2024)

6.1 Contributions of the LeME Transforma Project to Citizenship and Professional Practice

From the synthesis of discourse, especially in the first part, considering the formative experience of the LeME Transforma Project, it is possible to identify that the students recognized the importance of Statistics, whether for daily activities or for social and political actions: "*it [Statistics] shapes our choices, from the moment we wake up until the moment we go to sleep*" (Excerpt from the synthesis of discourse). Thus, Statistics is perceived by them in the information disseminated by the Brazilian Institute of Geography and Statistics (IBGE), in supermarkets linked with Excel and financial mathematics, for financial expense control and price comparison, in interpreting the information broadcasted in the media, in politics, in weather forecasting, and in choosing what to wear and where to go.

As mentioned among the participants of the Project, statistical information is commonly disseminated in the media — "*for interpreting the information presented on television, in newspapers*" and in politics — "*who I will vote for in the election*" (Excerpts from the synthesis of discourse). In this sense, Statistics plays a significant social role, as it provides tools for individuals to critically analyze the information presented on television, the internet, magazines, advertisements, textbooks, etc., helping them make decisions and avoiding being influenced by biased or inaccurate interpretations of the data. According to Gal (2019), this is precisely the function of Statistical Literacy, as it makes citizens capable and willing to effectively engage and make sense of the statistical information and data they encounter in their daily lives.

In this context, by working on the PAE with real data collected and analyzed by themselves, assuming the role of protagonists, the students were able to reflect, in addition to bringing statistical content closer to the reality in which they live. There is, therefore, a movement that surpasses curriculum issues and reaches a formation for critical citizenship, which is also proposed in the objectives of LeME Transforma. Thus, Statistics teaching is based on the principles that guide Critical Education, as described by Campos et al. (2011).

It is worth highlighting the importance of Statistics teaching being focused on everyday issues, as "it is in this critical classroom that, on the one hand, the teacher and his students [...] become aware of social aspects often unnoticed by them, but which are strongly present in it (everyday life)" (Campos et al., 2011, p. 477). This can be highlighted in the synthesis of discourse when the student shares: "*it caught me off guard when a colleague of mine is going to open a market and I said: okay, but have you done research? Have you seen if this market can be placed in that location? If you will have a good return? But all with a quick brushstroke that I gave within the project [...]*" (Excerpt from the synthesis of discourse).

In this excerpt from the synthesis of discourse, the students demonstrated an

understanding of the resources that Statistics can offer in defining a commercial space, which highlights contributions of the LeME Transforma Project to their formation, beyond the curriculum. Thus, the implementation of investigative projects, such as the PAE, by addressing themes that respect the motivations of those who research, also helps to establish connections, whether professional, social, or economic. Such issues were mentioned in the focus group, where it is recognized that "*that statistics is in everything, not just in the subject itself*" (Excerpt from the synthesis of discourse).

The Project participants also related statistical knowledge to financial issues when they described the strategies they used to manage and make conscious choices regarding money. Two excerpts stand out: "*linked with Excel and financial mathematics, for expense control*" and "*which product I will buy, which is more worthwhile or cheaper*" (Excerpts from the synthesis of discourse). In this case, it is important to emphasize the potential of linking Financial Education to Statistics, considering the civic education of the students, as demonstrated above, and that arise in the PAE, due to the freedom in the chosen themes and research paths.

According to Coutinho and Teixeira (2015), the definition of Financial Education and Financial Literacy are similar because they involve understanding, interpreting, and making decisions regarding financial issues. Thus, Financial Education, like Financial Literacy, plays a social role and for citizenship (Teixeira, 2015), something that was mentioned and emphasized in the synthesis of discourse. Therefore, although the main focus of LeME Transforma is Statistics, it can be considered that the Project also contributed, in some way, to the development of financial awareness of the students, highlighting skills anchored in these two areas and geared towards citizenship. Thus, combining these knowledge areas, in an interdisciplinary manner, as described by Cavalcante et al. (2021), proves to be a potential path for the individual development of citizens, who are confronted daily with economic and statistical information.

In addition to financial issues, the students mentioned probability, specifically linked to weather forecasts, often used intuitively to make choices in everyday and professional situations — "*We think about the weather, the probability of rain, of sunshine. We choose our clothes based on this, our shoes, where we will go*" (Excerpt from the synthesis of discourse). It is worth noting that understanding probability laws is necessary in different situations of daily life, as exemplified above, since Probability studies randomness and provides tools to measure and quantify uncertainty in statistical processes, being, therefore, a fundamental part in this area (Lopes & Mendonça, 2016).

Thus, the understanding of probability plays a fundamental role in many aspects of daily life, including the interpretation and use of weather forecasts to make informed decisions and face challenges related to the weather, among other decision-making situations. Therefore, considering the importance and the close relationship between statistical and probabilistic knowledge, the potentialities of activities that integrate these two fields, which can be developed in the LeME Transforma Project and, thus, contribute to the formation of students, both in the curricular sense and for citizenship, are highlighted.

Therefore, it can be affirmed that LeME Transforma has the potential to develop statistical knowledge that goes beyond curriculum demands and contributes to the civic education of students, as it provides for the realization of investigative processes in which the themes and stages of research are developed authentically, addressing themes chosen by the students themselves and close to everyday issues.

Through these investigative processes, students not only learn statistical concepts but also develop skills in critical thinking, data analysis, and decision-making. Moreover, LeME

Transforma allows for knowledge from different areas to be addressed, such as financial and probability, in an interdisciplinary and contextualized manner with real-world situations. This not only reinforces the relevance of statistics in everyday life but also prepares students to face challenges and make evidence-based decisions in various areas, contributing to their civic education.

6.2 Contributions of the LeME Transforma Project to Professional and Teaching Formation

Within the context of the synthesis discourse, especially in its final part, statistical research began to be used to seek attention and awaken students' interest in the studied content, showing that the formation provided by the LeME Transforma Project can contribute to the construction and mobilization of professional knowledge. Additionally, the prospective teachers saw it as a way to improve themselves and to use their content as tools for academic formation, that is, in the construction of experiential knowledge.

Regarding classroom practices and activities, the prospective teachers observed the potential of Statistics for teaching, which can be observed in the following excerpt: "*I think statistics can help us in the classroom, to know which types of activities are more accepted by most students*" (Excerpt from the synthesis discourse). In the cited excerpt, it is possible to identify the use of Statistics beyond the content-focused bias of the classroom, in this case, used as a means of understanding students' preferences and motivations.

In this scenario, the construction of teacher professional knowledge is understood, which, according to Tardif (2014), is diverse and heterogeneous, as well as originating from various sources, meaning that a teacher uses different knowledge, with various approaches, in order to achieve a certain teaching objective. Thus, participation in the LeME Transforma Project, although brief in the context of teacher formation, showed potential to contribute to the constitution of these professional knowledge. This is mainly because it allows these individuals to build learning experiences, not only about the content, but also about its importance and how to approach it, which is expected to later reflect in pedagogical practice in the classroom.

According to Lopes (2010), Statistics teaching was neglected for a long time in Basic Education, and this fact resulted mainly in the lack of ability of individuals, both students and the adult population, to contextualize statistical concepts in everyday situations. However, future teachers, from the experience of participating in the LeME Transforma formation, were able to see Statistics as a tool for specialization, as they compared it to a language: "*for me, statistics is like another language*", they further explained the excerpt by saying that in the "*Just as you learn English and Spanish, it opens up a range of infinite possibilities, and having this knowledge of reading, of graphs, especially in the academic area, is very important because you can specialize much more, you can understand much more*" (Excerpts from the synthesis discourse).

In the context of the excerpt above and Tardif's (2014) experiential teacher knowledge, it is understood that the prospective teachers, participants of the project, composed of a plurality of areas, in the courses of Mathematics Teaching, Portuguese/Spanish Literature, and Pedagogy, had the opportunity to develop knowledge and build knowledge that will contribute to the skills of knowing-how and knowing-being. In this context, Gauthier et al. (2013) validate Tardif's position regarding teaching as the mobilization of various knowledge, forming a repertoire that supplies the teacher in specific teaching situations.

The prospective teachers also emphasized in their discourse the recognition and importance of statistical knowledge, beyond the specific discipline, also for conducting research

and data collection in other contexts, such as for developing works during their initial formation. This is evidenced in the excerpt: "*when we are going to do research for some work and we look for data and these data have statistics and everything else*" (Excerpt from the synthesis discourse). In this perspective, the importance of statistical competencies comes, which interrelate and provide students with the ability to understand, interpret, and use statistical data effectively (Campos, Wodewotzki & Jacobini, 2011). Moreover, when it comes to teaching, mastery of content knowledge, although not sufficient, is indispensable for pedagogical practices in this area (Schreiber & Porciúncula, 2021), as well as for the educator to recognize the singularities that differentiate it from other fields of teaching (Groth, 2007).

From the above, it is understood that the formation for the LeME Transforma Project mobilized statistical knowledge, which can be used as allies by teachers from various fields of knowledge, since, through it, it is possible to better understand student preferences and thus plan more attractive classes. Therefore, the importance of formations with a statistical bias for teachers and prospective teachers was evidenced, not only in the scope of the Mathematics course, since, in addition to mobilizing the presented teacher knowledge, they can assist in the academic trajectory and practice of these professionals.

7 Conclusion

The students' participation in the Project proved to be relevant for their formation, as it related to and made them reflect on Statistics in daily life and in the professional sphere. The conduct of research, based on real data collected and analyzed by the students themselves, promoted an educational approach that went beyond the formal curriculum, enabling them to take an active and critically reflective role in learning. This helped them understand how statistical concepts apply to everyday life and how they can be used to understand and solve real-world problems.

The results analyzed, based on the shared collective discourse, provided evidence of formation for critical citizenship, empowering students to analyze information, make informed decisions, and actively participate in society. Therefore, it is expected that they will be able to question, evaluate evidence, and form informed opinions on important issues, which is essential for them to become responsible and engaged citizens.

Financial issues were mentioned at different moments in the synthesis discourse - in budget control, in making purchases, and in comparing product prices - integrating such knowledge with Statistics. This is mainly because Statistics plays a fundamental role in the analysis and interpretation of financial data, helping individuals make decisions and understand risks and uncertainties associated with finances. Therefore, these are important knowledge for the civic education of students.

Regarding Probability, the students mentioned weather forecasts and how they influenced daily tasks. Considering the importance and interrelation between statistical and probabilistic knowledge, the potential of activities that integrate these two fields for civic education is highlighted. This is because, armed with such skills, students are able to make more informed decisions and face the challenges of daily life with more confidence and knowledge.

In terms of professional development, the prospective teachers observed the relevance of statistical knowledge in the planning and implementation of educational activities. This is because, through Statistics, prospective teachers can better understand the motivations of their students, demonstrating the potential of Statistics and the formation itself beyond the curricular content. Furthermore, Statistics was related to the learning of a new language by the prospective

teachers, since, based on this knowledge, it is possible to understand and communicate in other ways. Therefore, the formation potentiated the construction of plural knowledge, indispensable to teaching, as well as mobilized reflections on the role of Statistics in the civic and critical formation of those involved in the Project.

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