

## PLAYFUL AND MOTIVATIONAL FACTORS IN THE TEACHING OF STATISTICS IN BASIC EDUCATION: REFLECTIONS FROM THE COLLABORATIVE TEACHER TRAINING GROUP—MOSAICO EDU

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*This article aims to investigate the playful-motivational factors present in the discussions of the Collaborative Group for Teacher Training in Statistical Education aimed at implementing the Statistical Multimedia Literacy program. Based on a research approach that uses a collective of the researchers' field diary, data related to participating in the group was analyzed. Analyses revealed four playful-motivational factors for teaching statistics, namely: didactic and literary books for teaching and learning statistics; online interactive digital technologies; Statistical Learning Project; and social context. Attention to these factors in the development of activities has potential for providing students with feelings of pleasure, joy, and well-being. Furthermore, collaborative spaces for teacher training might support teachers' exchange of this knowledge.*

### INTRODUCTION

Statistics, unlike mathematics, focuses on numbers in a given context as data from an investigative process (Lopes & D'Ambrosio, 2015). When considering the current context of a viral pandemic, the importance of statistical knowledge is better understood. The situation demands that citizens be literate in statistics so that they can understand their reality and to support informed decision-making. In this way, statistics can help in the development of citizenship (Gal, 2015, 2021).

That said, studies on how to teach and learn statistics become relevant. Although statistics was included in the Brazilian educational curriculum at the end of the 20<sup>th</sup> century, its teaching in schools is still restricted (Votto, 2018). The process of teaching statistics at school appears to become a challenge because many countries like Brazil face several dilemmas including teachers with little or no knowledge of statistics in terms of both content and didactics; initial and continuing training structure; and heterogeneity in education quality for different parts of the countries due to their social and economic status (Gal, 2015).

From this context, the *Collaborative Group for Teacher Training in Statistical Education*, MoSaiCo Edu, was created in 2018, with the aim of disseminating pedagogical practices and discussions about statistical education. Since its inception, teachers from all levels of education have participated in the group, from early childhood education to higher education, as well as graduates from different areas. Currently, the group aims to implement the Statistical Multimedia Literacy program, LeME, in basic education schools. The LeME program consists of the development of statistics workshops for young people in elementary school and is usually given by undergraduate students pursuing teaching degrees from the Federal University of Rio Grande – FURG. This program was first implemented in 2012, in a pre-vocational school, located in the extreme south of Brazil. In 2019, the program received funding from a Carlos Chagas Foundation. In view of this, its locus of development was expanded to two schools of basic education, serving about 150 elementary school students aged 7–9-years old.

The program's design is based on constructivism (Piaget, 1975), mainly through the execution of Learning Projects (Fagundes et al., 1999) with a focus on statistics (Porciúncula, 2022). With these projects, students experience a scientific investigation based on a topic of interest and then carry out the stages of the investigative cycle. Furthermore, the teachers and undergraduates who work at LeME and constitute the MoSaiCo Edu, are concerned with enabling playful experiences for students, by creating a playful environment for learning mathematics and statistics (D'Ambrosio, 1993; Luckesi, 2002; Votto, 2018).

Thus, in MoSaiCo Edu, we seek to strengthen the relationship between the theories mentioned above and the pedagogical practice of teachers and undergraduates. Knowing that statistics encompasses both cognitive and affective aspects (Batanero, 2001; Gal, 2002), this article aimed to investigate the playful-motivational factors of statistical education present in discussions of the MoSaiCo Edu group aimed at implementing the LeME program.

In this article, playfulness is considered to be a subjective dimension, constituting itself as an internal phenomenon of a subject that has broad manifestations (Brougere, 1998; Luckesi, 2002). This conception emphasizes that different actions of a subject can provide them with playful feelings, that is, of pleasure, joy, and well-being in ways that transcend the use of materials, such as toys and games. In this way, various human actions, such as reading, riding a bicycle, or even carrying out statistical research and participating in group work, can be experienced as playful by students as long as they provide the subjects with feelings of pleasure, joy, and well-being (Votto, 2018).

From this context, among the many types of knowledge that a teacher learns during professional development, the knowledge about students stands out. Therefore, in a model of pedagogical reasoning, a teacher must consider, the “motivations, interests, self-esteem (...)” of the students (Shulman, 2014, p. 216). As a result, actions such as the establishment of a group of teachers to debate recreational strategies such as the Statistical Learning Project become relevant.

## METHODOLOGICAL PATH

This article presents qualitative research (Minayo, 2008) in the form of a case study (Yin, 2001) to answer the research question: Which playful-motivational factors for teaching statistics in basic education are evidenced by teachers and undergraduates in the MoSaiCo Edu group for implementing LeME? The subjects that make up this study are the teachers and undergraduates who were part of the MoSaiCo Edu collaborative teacher training group in 2021. The group met fortnightly to discuss various topics, from theoretical study to pedagogical practices for teaching statistics and planning the application of the LeME program in schools. For data collection, the methods of Zabalza (2004) and Porlán and Martín (1997) were used, in which the researchers' notes in a collective field diary were used. Such records were completed during the fortnightly meetings with the MoSaiCo Edu group, from March 11, 2021, to September 2, 2021. According to Zabalza (2004), “from a methodological point of view, the 'diaries' are part of approaches or lines of research based on 'personal documents' or 'autobiographical narrations'” (Zabalza, 2004, p. 14). The author characterizes this technique as qualitative, which has gained emphasis in recent years, in the context of educational research.

With regard to data analysis, the content analysis proposed by Bardin (2016) was used as a methodological procedure. The methodology is based on three chronological phases for analysis: 1) pre-analysis; 2) exploration of the material; and 3) treatment of the results achieved and interpretation (Bardin, 2016). In the first stage, an initial reading of the analysis material (collective field diary of the researchers) was performed. Registration units were created. These are text fragments that make sense, based on the objective of investigating the playful factors present in the diary. In the second stage, after a first reading of the registration units, the exploration of the material took place. This aimed to understand and categorize similar recording units. Finally, the third stage of content analysis took place. This refers to the interpretation of the listed categories, looking for theories to understand them, in order to answer the research objective about what motivational playful factors are present in the discussions of the collaborative group MoSaiCo Edu.

This process revealed four thematic categories that constitute *playful and motivational factors in the teaching of statistics in basic education, namely: didactic and literary books; technologies; learning project; and social context*. These categories are described in detail below.

## RESULTS AND DISCUSSION

In this section, the fragments written in the field diary will be presented in a systematic way, referring to each category revealed by the content analysis.

As shown in Table 1, each of the thematic categories comprises what was called in this study a playful-motivational factor for the teaching of statistics in basic education. According to our analyses, these factors have playful potential by enabling students to feel pleasure, joy, and well-being, motivating students in different ways. The table was created with the record units that are part of each category. These are just a part of the records contained in the field journal. These aspects are discussed below.

Table 1. Playful and motivational factors in the teaching of statistics in basic education

Thematic categories	Excerpts from the researchers' field diary (2021)
Textbooks and Literary Books on Statistical Literacy	<p>When the MoSaiCo Edu group presented the literary book created by Pedro Henrique Barcarolo entitled "A Journey in the Statistical Universe" on the teaching of statistics, a teacher brought up in her reflections the issue of working with a learning project and the <i>interdisciplinarity</i> presented in the book. It also refers to being a <i>creative, playful, and easy to understand book</i>. Another teacher commented that through the book one can work on literature and build statistics together with the character (little prince). 11<sup>th</sup> March 2021</p> <p>Also, it was commented that <i>the textbook is being a great ally</i>, and that the children are motivated with this material, because it is palpable and colorful, therefore, the children were very pleased to receive this textbook. 24<sup>th</sup> June 2021</p>
Online Interactive Digital Technologies	<p>One of the teachers highlights the group an activity she developed with her students, motivated by the discussions of MoSaiCo Edu. In this, she used digital <i>technologies such as the Canva and Padlet application</i>, for students to write different texts of free choice, that is, topics of their interests. From these texts, statistics were built to support the information written in the text, giving rise to an online magazine that was exposed on an electronic wall for the entire school community. These were strategies carried out for students to motivate themselves and enjoy literature, says the teacher. According to a satisfaction survey carried out by the teacher in question, the result was positive, as the students liked it. 25<sup>th</sup> March 2021</p>
Learning Project	<p>A teacher, when commenting on the proposed implementation of the LeME project with her 7<sup>th</sup> grade students, reports that the students <i>felt motivated</i> when they knew that they could research <i>themes of their interest</i> in the LeME project, not being restricted to the class content. "They came excited," says the teacher. 2<sup>nd</sup> September 2021</p> <p>Teachers realized that when students have the opportunity to choose themes that motivate them, that bring them <i>pleasure in research</i>, they will be more motivated, developing their <i>autonomy and protagonism</i> during the learning project. In addition, the teacher will have the possibility to know the curiosity and interests of the students, through the themes chosen by the students, <i>strengthening the bond between them</i>. 2<sup>nd</sup> September 2021</p>
Social Context	<p>At this meeting, the teachers presented the text "Statistics in a Bioecological Vision of Human Development" by Bronfenbrenner. During the group discussions related to the text, the teachers realized that <i>statistical literacy goes beyond the walls of the school</i> and can have repercussions on changes in the student's life and consequently in his family.</p> <p>A teacher problematizes <i>the changes in micro attitudes</i> that actions, social and statistical aspects can confront. 24<sup>th</sup> June 2021</p>

The first playful-motivational factor presented here is the use of *literary and didactic books* for the teaching of statistics because books are presented as a creative resource that draw the attention of students. According to Faria (2004), the literary text is polysemic because its reading provokes varied reactions in the reader, such as emotional and intellectual pleasure. Several fears arise about the use of literary texts in the classroom, such as the choice of text, which needs to be aligned with the literary

tastes of the subjects of the teaching–learning process (Souza, 2015). Furthermore, this category encompasses interdisciplinarity, because students can develop different types of knowledge from a story and provide the reader with satisfaction from acquiring varied knowledge, experiencing existential situations, and encountering new ideas (Faria, 2004).

The use of *digital technologies*, which constitutes a category of analysis, proved to be a playful-motivational factor because it enabled an appreciation of the work developed by students by disseminating student texts to the entire community, which corroborated for their motivation with the educational process. In the meantime, the study by Beluce, Oliveira, and Bzunek (2019) elucidates that the use of digital technologies in the classroom can strengthen student motivation to learn. Therefore, it is clear that numerous digital innovations enhance school activities in different ways, one of them being the motivation on the part of the students.

According to the teachers, the *Learning Projects*, a methodology used by the LeME program, have potential for being fun and motivational, mainly because they allow students to research topics of interest to them while addressing required curricular content. When talking about project-based learning, “it is essential that the question to be researched starts from curiosity, doubts, inquiries from the student, or from the students, and not imposed by the teacher. This is because motivation is intrinsic, it belongs to the individual” (Fagundes et al., 1999, p. 16). In this sense, statistics has a playful potential mainly through research (Votto, 2018) because research uses real data and can be tailored to students' interests (Scheaffer, 1990).

In this regard, the content analysis of the researchers' diary also revealed a relationship between the choice of research topic and the strengthening of the bond between teacher and student. Using as a pedagogical strategy that is fun (i.e., of interest) for the student, such as the projects, can contribute to students' intrinsic motivation and bring teacher and student closer because students get involved and remain on task because the activity instigates pleasure, challenge, curiosity, and interest (Ryan & Deci, 2000). According to Freire (1996), to educate requires, among other elements, knowing how to listen, availability for dialogue, and wanting students to do well. That said, the author emphasizes that teacher training should encompass criticality on the one hand and on the other “recognition of the value of emotions, sensitivity and affectivity” (Freire, 1996, p. 20).

Furthermore, the teaching of statistics makes it possible to value the *social context* of students, another playful-motivational factor. By attending to the social context of students, teachers are able to understand students' reality, assist students with decision-making, and influence a change in students' attitudes. In line with this reflection, Freire (1996) states that teaching requires respect for the student's knowledge. Statistics, with its interdisciplinary potential, can combine statistics content with content from different disciplinary areas and with the daily lives of students. Thus, statistics work must start from real data and assist with decision making, thus contrasting with a focus only on the accuracy of methodological procedures (Holmes, 1986). In the same sense as Holmes (1986), Batanero and Díaz (2011) point out the importance of contextualizing real-life situations and problems when developing work with statistical projects in the classroom. From these perspectives, it is understood that relating statistics to the social context of students will contribute to making the statistical teaching and learning process fun for students.

## FINAL CONSIDERATIONS

The analysis revealed four playful-motivational factors for teaching statistics in basic education, namely: *didactic and literary books on statistics; online interactive digital technologies; learning project; and social context*. These factors have playful potential because they can provide students with feelings of pleasure, joy, and well-being. Thus, by including the playful-motivational factors discussed in the teacher training group, LeME becomes potentially playful and motivational. In view of the results, we reiterate the importance of teacher training moments, such as those from the MoSaiCo Edu group, which consider both cognitive aspects for the teaching statistics, as well as playful-motivational factors—knowledge of these is fundamental for the professional development of teachers.

That said, when considering the fact that motivational problems are capable of interfering with students' learning, the discussion of playful-motivational factors in teaching becomes relevant. In this context, engaging students with statistical research by using learning projects, with their potential to include contextualized data of student interest, is presented as a relevant learning strategy that can contribute to the intrinsic motivation of students.

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