EMP Educação Matemática Pesquisa
ISSN 1983-3156
Qualis A1
http://dx.doi.org/10.23925/1983-3156.2024v26i4p035-066

Inclusion and social justice in a statistical literacy project: critical statistical education for young people in vulnerable socio-economic-environmental situations

Inclusión y justicia social en un proyecto de alfabetización estadística: educación estadística crítica para jóvenes en situación de vulnerabilidad socioeconómica-ambiental

Inclusion et justice sociale dans un projet d'alphabétisation statistique : education statistique critique pour les jeunes en situation socio-économique et environnementale vulnérable

Inclusão e justiça social em um projeto de letramento estatístico: educação estatística crítica de jovens em situação de vulnerabilidade socioeconômico-ambiental

Fernanda Angelo Pereira[1]
Secretaria Municipal de Educação de Pirapetinga
Doutorado em Educação em Ciências
https://orcid.org/0000-0003-0613-6585

Mauren Porciúncula[2]
Universidade Federal de Rio Grande
Doutorado em Informática da Educação
https://orcid.org/0000-0003-1161-8220

Abstract

We present research, an excerpt from a doctoral thesis, focusing on Critical Statistical Education (CSE) of students, aged between 14 and 17, from a pre-professional educational institution that serves young people in situations of socioeconomic vulnerability. Students developed Statistical Learning Projects (Projetos de Aprendizagem Estatísticos - PAE) in the context of implementing of the Statistical Literacy Multimedia Project (Projeto de Letramento Multimídia Estatístico - LeME). Our objective was to investigate emerging aspects involved in LeME that can mobilize an CSE and promote inclusion and social justice. To this end, transcripts of collective interviews with students held after completing the PAEs were analyzed. This analysis was carried out with the help of the Collective Subject Discourse technique and focused mainly on concepts related to Critical Statistical Education, inclusive education and social justice. The analysis of the answers to two interview questions revealed that the LeME mobilized several characteristics of the CSE, such as the contextualization of statistical concepts, collaborative work, encouragement of analysis and interpretation of results, a democratic learning environment, as well as critical reflection on the role of statistics in society.

[1] feducamat@gmail.com
[2] mauren.porciuncula@gmail.com

Regarding aspects related to inclusion and social justice, characteristics were observed in the LeME such as group work, use of real data, construction of statistical knowledge, development of social skills and reflection that are in line with a cooperative learning approach to inclusion. The LeME also made it possible to promote social justice through reading and writing about the world, considering the context and reality of the students.

Keywords: Critical education, Statistical literacy, Citizenship, Social justice, Inclusion.

Resumen

Presentamos una investigación, extracto de una tesis doctoral, centrada en la Educación Estadística Crítica (EEC) de estudiantes, con edades entre 14 y 17 años, de una institución educativa preprofesional que atiende a jóvenes en situación de vulnerabilidad socioeconómica. Los estudiantes desarrollaron Proyectos de Aprendizaje Estadístico (PAE) en el contexto de la implementación del Proyecto de Alfabetización Multimedia Estadística (LeME). Nuestro objetivo era investigar aspectos emergentes involucrados en LeME que pueden movilizar una EEC y promover la inclusión y la justicia social. Para ello, se analizaron transcripciones de entrevistas colectivas a estudiantes realizadas después de completar los PAE. Este análisis se realizó con ayuda de la técnica del Discurso del Sujeto Colectivo y se centró principalmente en conceptos relacionados con la Educación Estadística Crítica, la educación inclusiva y la justicia social. El análisis de las respuestas a dos preguntas de la entrevista reveló que el LeME movilizó varias características de la EEC, como la contextualización de conceptos estadísticos, el trabajo colaborativo, el fomento del análisis y la interpretación de resultados, un ambiente de aprendizaje democrático, así como la reflexión crítica sobre El papel de las estadísticas en la sociedad. En cuanto a aspectos relacionados con la inclusión y la justicia social, se observaron características en el LeME como trabajo grupal, uso de datos reales, construcción de conocimiento estadístico, desarrollo de habilidades sociales y reflexión que están en línea con un enfoque de aprendizaje cooperativo para la inclusión. El LeME también permitió promover la justicia social a través de la lectura y la escritura sobre el mundo, considerando el contexto y la realidad de los estudiantes.

Palabras clave: Educación crítica, Alfabetización estadística, Ciudadanía, Justicia Social, Inclusión.

Résumé

Nous présentons une recherche, extrait d'une thèse de doctorat, axée sur l'éducation statistique critique (ESE) d'étudiants, âgés de 14 à 17 ans, d'un établissement d'enseignement préprofessionnel au service des jeunes en situation de vulnérabilité socio-économique. Les étudiants ont développé des Projets d'apprentissage Statistique (Projetos de Aprendizagem Estatísticos - PAE) dans le cadre de la mise en œuvre du Projet d'alphabétisation Statistique Multimédia (Letramento Multimídia Estatístico – LeME). Notre objectif était d'étudier les aspects émergents impliqués dans le LeME qui peuvent mobiliser une ESE et promouvoir l'inclusion et la justice sociale. À cette fin, les transcriptions des entretiens collectifs avec les étudiants réalisés à l'issue des PAE ont été analysées. Cette analyse a été réalisée à l'aide de la technique du discours collectif sur le sujet et s'est concentrée principalement sur les concepts liés à l'éducation statistique critique, à l'éducation inclusive et à la justice sociale. L'analyse des réponses à deux questions d'entretien a révélé que le LeME mobilisait plusieurs caractéristiques de l'ESE, telles que la contextualisation des concepts statistiques, le travail collaboratif, l'encouragement à l'analyse et à l'interprétation des résultats, un environnement d'apprentissage démocratique, ainsi qu'une réflexion critique sur le rôle des statistiques dans la société. Concernant les aspects liés à l'inclusion et à la justice sociale, des caractéristiques ont été observées dans le LeME telles que le travail de groupe, l'utilisation de données réelles, la construction de connaissances statistiques, le développement de compétences sociales et la réflexion qui s'inscrivent dans une approche d'apprentissage coopératif de l'inclusion. Le LeME a également permis de promouvoir la justice sociale à travers la lecture et l'écriture sur le monde, en tenant compte du contexte et de la réalité des étudiants.

Mots-clés : Éducation critique, littératie statistique, citoyenneté, justice sociale, inclusion.

Resumo

Esta pesquisa apresenta um recorte de uma tese de doutorado, com foco na Educação Estatística Crítica (EEC) de estudantes, com idades entre 14 e 17 anos, de uma instituição de ensino pré-profissionalizante que atende jovens em situação de vulnerabilidade socioeconômica. Os alunos desenvolveram Projetos de Aprendizagem Estatísticos (PAE) no contexto de implementação do Projeto de Letramento Multimídia Estatístico (LeME). O objetivo foi investigar aspectos emergentes envolvidos no LeME que podem mobilizar uma EEC e promover a inclusão e justiça social. Para isso, foram analisadas as transcrições de entrevistas coletivas com os

estudantes realizadas após a conclusão dos PAE. Tal análise se deu com o auxílio da técnica do Discurso do Sujeito Coletivo e concentrou-se, principalmente, nos conceitos relacionados à Educação Estatística Crítica, à educação inclusiva e à justiça social. A análise das respostas de duas questões da entrevista revelou que o LeME mobilizou várias características da EEC, como contextualização dos conceitos estatísticos, trabalho colaborativo, incentivo à análise e interpretação dos resultados, ambiente democrático de aprendizagem, bem como a reflexão crítica sobre o papel da estatística na sociedade. Em relação aos aspectos relacionados à inclusão e justiça social, foram observadas características no LeME, como trabalho em grupo, uso de dados reais, construção de conhecimentos estatísticos, desenvolvimento de habilidades sociais e reflexão que estão de acordo com uma abordagem de aprendizagem cooperativa para a inclusão. O LeME também possibilitou a promoção da justiça social por meio da leitura e escrita de mundo, considerando o contexto e a realidade dos estudantes.

Palavras-chave: Educação crítica, Letramento estatístico, Cidadania, Justiça social, Inclusão.

Inclusion and social justice in a statistical literacy project: critical statistical education for young people in situations of socio-economic-environmental vulnerability

The Statistical Multimedia Literacy Project[3] (LeME) is a pedagogical strategy that has the potential to promote inclusion and social justice, as it aims to bring about social change through active, playful, and interdisciplinary pedagogical practices that promote the statistical literacy of children and young people, so that they can independently and critically read the statistical information disseminated in society, especially by the media (Porciúncula, 2022). We understand statistical literacy as the ability to understand, interpret, and use statistical information critically and effectively in the context of everyday life. It includes the ability to analyze statistical data, interpret graphs and tables, understand measures of central tendency and dispersion, recognize patterns and trends, and make informed decisions based on quantitative information (Gal, 2002, 2019).

LeME is presented as a pedagogical action that has the potential to develop a critical view of the world through the skills developed in interpreting statistics, to increase young people's self-esteem and self-confidence, and to promote social participation and protagonism (Porciúncula, 2022). This vision is close to what Campos (2007) calls Critical Statistical Education, which prioritizes the teaching of statistics with the aim of developing students' criticality and engagement with political and social issues. These issues need to be relevant to young people as citizens of a democratic society, so that they can develop an awareness of the struggle for social justice, equality, and human rights.

We also understand that it is possible to promote social justice through statistical literacy, not only by studying social phenomena and raising awareness of statistics or the lack of them in relation to minority groups or those suffering some form of injustice, but also by guaranteeing the right of every human being to access education (Knight et al., 2022). In this context, education is mainly expressed through statistical literacy, which allows for a critical reading of the world based on statistical information that is widely disseminated in society,

[3] https://leme.furg.br/pt/

enabling citizens to make decisions, judgements and exercise active citizenship in a democratic society (Porciúncula et al., 2019).

So, in this text, we are looking for elements that will help us answer the following question: What aspects emerge from the responses of students at a pre-vocational education institution about their participation in LeME that mobilizes Critical Statistical Education and can promote inclusion and social justice? In order to clarify the proposed theme and answer the question, we will present a brief theoretical section on Critical Statistical Education and how we perceive inclusion and social justice in the teaching of statistics; we will detail the context of the implementation of this project; we will present the methodological procedures used, the results and a discussion in the light of the proposed theoretical framework, ending with the final considerations.

Critical statistical education and the promotion of inclusion and social justice

The Critical Statistical Education (ECC) perspective, according to Campos (2007), focuses on developing students' ability to analyze, interpret, and question statistical information in a reflective and deliberate way. Rather than simply teaching statistical techniques and formulas, ECC aims to provide a deeper understanding of statistical concepts and encourage students to become actively involved in the decision-making process. To realize this educational approach, the teaching of statistics must go beyond the mere transmission of complex techniques and provide students with the skills to interpret the real world based on information and data disseminated through different media sources, enabling them to make informed decisions from a critical viewpoint of society.

Campos (2007) proposes a concept of ECC that combines the objectives of statistical education with those of critical education. This approach aims to promote reflective and democratic learning of statistics and to engage students in a socially engaged way. The author emphasizes the importance of problematizing education, stimulating students' creativity and reflection, and involving them critically in the reality in which they live. He also stresses the need to recognize the political aspects inherent in education, both in the educational process and in the content taught. It also emphasizes the value of democratizing teaching through

initiatives that promote debate and democratic attitudes in the school environment, prioritizing collaborative work, encouraging dialogue, social responsibility, and interpersonal relations, and defending ethical principles and social justice.

In this sense, statistical education, which also includes critical education, should have the following characteristics, as shown in Table 1, as proposed by Campos (2007):

Table 1.

Characteristics of critical statistical education (Campos, 2007, p. 123-124)

- Problematize teaching and working with statistics through projects using the principles of mathematical modeling.
- Allow students to work individually and in groups.
- Use real examples, work with real data, always contextualized in a reality that is consistent with the student's reality.
- Encourage debate and dialogue among students and with the professor.
- De-hierarchize the classroom environment, adopt a democratic approach to teaching, delegate responsibility to students.
- Encourage students to analyze and interpret results, value writing.
- Making the classroom more thematic, i.e., giving priority to activities that allow the discussion of social and political issues related to the students' real-life context.
- Promote judgments about the validity of ideas and conclusions, encourage critical thinking, and ask students for their positions on the issues raised in the debates, sharing their reasons and conclusions with the class.
- To prepare students to interpret the world, to practice the discourse of social responsibility, to promote individual freedom and social justice, to involve students in a larger mission to improve the society in which they live.
- Use technological foundations in teaching, valuing, and developing instrumental skills for students who live in an eminently technological society.
- Valuing reflective knowledge in conjunction with technological knowledge in order to develop a critical awareness of the role of statistics in the social and political context in which students find themselves.
- Adopt its own rhythm, a flexible timing for the development of topics.
- Combine productive and directive knowledge.
- Highlighting the hidden curriculum, discussing it with the students, allowing them to participate in the decisions made and in the control of the educational process.
- Constantly assess the development of reasoning, thinking, and statistical literacy.
- Demystify the assessment process for students, allowing them to participate in decisions and take responsibility for this process.

One aspect proposed by Campos (2007, p. 123) for the promotion of an EEC is to "prepare students to interpret the world, practice the discourse of social responsibility, promote individual freedom and social justice, and engage students in a larger mission to improve the society in which they live". This influence on Campos's (2007) studies comes primarily from

Paulo Freire's critical education and pedagogy. According to Freire (2015), we must offer an education that provides students with the means to critically grasp their reality, so that through the development of critical thinking, they can take positions that are integrated with the demands of democratization. Critical thinking is thinking that perceives reality as a process of evolution, of transformation, and not as something static (Freire, 2018). It helps people become more informed, analytical, and capable of forming reasoned opinions rather than just passively accepting information.

Therefore, the individual must be aware of the phenomena that occur in society, establish a dialectical relationship with his social context, no longer be excluded from the orbit of decisions and commanded by the advertising media, so that he questions what he hears on the radio, sees on television and reads on the Internet. Facts, news, and communication about social phenomena are related to statistics, and therefore understanding this information requires statistical knowledge.

Knight et al. (2022) analyze a scenario that relates the understanding of quantitative information in society to social justice and how critical education can bring about an understanding of social phenomena and create social change through awareness. According to the authors, as citizens, we must learn to critique data by considering the consequential nature of its use (and abuse) through the socio-historical interrogation of that data. To do this, we need to develop quantitative and procedural skills that allow us to process a set of data, select and apply appropriate analyses, make inferences, and weave arguments based on data.

According to Dacia et al. (2021), teaching statistics in the context of using statistical knowledge to empower students to make a difference in their world is a way to do social justice. By combining statistics and social justice, students will be able to truly understand data and make real-life connections so that they understand the importance of the statistics they are doing (Dacia et al., 2021).

Gutstein (2006), with regard to teaching mathematics for social justice, lists what he calls pedagogical goals for social justice. He points to three important and independent goals because certain principles apply regardless of what is taught. Thus, these goals can be revisited

depending on the discipline and can be independent and interdependent with the goals of the subject.

We note that the pedagogical goals for social justice described by Gutstein (2006) can influence students to develop positions on relevant social issues, important issues such as inequality and social exclusion. As we pointed out earlier, understanding information and questions about social phenomena may require statistical literacy, which allows citizens to understand information in order to make decisions and judgments.

However, if statistical literacy is not provided in basic education, for example, citizens may not acquire skills that could provide a better understanding of the information needed to exercise citizenship. Individuals may have difficulty understanding statistics that can influence future decisions in their daily lives. According to Porciúncula et al. (2019):

> (...) Social exclusion, as far as statistical literacy is concerned, corresponds to the inability to critically read statistical information that is widely disseminated in society, especially by the media. Therefore, statistical literacy presents itself as an alternative to this exclusion, since its main objective is to enable citizens to read such information autonomously and critically, thus promoting social justice. (Porciúncula et al., 2019, p. 29)

Statistics education, through mathematics education and statistical literacy, has the potential to become a tool for broad education, the struggle for rights, social emancipation and citizenship, preparing citizens and society for the responsibility of collectively building a project for inclusion and social justice (Kistemann, 2014).

Hick (2009) adopts a social justice orientation as a starting point for understanding and developing more inclusive practices in education, so that fewer children suffer from exclusion or marginalization. The author argues that the issue of inclusive pedagogy extends beyond students with disabilities to all students who may be at risk of underachievement. From this perspective, Hick (2009) points to the need to develop approaches that explicitly aim to promote inclusive education as a process of social justice.

Putnam (2009) supports the perspective of Hick (2009) when she writes that inclusive education means that all students participate in the academic and social life of the classroom. According to the author, the challenge of inclusion lies in balancing the diverse learning needs

of all students while keeping the classroom functioning without problems that the professor cannot manage.

On this basis, she suggests the implementation of cooperative learning as a pedagogical strategy, claiming that it is one of the most important educational interventions for successful inclusion. To this end, Putnam (2009) presents the basic principles of cooperative learning, which has the potential to involve students working together in small groups to achieve learning goals. She explains that in order for this strategy to produce high achievement and positive social and psychological outcomes, certain conditions must be met, including positive interdependence, individual responsibility, cooperative skills, interaction, and group reflection.

In this sense, positive interdependence refers to the feeling that the members of each group must work together to achieve the goal. This is the essence of cooperative learning. The idea is that students care about each other's performance and thus coordinate their actions to achieve a common goal. Individual responsibility requires that all group members are responsible for learning the information and contributing to the group's goal. Thus, students with learning disabilities should be encouraged to take responsibility for learning and contributing to their group in a way that is consistent with their limitations.

Face-to-face interaction has the potential to promote positive academic and social outcomes in the context of cooperative learning. Working in small groups provides opportunities for students to actively participate, discuss ideas, make decisions, and participate in negotiations.

Students engaged in cooperative activities are encouraged to reflect on how they worked as a team and how they achieved the proposed goal. During group reflections, students assess their social and academic skills, focus on lesson objectives, work on presentation and listening skills, and reflect on their progress.

In this way, cooperative learning, as proposed by Putnam (2009), can be associated with the characteristics of ECE, when Campos (2007) highlights the importance of problematizing teaching through projects that promote working in groups, encouraging debates and dialogues among students, in which they take responsibility and make decisions. In addition, Gutstein's (2006) pedagogical goals of social justice can be articulated with ECE, as it is important to

prioritize activities that allow the debate of social and political issues related to the real context of students' lives, promoting individual freedom and social justice, engaging students in a larger mission to improve the society in which they live (Campos, 2007).

Therefore, we believe that a school environment that promotes ECE also has the potential to promote inclusive education for social justice, as discussed above. Thus, ECE can not only enhance data analysis skills from a critical perspective, but also provide students with an understanding of complex social justice issues, contributing to a more inclusive and equitable education.

The statistical multimedia literacy project and statistical learning projects

As an educational, social technology, LeME has been developed through a collaborative and interactive process with the community (university, school, researchers, extension workers, students, and professors) and represents an effective solution for educational and social transformation. LeME is part of an extension program at the Universidade Federal do Rio Grande (FURG), conceived and coordinated by the second author of this article. Over the past 10 years, LeME has been implemented in primary and higher education institutions by students from FURG programs.

LeME aims to promote social change through meaningful, playful and interdisciplinary teaching practices. These practices aim to develop statistical literacy in individuals, enabling them to interpret autonomously, and critically the statistical information disseminated in society, especially by the media (Porciúncula, 2022).

When it was conceived in 2011, it was recognized for covering topics such as human rights and social justice, although the main focus was on education (Porciúncula, 2022). LeME starts from the premise that it is a human right and an element that promotes social justice for a subject to be statistically literate. For this to happen, a young person must meet globally recognized requirements, such as: understanding why data is necessary and how it can be produced; being familiar with basic concepts and ideas related to descriptive statistics and graphical and tabular presentations; understanding how the inferential process is achieved.

The main pedagogical strategy of LeME is the development of Statistical Learning Projects (PAE). According to Bender (2014), learning projects are an exciting and innovative teaching format in which students are motivated by real-world problems that they can potentially contribute to their community. The main idea of a PAE is to propose the development of statistical research. According to Batanero (2019), working on statistical projects and investigations is recommended by many statistics educators to better educate statistically literate citizens.

By participating in LeME, students are invited to create their own PAE. To do so, they must first define a research topic. Students can choose any topic they like, whatever interests them, because motivation is intrinsic, it is the individual's own (Fagundes et al., 1999). Once the topic has been defined, the student is invited to reflect on his or her curiosity about the topic in order to identify possible research questions and hypotheses to be tested.

As a methodological choice, the project uses opinion research (survey), in which data is collected through the answers of the respondents to a questionnaire designed by the person conducting the PAE, for example. Thus, the student will have to identify the participants in their research, i.e., who will be the respondents to the questionnaires. Next, they will design an instrument to collect data for their research, which could be a questionnaire to collect the opinions of the selected sample or population.

Once these initial tasks are completed, the student will collect the data. This process may take the form of an interview in which the student asks each of the participants questions and writes down their answers. After collecting the data, students will need to organize the data for analysis. They will be able to use statistical analysis tools to obtain results and summarize the data.

With the results of the survey in hand, it's time to think about how to communicate and disseminate this information to the public. Students can think of different strategies to communicate the results of their research, using posters, infographics, videos, seminars, lectures, etc. At the end of the activity, it would be interesting to carry out an evaluation to systematize all the knowledge built up during the implementation of the project, the main findings of the research, the knowledge acquired on the subject and from other fields of

knowledge, and also the statistical knowledge mobilized, in order to assess the development of statistical literacy.

The PAE can be carried out in working groups, i.e., students can be grouped according to their affinity with the research topics and work together in a collaborative learning process. According to Bender (2014), collaborative teamwork is crucial for experiences with the project methodology, as it allows for shared responsibilities and collaborative decision-making, thus making learning experiences more authentic.

During the project, students can define the topics they want to research, and can learn more about subjects that are part of their reality and context, as well as solve actual problems that are relevant to them. In this way, students can get closer to the social phenomena that surround them and understand them, enabling them to read the world and feel prepared to transform it (Gutstein, 2006).

We believe that the PAEs proposed by Porciúncula (2022) are in line with the methodological proposal put forward by Putman (2009) to promote an inclusive environment. A PAE enables the construction of knowledge through statistical research, considering authorial themes determined by the students (Porciúncula, 2022). By developing a PAE and being part of a working group, students have the opportunity to experience an environment of cooperation, reciprocal exchanges and mutual respect.

Although it is not part of the curriculum of pre-vocational courses, since its creation, LeME has been implemented in a pre-vocational educational institution, the locus of this research, the Centro de Convivio dos Meninos do Mar[1] (CCMar), located in the city of Rio Grande, RS. LeME takes place as an extension activity of FURG with the support of public and private funding institutions.

As the pre-professional courses at CCMar are held every semester, the LeME takes place on 10 days of the term, usually at the end of the semester. As well as carrying out statistical research, students also have contact with other statistical concepts, such as population, sample, measures of central tendency and variability, types of graphs, tables, types of statistical research and statistical variables. LeME classes are taught by FURG undergraduate students who receive specific training to implement LeME. In the semester in question, there were professors from

the degree courses in Mathematics, Pedagogy, and Literature. This whole process is coordinated by a technical team made up of seven people, of which the authors of this article are a part.

The educational institution where LeME was implemented, CCMar, is a school dedicated to the pre-vocational training of young people between the ages of 14 and 17 who are socially, economically and environmentally vulnerable. The focus of this institution is on serving young people from underprivileged communities, in order to motivate a transformation that will lead them to social participation in solidarity and fraternity.

In this context, LeME has stepped up its actions aimed at boosting the skills of a socially underserved youth population. The aim of these actions is to turn young people into researchers, enabling them to learn statistical literacy in order to develop the skills needed to read, autonomously and critically, the statistical information present in the most diverse social spaces, which can contribute to social transformation.

Research methodology

The research approach is qualitative in nature and is characterized as a participant-observer field study, as described by Yin (2016). In this approach, the researcher is integrated into the real-world environment being studied without exerting control over the events taking place. The main means of data collection are field diary/observation records and interviews. The focus of this study is on the interviews conducted during the research.

The research participants were 119 students who attended CCMar's pre-vocational courses in the second semester of 2022, the period in which the data collection took place. CCMar offers pre-vocational courses during the school day to young people between the ages of 14 and 17 who are socially, economically and environmentally vulnerable. During the period in question, these young people also participated in LeME as part of their training and developed a PAE. LeME, an extension program of FURG, takes place at CCMar every semester for a period of 10 days.

After participating in LeME, students were invited to be interviewed about the work they had done as part of the project. Structured interviews were conducted with the student working groups formed during the execution of the PAE. Approximately 80% of the students

participated in the face-to-face interviews. The interviews, which took place two weeks after the end of LeME during class time at CCMar, were recorded on audio files and then transcribed. The purpose of the interviews was to obtain information about the students' experiences with LeME and to identify the knowledge and skills they may have acquired. The questions for the interviews were designed based on the principles of ECE, the main focus of the analysis, in order to obtain information on the aspects covered in this text.

The decision to conduct group interviews was made in order to provide students with a more familiar environment in which to share their perspectives on their attitudes and actions during the project. The groups interviewed had the following research topics, according to their pre-professional courses: bakery curiosities; bread curiosities and favorite snacks; computer science; culinary interests; opinions on pizza; peripherals; nails and health; information evaluation; human resources curiosities; financial education; the position of human resources assistant; recruiting, selecting and perfecting talent; banking; agriculture; administrative knowledge; administrative curiosities; nautical education; music psychology. It was observed that, through the group interviews, each member recalled to his colleagues how he carried out the work, recalling the process step by step, the decisions made and the challenges faced.

The discourse of the collective subject

To analyze the responses, we used the Collective Subject Discourse (CSD) method. According to Lefrève (2017), CSD is an approach that aims to give form and methodology to social representations, seeking to understand the reality of these representations through speeches and statements. This methodology seeks to ensure that collective statements directly express the thinking of the communities involved, with the aim of giving a voice to collectivities. Therefore, the CSD becomes a valuable tool for synthesizing the individual discourses collected in our research, allowing the identification of ideas and opinions shared by the students, while preserving the social and collective context and facilitating the understanding of collective perspectives (Lefrève, 2017).

In the analytical process used to construct the discourses, the responses to two questions were selected, although a total of 18 questions were asked during the interview for the analysis

discussed in this article: "Did you know statistics like this before? Did you imagine that statistics could be this?" and "What did the research add to your education? The terms "this" and "research" in the first and second questions, respectively, refer to the statistical research conducted during the implementation of the PAE. We chose these two questions because we believe that they address the essential characteristics that we want to analyze on this occasion. In addition, the set of answers to all the questions is extensive, making it impossible to carry out a complete analysis in just one article.

We carried out a first stage in which we analyzed the Key Expressions (KE) from the students' answers to the interview questions. Sometimes, during the interviews, the students brought up other topics that were not directly related to the topic of the questions. The KEs are the most significant fragments of the text, i.e., those that respond to the question, and can be literal, continuous, or fragmented passages.

Next, we identified the central ideas (CIs) present in each of the ECHs, a concise description of the meaning contained in the ECH, a kind of semantic label. This process of identifying the CIs was marked on the ECHs with different colors for each CI, which proved to be challenging because some ECHs were related to several CIs at the same time. However, in order to construct the discourses, it was necessary to choose the CI that stood out the most in the ECH.

In the next phase, based on the CIs, the Anchorages (AC) were observed, which refer to specific characteristics of the EEC, as presented by Campos (2007) and shown in Table 1 of the previous section. The purpose of CAs is to highlight the concept, theory, ideology, or even belief that underlies the ECH. Table 2 below shows an example of how this process was carried out in our analysis:

Table 2.

Example of the process of identifying ECH, IC and AC for the construction of a CSD

What did the research add to your education?		
Key Expressions (KE)	**Central Ideas (CI)**	**Anchorages (AC)**
We learned how to make graphs, I didn't know, I'd never had any contact with graphs.	**Acquired statistical knowledge**	Evaluate the development of reasoning, thinking and statistical literacy
if we were to open a business now, we'd know which pizza would make the most, or we'd know what we were spending and what we weren't, with the graphs.	**Applying statistical knowledge at work**	Development of a critical awareness of the role of statistics in the student's social and political context
greater knowledge about our course and why people are increasingly eating healthy, pesticide-free vegetables and fruit.	**Reflection on the research findings**	Encouraging analysis and interpretation of results

We then proceeded to merge the ECHs that had CI or CA with a similar meaning. Our methodological choice took into account the fact that, since we were dealing with the responses of several individuals to the same question about a common activity that they all performed, we observed many similarities in the responses. Thus, we obtained CI and CA with similar meanings within the same question. In addition, in order to obtain a more comprehensive answer to the questions asked, we constructed discourses that refer to each of the questions asked during the interviews, considering their similar CIs and CAs.

Since the students belong to different professional courses and their work deals with issues related to these courses, their answers contain contextualization of the issues. For this analysis, we tried to highlight fragments that addressed a more general discussion of the project, without damaging the content of the students' answers, preserving their original meaning. In addition, we noticed several similar HCEs that were represented by only one of them in the speeches.

The speeches show small additions we made to make the text more fluid and cohesive, and to include phrases that address the context of the questions. These additions are underlined. Next, we present the two speeches constructed on the basis of this study, followed by an analysis of these speeches in the light of the proposed theoretical framework, taking into account the objectives pursued.

Results

In the process of constructing the CSD for the question "Have you ever seen statistics like this? Did you imagine that statistics could be like this?" (Table3), 10 CIs were identified, which are: did not know statistics; knew statistics; had negative expectations before participating in LeME; found it difficult to make the graphs; cleared up doubts; acquired statistical knowledge; reflected on the constitution of research shared in the media; enjoyed studying statistics; had to relate to people; improved social interaction. Subsequently, the following CAs were identified: assessing the development of reasoning, thinking and statistical literacy; developing a critical awareness of the role of statistics in the student's social and political context; personal development. The CA "personal development" is not directly a principle identified by Campos (2007) for the promotion of ECE, but it was an aspect that emerged from the data analyzed, which we will show to be important in the context analyzed and also for ECE.

Table 3.

DCS of the answers to the question, "did you know statistics in this way before? Did you imagine that statistics could be that too?"

No, I've never seen that. I didn't even know that statistics existed. I've never seen a graph. I didn't really know anything about statistics. For me, I just saw a graph and I thought it was just a graph. To me, statistics were just for death statistics, I don't know. I didn't really know what it was. I thought that statistics was mathematics. Because I had never worked with graphs in school, only chemistry, so statistics didn't even cross my mind. I really had no idea. When they said graphs, I'd seen graphs like this in sixth grade, a professor, she used to explain graphs, but only bar graphs. The table, more or less, it's not something I see every day, you know? And I knew a lot less, but it's easy to do. In the third year, I had to do graphs, but I ended up forgetting and when I came here, I said I don't know. But then I ended up learning it all again with the help of the professors. In math we used to do a lot of statistical problems that we had to do, I don't know what, probability, a lot of stuff in school. It was interesting. I did some investment research once. But even before I joined LeME, people were scaring us that LeME was there, that I don't know what, that LeME was this, that it was really hard. So I thought the stats were horrible because I didn't know what stats were. I thought it was going to be a 7-headed beast, that it was just going to be a lot of math, and I thought when I got to that part of the course I was going to give up. Not just me, but a lot of people. And then we saw that it wasn't as hard, it wasn't as easy, but it wasn't as hard as we thought it was going to be. In fact, I thought statistics

would be about calculations that I wouldn't know how to do, I thought pure math, calculus. Even so, I thought it would be easier, especially that one (sector graph), I thought it would be very easy. What I did there turned out to be very wrong, but I found it difficult. Still, I think it was good for us to do it, and we cleared up a lot of doubts because I didn't understand the graph either, I was looking at the numbers and I had no idea of the science behind it. Now I look at it and I have a little idea when it's on TV, something like that, you can get an idea now and you keep thinking "how was this research done?", "how did he put this data together?", "how many people participated? Now we think about it, we don't look at the survey that used to be in the newspaper and say "oh, it's a graph, some numbers, so many percentages there and it's..." or "what's 40%? Now we know. Like, we see a graph, we can interpret it and think about what's behind it, how it was done. So for me, statistics was cool. I hope it stays like that and doesn't get worse. I say it's not just the knowledge you get from studying, but the knowledge you take away for your life. I took away that dealing with people is easy, but I don't like it, I took away that knowledge as a person. Even the people who didn't manage to develop, it's also a good project to develop social issues, to lose some of that shyness.

For the discourse related to the answers to the question "What did the research add to your education?" (Table 4), a total of 10 CIs were identified, namely: acquired statistical knowledge; perception of the usefulness of statistical knowledge; difficulty with mathematics; reflection on the acquired statistical knowledge; application of statistical knowledge at work; reflection on the conclusions of the research; appreciation of the knowledge shared at the educational institution; acquired knowledge about colleagues' research; improvement of social interaction; perception of the importance of statistical knowledge. The following CAs were observed: Problematizing teaching, working on statistics through projects; using real examples, working with real data, contextualized in a reality that corresponds to the students' reality; allowing students to work individually and in groups; favoring and encouraging debate and dialogue among students and with the professor; de-hierarchizing the classroom environment; assessing the development of reasoning, thinking and statistical literacy; thematizing teaching; developing a critical awareness of the role of statistics in the students' social and political context; encouraging analysis and interpretation of results; fostering criticality; personal development; preparing students to interpret the world.

Table 4.

DCS of the answers to the question "what did the research add to your training?"

A lot. It made us do research, make graphs, it helped a lot. We learned how to make graphs, which I didn't know because I never had any contact with graphs. It also added information, which I think is very important, even to learn how to make graphs, to do these things. Because pie charts, I didn't even think about how to do them, how to divide them, like this, I knew how to do things, but the area of the division was kind of bad, one was higher than the other. It didn't look well divided, so they taught me until I started doing it that way, even in school. It turned out great. I think it also added wisdom, reasoning, a lot of growth in terms of different graphs, because a lot of people only know bar graphs, others only know pie graphs, so we learned different types, different types of statistics, different types of graphs. During the time we spent with LeME, we learned a lot about statistics and

a lot about these graphs. I noticed that a lot of people didn't know or had forgotten how to do graphs, we didn't know, we didn't know how to do the collection and the graphs, so I think there's a way that maybe in the future it will also add a lot, some course that you want to do, you already know how to do statistics, work in a team, different things, know what mode is, what median is, those basic things. I think it's good to have the knowledge of statistics that they mentioned for college. But the math part was boring. Anyway, I think it might have added to my education because, for example, I got a better head for it, you know? For example, if we were to start a business now, we'd know what pizza would make, or we'd know what we're spending and what we're not spending, with the graphs. If we want to start a business, it also helps a lot because it gives us a push because we already know. Like, we already know what we need to know. I think it also adds to the administration, yes, because administration itself involves a lot of percentage stuff. It also added to our knowledge of our course and the fact that people are increasingly eating healthy, pesticide-free fruits and vegetables. Our survey was more to find out if people need to know more about IT or not. Obviously, yes, from what we've gathered, we've seen that there are a lot of people who will learn a lot if they go into IT. The research also helped us find out how music is present in our routine. When we did the research and also in the "ssor" work, it just showed how music is present in our routine. Whenever we're about to do something... when we're in a bad mood or something, we put on some music to get us back. Every song inspires your mood, if you're sad, don't you put on a song about suffering or a sad song? So you can see how this music that you don't pay much attention to is present in your routine. Also, understanding the lack of knowledge about Nautica makes me appreciate what I'm learning more, knowing that most people don't have it. Another thing was that when they came to interview us, we also learned some things from other surveys. At the end of the day it was really good knowledge because it wasn't just copying or answering. There were times when I got together with other classes, I had to interact with other people who were very different from me, but it was a really fun experience. I think it took away a bit of the shame because, because before our class didn't even talk like that, now we interact. It's helped people who are more shy to be able to express themselves more with people, to be able to speak more calmly. I think it was more contact with other people, working in a group, and doing everything as a team. So this social development is also interesting. So the knowledge we gained from the research is something that will be very important on a resume. A person who has a statistical background, who knows how to do statistics, how to collect data, and how to calculate, has a certain advantage over other people who don't. It's knowledge for life. It's knowledge for life. So if you have to calculate the percentage of something, you'll know it right away. It's hard in your head, but you'll know how to do it.

Next, we'll present a discussion of the two speeches made at the time of this article, highlighting elements that can help us understand the students' point of view and thus achieve the proposed objectives. Throughout the text, we will look at clippings from the speeches, observing the characteristics of an EEC, as well as aspects for promoting inclusion and social justice in the light of the proposed theoretical framework.

Discussion

The discourse relating to the question “Did you know statistics in this way before? Did you imagine that statistics could be that too?” (Figure 3) shows that, before taking part in LeME, the student[1] had never seen a graph and was unaware of statistics: ‘- I didn’ *t even know statistics existed. I'd never seen a graph. I didn't know statistics, to tell you the truth* “ (DSC excerpt). He mentions that statistics was only for finding out about deaths, and he had no idea what it really was. The student mentions that before he thought statistics would be very difficult

and that many people thought about giving up, but after the project he realized that it wasn't as scary as he thought.

Despite the fact that statistics content has been part of the Basic Education curriculum since the publication of the National Curriculum Parameters (PCN), and is even more present in the National Common Curriculum Base (BNCC) (Pereira, 2019), there are some students who are not familiar with statistics. Without this contact, students do not have the opportunity to be statistically literate (Gal, 2002); therefore, they are deprived of developing the ability to critically read statistical information that is widely disseminated in society, characterizing a form of social exclusion (Porciúncula et al., 2019).

After participating in LeME, the student reports that he feels better prepared to interpret graphs and think about the research behind them, which represents a growth in his ability to analyze data and statistical information: "- *Like, we see a graph, we can interpret it and think about what's behind that graph, how it was done"* (DSC clipping). The student refers to LeME as an opportunity in which he carried out research, made graphs and learned about statistics in a practical and contextualized way. This shows that the student is able to assess his learning and development in understanding statistical concepts, one of the principles pointed out by Campos (2007) for an EEC. This skill can also contribute to his reading of the world, because by understanding graphics in news stories in the mainstream media, the student will be able to understand information about society and the world, developing a socio-political awareness for social justice (Gutstein, 2006).

The student also mentions that before he didn't understand the science behind the graphs and research, but now he can interpret them and question how they were made:

> *- I didn't understand the graphs either, I looked at the numbers and had no idea of the science behind it. Now I look and I have a little idea when it's on TV, something like that, you can get a sense of it now <u>and</u> you keep thinking, 'how was this research done?', 'how did he put this data together?', 'how many people took part?* (DSC excerpt)

Gould (2010) states that given the massive exposure to data and quantitative information, an adequate statistics education must enable students to recognize data when they see it, understand how its analysis can help them, and most importantly, know how to do it. For the author, given the technological advances of mankind, it is crucial that students understand the usefulness of statistics to critically analyze published information.

Through his experience at LeME, the student reports that he was able to dispel doubts and learn how to interpret graphs and data, which led him to question how surveys are conducted, how many people participate, and how graphs are put together. He began to

critically analyze the information presented in polls published in the media: - *Now we know. Like, we see a graph, we can interpret it and think about what's behind it, how it was done"* (DSC excerpt). On the basis of the statistical knowledge that students say they have acquired, they feel capable of understanding and questioning information, which enables them to deepen their understanding of society, which can lead them to think about changing the reality around them (writing the world) and addressing social issues (Gutstein, 2006).

This perception of the students shows aspects of the potential development of a critical awareness of the role of statistics in its social and political context (Campos, 2007), as the students express a significant change in their perception of statistics. Now, when they see graphs or surveys, they question how they were made, how many people participated, and reflect on the credibility of the data presented. We can see signs of the student's critical and questioning attitude toward statistical information.

The student also mentions that participating in LeME allowed him to develop his skills in dealing with people and to lose his shyness: "- *it's also a good project to develop social issues, to lose some of that shyness"* (DSC excerpt). This suggests that there was room for discussion and interaction during the project. The student points out that the experience with statistics in LeME provided useful knowledge not only for his studies, but also for his personal life, such as socializing with other people and learning to work in a team, which strengthened his social skills. This evidence supports the idea that the environment provided by LeME contributed to a cooperative learning context in which students had the opportunity to develop social skills that were useful not only in school, but also in work and life. According to Putnam (2009), learning environments with these characteristics are conducive to inclusive education because they allow for the involvement of students working together toward a common goal, as is the case with PAE.

Students attach great value to these socio-emotional skills, as they favor harmonious coexistence and healthy relationships with others. Although Campos (2007) does not explicitly address these aspects in the context of promoting ECE, we can associate these characteristics with preparing students for a more comprehensive interpretation of the world, encouraging discourse on social responsibility, encouraging individual freedom and seeking social justice (Campos, 2007). In this way, students are motivated to engage in a greater mission of improving the society in which they live, starting with their own personal development and learning to interact respectfully with others, including those who are different.

This analysis shows how LeME, based on the principles of Critical Statistical Education, was able to change students' perception of statistics, making it more accessible and meaningful,

as well as promoting social skills and reflection on its application in their reality. For Knight et al. (2022), we cannot achieve a just society without addressing inequalities in literacy skills for understanding quantitative information, statistics and data. The authors highlight the importance of learning experiences that support students, usually marginalized by data literacy education, in obtaining statistical skills to work with data, which engage students with issues of power and inequalities in society.

LeME stands out as an important opportunity for socially, environmentally and economically vulnerable students. From an inclusive perspective, it provided the development of social skills, as well as promoting equity and social justice by providing access to statistical knowledge that is not usually easily accessible to these groups.

These points highlight the importance of EEC, statistical literacy and an inclusive approach to education in providing meaningful learning opportunities and empowering students to become critical and engaged citizens in society. By having the opportunity to understand quantitative information about social phenomena, students have the possibility of developing a critical conscience which, for Freire (2015), is when the subject's conscience integrates with reality, perceiving how things and facts are in empirical existence.

The principles of Critical Statistical Education observed in the students' discourse show how the approach used in LeME, the development of the PAE, can promote the perception of the natural variability of data from social phenomena (Pereira et al., 2021) and the learning of statistics in a contextualized, inclusive, reflective and critical way, providing a more positive and applicable view of this discipline.

In relation to the discourse "What did the research add to your education?", this shows an approach in which the student is encouraged to actively participate in the learning process based on the development of the PAE: *"- It made us do research, make graphs, it helped a lot" (*DSC excerpt). Students were invited to explore a topic according to their curiosity, which can problematize teaching by enabling them to study a subject in a critical, questioning and reflective way in order to gain a deeper understanding of the topic in question (Campos, 2007).

The student describes in detail how the research was conducted, showing an understanding of the process and the results obtained. He also mentions that the statistical research involved the construction of graphs and the collection of data for analysis, which characterizes a project involving the practical application of statistical concepts. He participated in the research process and learned how to construct different types of graphs, such as pie charts and bar graphs: *"- During the time we spent with LeME, we learned a lot about statistics and a lot about these graphs (...) knowing what mode is, what median is, these basic things*" (DSC

excerpt). This excerpt exemplifies the student's reflection on his learning acquired during the research, showing a personal assessment of his development in terms of understanding statistical concepts (Campos, 2007). In addition, the statistical knowledge he has acquired can contribute to the group's goal, taking into account his individual responsibility for the project (Putnam, 2009). Throughout the research, each working group had to analyze the data, consider statistical measures, and then construct graphs to communicate the results. As a result, the individual skills acquired by the student may have contributed to the development of his group.

The student also emphasizes that the research added knowledge about statistics, data collection, and calculations that are useful in everyday life and in a possible career, such as in administration:

> - *I think it's good to have for college, as they said, for us to have knowledge of statistics, there's a lot of it at college (...) if we were to open a business now, we'd know what pizza would make or we'd know what we're spending and what we're not, with the graphs. If we want to go into business, it helps a lot too, because it gives us a boost, because we already know.* (DSC excerpt)

Working with the PAE allowed students to see the usefulness of statistics by prioritizing statistical research based on real data in the students' context. For Campos (2007), this feature, as well as others proposed in his study, allows students to develop criticality and engagement in political and social issues relevant to their reality as citizens.

The student emphasizes the practical application of statistics in his or her life, such as understanding graphs to make analyses and decisions, stressing the importance of using real examples, always contextualized within a reality that is consistent with that of the student (Campos, 2007):

> - *<u>It also increased</u> our knowledge of our course and the fact that people are increasingly eating healthy, pesticide-free fruits and vegetables. Our survey was more about whether people need to know more about IT. Obviously, yes. From what we've gathered, we've seen that there are a lot of people who will learn a lot if they go into IT. The survey also helped us find out how music is present in our routine (...) understanding the lack of knowledge about Nautica makes me value what I'm learning more, knowing that most people don't have it.* (DSC excerpt)

Batanero (2019) emphasizes that a context that is familiar to the student is fundamental for a better understanding of statistical concepts; in addition, the author states that it is necessary to find appropriate contexts that serve to make sense of the different statistical methods.

According to Gutstein (2006), one of the pedagogical goals of social justice is to value the reality, culture, and context of students so that they can build new ones for their reading of

the world based on this knowledge, valuing their cultural and social identity. One of the principles of PAE is that students choose their research topic according to their curiosity, not only to promote student protagonism, but also to propose topics that are familiar to students, a basis for building statistical knowledge (Porciúncula, 2022).

Through his research, the student has found that many people lack this knowledge, as well as nautical skills. He also values raising awareness about the importance of healthy eating and how music can influence everyday life. This evidence also shows the potential of LeME to encourage students to analyze and interpret the results, to share their justifications and conclusions, which promotes the formation of critical thinking based on a thematization of teaching (Campos, 2007) and the development of skills related to statistical literacy (Gal, 2002).

This aspect can lead to the development of a critical awareness of the role of statistics and its usefulness (Campos, 2007), as the student shows how the research has contributed to a deeper understanding of the problems that are part of their reality through statistics, which is essential in critical education (Skovsmose, 2001). This understanding can contribute to his reading of the world, enabling him to reflect on his life through a political lens, which also deepens his understanding of society to understand power relations, inequalities in resources and opportunities between different social groups, and discrimination based on race, class, gender, language, and other differences (Gutstein, 2006).

The student mentions that the class was more interactive and that the research was a fun and enriching experience that showed a less hierarchical approach to education. In LeME, the intention is to create a democratic learning environment and to delegate responsibility to the students so that they can make decisions and be protagonists in the construction of their knowledge:

> - *(...) He made us do research, put together graphs (...) they came to interview us (...) because it wasn't just copying or answering, there were times when I got together with other classes (...) working in groups, doing everything as a team (...) A person who has a statistical background, who knows how to do statistics, collect data and calculate, has a certain advantage over other people who don't.* (DSC excerpt)

These elements are characteristics of ECE mobilized by LeME when this teaching and learning context favors dialogue among students, allows group work, and promotes a democratic environment by allowing students to make decisions about their research (Campos, 2007).

The student mentions that during his participation in LeME he developed important skills for his personal and professional life. The discourse mentions the interaction between

students, the exchange of ideas and the group coexistence, when the student reports that the research was carried out as a team, promoting collaborative work and collective learning, sharing knowledge and experiences:

> - *(...) it was a really cool experience because it wasn't just copying or answering questions, it was where I got together with other classes, I had to interact with other people who are very different from me, but it was a really fun experience. I think it took away a little bit of the shame, before our class didn't even talk like that, now we interact (...) I think it was more contact with other people, working in a group, doing everything as a team.* (DSC excerpt)

This section highlights some basic principles of cooperative learning for promoting inclusive education, according to Putnam (2009). The characteristics we observe are a group work in pursuit of a common goal (the essence of cooperative learning), the development of social skills, interaction among students with active participation, and reflection on the evaluation of one's own developed social skills and progress.

The student mentions the interaction with other classes, living with different people, and the experience of working as part of a team. He reports that LeME has helped him to overcome his shyness, to express himself better and to relate to others in a calmer way. This social and integrative perspective shows how LeME can contribute to the personal and social development of students, preparing them to interpret the world, involving them in a larger mission to improve the society in which they live, and mobilizing the characteristics of EEC (Campos, 2007).

The student shows a critical attitude towards the results of the research and points out that learning statistics can be useful in his personal and professional life;

> - *(...) the knowledge that we brought from the research is something that will be very important on a CV. A person who has statistical training, who knows how to do statistics, collect data and calculate, has a certain advantage over other people who don't. It's knowledge for life. It's knowledge for life.* (DSC excerpt)

In a sense, this can prepare them to interpret the world by recognizing that statistics is part of their lives and allows them to position themselves critically in the face of information in the media (Campos, 2007). Such a critical perspective, according to Lesser (2007), incorporates and facilitates an awareness of social justice issues and prepares students to be engaged participants in a democracy, able to critically reflect on the role that statistics has played and can play in society.

Students demonstrate a reflective understanding of the importance of statistics in their lives and in society in general, and a critical vision in analyzing the knowledge gained from research and how it can positively impact their education. This understanding of the students is

the first step towards exercising active citizenship and being prepared to understand the messages and decisions of their leaders or to participate in social transformations, which also contributes to their reading of the world (Gutstein, 2006; Batanero, 2019).

According to Gutstein (2006), one of the three pedagogical goals of social justice is to understand the conditions of society, and we consider statistical knowledge important for understanding quantitative information shared in the media about social phenomena. Thus, statistical knowledge is essential for reading graphs, rates, and tables presented in the news about birth rates, crime, inflation, etc. (Gal, 2019), as well as for contributing to the development of socio-political awareness to promote conscious processes for transforming reality (Gutstein, 2006).

The student recognizes the relevance of statistical knowledge to his education, highlighting the advantage of having statistical skills compared to others who do not. He emphasizes that this knowledge is applicable in real life, allowing him to calculate percentages and make informed decisions. This can be an important aspect that characterizes, in this context, the development of a critical awareness of the role of statistics in the social and political context in which the student is inserted, promoting the criticality and positioning of students in relation to the valorization of statistical knowledge (Campos, 2007).

The principles of critical statistical education identified in the speeches are fundamental for teaching that promotes meaningful learning, student engagement, and an understanding of statistics as a valuable tool for interpreting and interacting with the real world. In addition, these principles contribute to the promotion of an inclusive school environment and social justice, as highlighted throughout the analysis.

Table 5 below summarizes the aspects observed in the speeches according to the perspectives of critical statistics education (Campos, 2007), inclusive education (Putnam, 2009), and social justice (Gutstein, 2006). In the figure, we can see which characteristics of LeME mobilize an EEC and can promote inclusion and social justice.

Table 5.

Summary of survey results: LeME characteristics that mobilize EEC, inclusion and social justice

Aspects analyzed	Aspects mobilized in LeME	Summary
Critical Statistical Education	Problematize teaching by working on a learning project that focuses on statistical content. Encourage students to work in groups and individually to complete the project.	Problematization of teaching Group work

	Use real data, contextualized in a reality that corresponds to the reality of the students when they collect their own data together with their classmates.	Use of real and contextualized data
	Promote and encourage debate and dialogue among students and with the professor to make decisions during the project.	Encouraging dialogue
	De-serializing the classroom environment, promoting a democratic context, delegating responsibility to students by allowing them to make decisions about research topics, questionnaire construction, analysis, and communication of results.	Democratic environment
	Encourage students to analyze and interpret the results of their research, taking into account the context of the topics.	Interpretation of results
	To thematize the classroom, allowing for the discussion of social and political issues related to students' real-life contexts.	Thematic teaching
	Promote judgments about the validity of ideas and conclusions, encourage critical thinking, share with the class their justifications and conclusions about the results of their research.	Encouraging criticality
	Prepare students to interpret the world, practice the discourse of social responsibility, promote individual freedom and social justice, engage students in a larger mission to improve the society in which they live based on the statistical knowledge mobilized during the project.	Engagement in the transformation of society
	Valuing reflective knowledge combined with technological knowledge to develop a critical awareness of the role of statistics in the social and political context in which students find themselves, based on the statistical knowledge mobilized during the project.	Development of a critical conscience
	Evaluate the development of statistical reasoning, thinking and literacy based on the statistical knowledge acquired during the project.	Evaluation of acquired statistical knowledge
Social Justice	To enable a reading of the world based on the statistical knowledge acquired during the development of the project.	Making it possible to read the world
	Allowing the world to be written down by reading it. Understanding the statistics that explain social phenomena can drive conscious processes that influence students' involvement in transforming their reality.	Making it possible to write about the world
	Encouraging the development of positive cultural and social identities by valuing the student's reality and context, when they choose the topic they would like to research in the project, providing relevant themes for the student, allowing them to build new knowledge from a familiar base.	Valuing the student's reality and context
Inclusion	Mobilization of positive interdependence through group work in the development and completion of the project.	Positive interdependence
	Individual learning of statistical concepts such as the construction of tables, graphs, calculations of statistical measures and percentages in order to contribute to group work.	Individual learning
	Development of social skills through group work and data collection in the context of the project, which are desirable for success at work and in life.	Development of social skills
	Encourage interaction by working in small groups to complete the project, which allows for active participation, discussion of ideas, decision-making, and participation in negotiations.	Interaction and active participation

	Reflection on one's own performance during participation in the project to complete the task, evaluating the social skills developed, the statistical knowledge mobilized, the achievement of the proposed objectives and academic progress.	Reflection on own performance

The speeches highlight how LeME has the potential to contribute to the education of students by providing them with statistical skills, promoting critical thinking, raising awareness of social issues and encouraging personal and social development. Through this inclusive approach, statistical education can play an important role in the search for social justice, equity, and empowerment of students in situations of social, environmental and economic vulnerability through the mobilization of an EEC.

Final considerations

The aim of this text was to investigate the signs of Critical Statistical Education combined with inclusion and social justice in the application of LeME in the education of socioeconomically vulnerable students based on the following question: What aspects emerge from the responses of students from a pre-vocational educational institution about their participation in the Multimedia Statistical Literacy Project that mobilize Critical Statistical Education and can also promote inclusion and social justice? To this end, the analysis focused mainly on concepts related to Critical Statistical Education, from the perspective of inclusive education and social justice.

The methodology used for the analysis was the Discourse of the Collective Subject, which was based on the answers to two questions asked during an interview with the students. The questions were: “Did you know statistics in this way before? Did you imagine that statistics could be that too?” and ‘What did the research add to your education?’.

Analysis of the discourses revealed evidence of the presence of EEC in LeME, especially through the PAEs. Initially, the Central Ideas (CI) and Anchorages (AC) that were directly related to aspects of EEC were associated and, subsequently, these aspects were discussed in the light of the theoretical framework, emphasizing each one with excerpts from the DCS constructed, articulating with aspects pertinent to inclusion for social justice.

Considering the aspects related to inclusion and social justice, some characteristics were observed in LeME, such as group work, use of real data according to the student's context, construction of statistical knowledge, development of social skills, interaction, and reflection on one's own performance, which are in line with a cooperative learning approach for inclusion, as well as enabling the promotion of social justice through reading and writing about the world, considering the student's context and reality.

The text demonstrates several characteristics of Critical Statistical Education mobilized by LeME, such as the contextualization of statistical concepts, collaborative work, encouraging the analysis and interpretation of results, a democratic learning environment, as well as critical reflection on the role of statistics in society. These principles can promote a more engaging and inclusive approach to the teaching of statistics, allowing students to understand and apply this knowledge in their lives in a critical and conscious way, providing aspects for the promotion of social justice.

Therefore, the speeches show that LeME has the potential to contribute to students' education, providing them with statistical skills and knowledge, promoting statistical literacy and enabling a deeper understanding of the role of Statistics in the social and political context in which they are inserted. LeME, as a Social Technology, can be reapplied in different contexts so that the results described in this text can constitute other realities in order to promote Statistics Education allied to Critical Education, articulated with inclusive education and social justice.

References

Batanero, C. (2019). Statistical sense in the information society. In K. O. Villalba-Condori, A. Adúriz-Bravo, F. J. García-Peñalvo & J. Lavonen (Eds.), *Proceedings of the Congreso Internacional Sobre Educación y Tecnología en Ciencias* – CISETC (pp. 28-38). Aachen, Germany: CEUR-WS.org. https://ceur-ws.org/Vol-2555/paper2.pdf.

Bender, W. N. (2014). *Aprendizagem baseada em projetos*: *educação diferenciada para o século XXI*. Penso.

Campos, C. R. (2007). *A educação estatística: uma investigação acerca dos aspectos relevantes à didática da estatística em cursos de graduação*. [Tese de doutorado em Educação Matemática, Universidade Estadual Paulista]. https://repositorio.unesp.br/bitstream/handle/11449/102161/campos_cr_dr_rcla.pdf?sequ.

Dacia, S. L., Brooks, S., Conway, B. M., & Nguyen, H. (2021). Teaching Statistics for Social Justice-An Autoethnographic Research Report. *Georgia Educational Researcher*, *18*(1), 48-74. https://files.eric.ed.gov/fulltext/EJ1290056.pdf.

Fagundes, L. D. C., Sato, L. S., & Laurino, D. P. (1999). *Aprendizes do Futuro*: *as inovações começaram!* Ministério da Educação e Cultura.

Freire, P. (2015). *Educação como prática da liberdade*. Paz e Terra.

Freire, P. (2016). *Pedagogia da autonomia*: saberes necessários à pratica educativa. Paz e Terra.

Freire, P. (2018). *Conscientização*. Cortez.

Gal, I. (2002). Adults' statistical literacy: Meanings, components, responsibilities. *International Statistical Review*, 70(1), 1-25. https://doi.org/10.2307/1403713.

Gal, I. (2019). Understanding statistical literacy: About knowledge of contexts and models. In J. M. Contreras, M. M. Gea, M. M. López-Martín & E. Molina-Portillo (Eds.), *Actas del Tercer Congreso International Virtual de Educación Estadística*, (pp. 1-15). http://hdl.handle.net/10481/55029.

Gould, R. (2010). Statistics and the modern student. *International Statistical Review*, 78(2), 297-315. https://www.jstor.org/stable/27919839.

Gutstein, E. (2006). *Reading and writing the world with mathematics*: Toward a pedagogy for social justice. Taylor & Francis.

Hick, P. (2009). Reframing psychology for inclusive learning within social justice agendas. In Hick, P., Kershner, R., & Farrell, P. (Eds.), *Psychology for inclusive education*: New directions in theory and practice (pp. 81-95). Taylor & Francis.

Kistemann Jr, M. A. (2014). Por uma educação matemática para além do capitalcom justiça social. *ALME27*, 27, 145 -152.

Knight, S., Matuk, C. & DesPortes, K. (2022). Guest Editorial: Learning at the Intersection of Data Literacy and Social Justice. *Educational Technology & Society*, 25(4), 70-79. https://opus.lib.uts.edu.au/handle/10453/164887.

Lefèvre, F. (2017). *Discurso do sujeito coletivo*: *nossos modos de pensar, nosso eu coletivo*. Andreoli.

Lesser, L. M. (2007). Critical values and transforming data: Teaching statistics with social justice. *Journal of Statistics Education*, 15(1). https://doi.org/10.1080/10691898.2007.11889454.

Pereira, F. A. (2019*). A Educação Estatística e a elaboração de vídeos para a promoção do Raciocínio sobre Variabilidade na Educação Básica*. [Dissertação de mestrado em Educação Matemática, Universidade Federal de Juiz de Fora]. https://repositorio.ufjf.br/jspui/handle/ufjf/11164.

Pereira, F. A., Rodrigues, C. K., & Souza, F. dos S. (2021). A validação de vídeos para Educação Estatística com o suporte do CHIC. *Educação Matemática Pesquisa*, 22(3), 538–571. https://doi.org/10.23925/1983-3156.2020v22i3p538-571.

Porciúncula, M., Schreiber, K. P., & Laurino, R. (2019). Statistical Literacy: A strategy to promote social justice. *Revista Internacional de Pesquisa em Educação Matemática*, 9(1), p. 25-44. http://funes.uniandes.edu.co/27285/1/Porciuncula2019Statistical.pdf.

Porciúncula, M. (2022). *LeME - Letramento Multimídia Estatístico*: Projetos de aprendizagem estatísticos na Educação Básica e Superior. Appris.

Putnam, J. W. (2009). Cooperative learning for inclusion. In P. Hick, R. Kershner, & P. Farrell (Eds.), *Psychology for inclusive education*: *New directions in theory and practice* (pp 81-95). Taylor & Francis.

Skovsmose, O. (2001). *Educação Matemática Crítica*: a questão da democracia. Papirus.

Yin, R. K. (2016). *Pesquisa qualitativa do início ao fim*. Penso.

Disclaimer

The data supporting the results of this study will be made available by the corresponding author, FAP, upon reasonable request.

Date: June 19, 2024.